EXHIBIT 2:

RATE BASE

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2.2. EXHIBIT 2: RATE BASE

2.2.1 RATE BASE

2.2.1.1 RATE BASE OVERVIEW

The rate base used for the purpose of calculating the revenue requirement used in this Application follows *Chapter 2 of the Filing Requirements for Electricity Distribution Applications* issued by the Ontario Energy Board ("Board") on May 14, 2020 (the "Filing Requirements"). In accordance with the Filing Requirements, North Bay Hydro Distribution Limited ("NBHDL") has calculated the rate base as an average of the net capital balances at the beginning and the end of the 2021 Test Year plus a working capital allowance, which is 7.5% of the sum of the cost of power and controllable expenses.

In 2015, NBHDL committed to undertaking a comprehensive review of all of its processes and systems underlying its working capital requirements prior to its next cost of service application. In 2020, NBHDL hired Navigant to provide an updated Lead/Lag study and provide a review of best practices on areas of NBHDL's working capital that differed significantly from a benchmarking group. The primary driver of NBHDL's difference from other LDCs, as referenced in the Navigant report, is the average number of billing days. The updated Navigant study quantifies NBHDL's working capital allowance ("WCA") at 10.38%. Notwithstanding the results of the Navigant study, NBHDL has chosen to utilize the OEB's WCA of 7.5%. A detailed discussion of NBHDL's WCA is provided in the "Working Capital Calculation" section at page 46 of this Exhibit 2.

Net capital assets include in service assets that are associated with activities that enable the conveyance of electricity for distribution purposes minus accumulated depreciation and contributed capital from third parties. For purposes of this Exhibit, distribution assets refer to those assets that are most directly related to the distribution system, such as poles, overhead and underground lines, and transformers. General plant refers to assets that support the operation of the distribution system such, as computer hardware and software, vehicles, buildings, equipment. Capital assets include property, plant and equipment ("PP&E") and intangible assets; these are referred to as "capital" or "fixed" assets throughout this evidence. The rate base calculation excludes any non-distribution assets. NBHDL has not applied for, nor received, any Incremental Capital Module ("ICM") adjustments.

Controllable expenses include operations and maintenance, billing and collecting, community relations and administration expenses.

NBHDL has provided its rate base calculations for the years 2015 Board Approved, 2015 Actual, 2016 Actual, 2017 Actual, 2018 Actual, 2019 Actual, 2020 Bridge Year and 2021 Test Year in Table 2-1 below:

Table 2 - 1: Summary of Rate Base

Description	2015 OEB Approved	2015 Actual	2016 Actual	2017 Actual	2018 Actual	2019 Actual	2020 Bridge Year	2021 Test Year
Reporting Basis	**MIFRS**	**MIFRS**	**MIFRS**	**MIFRS**	**MIFRS**	**MIFRS**	**MIFRS**	**MIFRS**
Gross Fixed Assets, Opening Balance	106,852,867	106,852,867	112,354,333	117,032,985	121,322,449	127,363,833	133,293,031	138,380,869
Gross Fixed Assets, Closing Balance	113,541,517	112,354,333	117,032,985	121,322,449	127,363,833	133,293,031	138,380,869	143,676,696
Average Gross Fixed Assets	**110,197,192**	**109,603,600**	**114,693,659**	**119,177,717**	**124,343,141**	**130,328,432**	**135,836,950**	**141,028,783**
Accumulated Depreciation, Opening Balance	55,798,816	55,798,816	57,675,286	59,769,779	61,386,005	63,848,896	66,250,083	69,024,235
Accumulated Depreciation, Closing Balance	57,764,248	57,675,286	59,769,779	61,386,005	63,848,896	66,250,083	69,024,235	71,788,387
Average Accumulated Depreciation	**56,781,532**	**56,737,051**	**58,722,533**	**60,577,892**	**62,617,451**	**65,049,490**	**67,637,159**	**70,406,311**
Average Net Book Value	**53,415,660**	**52,866,549**	**55,971,127**	**58,599,825**	**61,725,691**	**65,278,943**	**68,199,791**	**70,622,472**
Working Capital	71,805,594	64,814,706	69,286,042	62,970,878	61,420,501	64,739,421	73,463,307	74,733,510
Working Capital Allowance (%)	10.31%	10.31%	10.31%	10.31%	10.31%	10.31%	10.31%	7.50%
Working Capital Allowance	**7,403,157**	**6,682,396**	**7,143,391**	**6,492,298**	**6,332,454**	**6,674,634**	**7,574,067**	**5,605,013**
Rate Base	**60,818,817**	**59,548,945**	**63,114,517**	**65,092,123**	**68,058,144**	**71,953,577**	**75,773,858**	**76,227,485**

NBHDL has calculated its 2021 rate base as $76,227,485, an increase of $15,408,668 over the 2015 Board Approved rate base of $60,818,817. This increase in rate base of $15,408,668 is attributable to an increase in the average net book value of capital assets of $17,206,812 combined with a decrease in the working capital allowance of $1,798,143, which is attributable to the lowering of the board-prescribed working capital allowance to 7.5%. In alignment with the DSP that was put forward in 2015, NBHDL has invested significantly back in its distribution system since the last Cost of Service (COS) application and this is reflected in the net book value variance; since the WCA has been decreased, the entirety of the rate base increase is due to investment activity in the system through an increase in net book value. Approximately 26% of the working capital increase of $2,927,916 is related to cost of power. Controllable OM&A expenses account for the other 74% as a share of the increase over the 2015 Board-Approved amounts for working capital.

NBHDL has provided a summary of its calculations of the cost of power and controllable expenses used in the calculations for determining working capital for the years 2015 Board Approved, 2015 Actual, 2016 Actual, 2017 Actual, 2018 Actual, 2019 Actual, 2020 Bridge Year and 2021 Test Year in Table 2-2 below. Further details of NBHDL's calculation of its cost of power calculations are provided in Table 2-35.

Table 2 - 2: Summary of Working Capital Calculation

Description	2015 OEB Approved	2015 Actual	2016 Actual	2017 Actual	2018 Actual	2019 Actual	2020 Bridge Year	2021 Test Year
Cost of Power	65,289,289	58,509,961	62,782,581	56,443,994	55,082,974	57,947,018	65,901,255	66,051,805
Operations	1,016,405	629,042	775,642	737,777	645,453	925,842	830,091	1,028,903
Maintenance	1,486,331	1,739,889	1,724,297	1,632,098	1,652,475	1,829,166	2,151,753	2,613,186
Billing & Collecting	1,233,810	1,109,424	1,186,321	1,204,043	1,258,639	1,142,030	1,413,651	1,328,174
Community Relations	2,200	44,252	334	0	0	0	0	0
Admin & General Expense	2,690,983	2,690,602	2,720,350	2,857,176	2,683,244	2,791,843	3,057,332	3,595,675
Donations - LEAP	16,700	14,550	16,700	15,560	15,560	15,560	15,560	18,823
Property Taxes	69,876	76,986	79,817	80,230	82,155	87,960	93,665	96,944
Working Capital	**71,805,594**	**64,814,706**	**69,286,042**	**62,970,878**	**61,420,501**	**64,739,421**	**73,463,307**	**74,733,510**

2.2.1.2 VARIANCE ANALYSIS OF RATE BASE

The following Table 2-3 sets out NBHDL's rate base and working capital calculations for the 2021 Test Year, 2020 Bridge Year, 2019 Actual, 2018 Actual, 2017 Actual, 2016 Actual, 2015 Board Approved and Actual, and the following variances:

- 2021 Test Year against 2020 Bridge Year;
- 2020 Bridge Year against 2019 Actual;
- 2019 Actual against 2018 Actual;
- 2018 Actual against 2017 Actual;
- 2017 Actual against 2016 Actual;
- 2016 Actual against 2015 Actual; and
- 2015 Actual against 2015 Board Approved.

Table 2 - 3: Rate Base Variances

Description	2015 OEB Approved	2015 Actual	Variance from 2015 OEB Approved	2016 Actual	Variance from 2015 Actual	2017 Actual	Variance from 2016 Actual Year	2018 Actual	Variance from 2017 Actual Year	2019 Actual	Variance from 2018 Actual Year	2020 Bridge Year	Variance from 2019 Actual Year	2021 Test Year	Variance from 2020 Bridge Year
Gross Fixed Assets	113,541,517	112,354,333	(1,187,184)	117,032,985	4,678,652	121,322,449	4,289,464	127,363,833	6,041,384	133,293,031	5,929,198	138,380,869	5,087,838	143,676,696	5,295,827
Accumulated Depreciation	57,764,248	57,675,286	(88,962)	59,769,779	2,094,493	61,386,005	1,616,226	63,848,896	2,462,891	66,250,083	2,401,187	69,024,235	2,774,152	71,788,387	2,764,152
Net Book Value	55,777,269	54,679,047	(1,098,222)	57,263,206	2,584,159	59,936,444	2,673,238	63,514,937	3,578,493	67,042,948	3,528,011	69,356,634	2,313,686	71,888,309	2,531,675
Average Net Book Value	53,415,660	52,866,548	(549,112)	55,971,127	3,104,578	58,599,825	2,628,699	61,725,691	3,125,866	65,278,943	3,553,252	68,199,791	2,920,849	70,622,472	2,422,681
Working Capital	71,805,594	64,814,706	(6,990,888)	69,286,042	4,471,336	62,970,878	(6,315,164)	61,420,501	(1,550,377)	64,739,421	3,318,920	73,463,307	8,723,887	74,733,510	1,270,203
Working Capital Allowance (%)	10.31%	10.31%		10.31%		10.31%		10.31%		10.31%		10.31%		7.50%	
Working Capital Allowance	7,403,157	6,682,396	(720,761)	7,143,391	460,995	6,492,298	(651,093)	6,332,454	(159,844)	6,674,634	342,181	7,574,067	899,433	5,605,013	(1,969,054)
Rate Base	**60,818,817**	**59,548,944**	**(1,269,872)**	**63,114,517**	**3,565,573**	**65,092,123**	**1,977,605**	**68,058,144**	**2,966,022**	**71,953,577**	**3,895,433**	**75,773,858**	**3,820,281**	**76,227,485**	**453,627**

NBHDL has calculated the materiality threshold on its rate base to be $78,428 for 2021 in accordance with the Filing Requirements. On this basis, NBHDL has selected a materiality threshold of $75,000. This calculation is summarized in Table 2-4 below:

Table 2 - 4: Rate Base Materiality

Description	2021 Test Year
Distribution Revenue Requirement	$15,685,587
Materiality Threshold	0.50%
Materiality Calculated	$78,428
Materiality Used	$75,000

NBHDL offers the following comments and Tables 2-5 to 2-12 in respect of the relevant variances identified above:

- **2021 Test Year:**

Table 2 - 5 – 2021 Test Year Rate Base

Description	2021 Test Year
Gross Fixed Assets	143,676,696
Accumulated Depreciation	71,788,387
Net Book Value	71,888,309
Average Net Book Value	70,622,472
Working Capital	74,733,510
Working Capital Allowance	5,605,013
Rate Base	**76,227,485**

As shown above, the total rate base in the 2021 Test Year is forecasted to be $76,227,485. Average net fixed assets account for $70,622,472 of this total. The allowance for working capital totals $5,605,013; $4,953,885 (or 88%) is related to cost of power expenses.

- **2021 Test Year vs. 2020 Bridge Year:**

Table 2 - 6 2021 Test Year vs. 2020 Bridge Year Rate Base

Description	2021 Test Year	2020 Bridge Year	Variance from 2020 Bridge Year
Gross Fixed Assets	143,676,696	138,380,869	5,295,827
Accumulated Depreciation	71,788,387	69,024,235	2,764,152
Net Book Value	71,888,309	69,356,634	2,531,675
Average Net Book Value	70,622,472	68,199,791	2,422,681
Working Capital	74,733,510	73,463,307	1,270,203
Working Capital Allowance	5,605,013	7,574,067	(1,969,054)
Rate Base	**76,227,485**	**75,773,858**	**453,627**

The total rate base is expected to be $453,627 higher in the 2021 Test Year than in the 2020 Bridge Year. This increase is shown above and is attributable primarily to an increase in average net book value of $2,422,681 partially offset by a decrease in working capital allowance of $1,969,054. The addition to gross fixed assets in 2021 is $5,295,827 and Table 2-32 provides a more detailed variance of year over year changes to gross assets. Details with respect to NBHDL's 2021 capital expenditure program are provided in NBHDL's Distribution System Plan ("DSP"), found in Appendix 2-A. The working capital allowance decrease was primarily a result of a reduction in the working capital allowance percentage from 10.31% to 7.5%.

12% of the increase in working capital can be attributed to the increase in cost of power expenses with other OM&A making up the remainder; the detailed calculation of the cost of power expense for the 2021 Test Year can be found in Table 2-35.

- **2020 Bridge Year vs. 2019 Actual:**

Table 2 - 7: 2020 Bridge Year vs. 2019 Actual Rate Base

Description	2020 Bridge Year	2019 Actual	Variance from 2019 Actual Year
Gross Fixed Assets	138,380,869	133,293,031	5,087,838
Accumulated Depreciation	69,024,235	66,250,083	2,774,152
Net Book Value	69,356,634	67,042,948	2,313,686
Average Net Book Value	68,199,791	65,278,943	2,920,849
Working Capital	73,463,307	64,739,421	8,723,887
Working Capital Allowance	7,574,067	6,674,634	899,433
Rate Base	**75,773,858**	**71,953,577**	**3,820,281**

The total rate base for the 2020 Bridge Year is expected to be $75,773,858, which represents an increase of $3,820,281 over the 2019 Actual year. This increase is shown above and is attributable primarily to an increase in average net book value of $2,920,849. Distribution assets increased $4,713,055, general plant assets $935,094, offset by contributed capital of ($560,311) for a total change of $5,087,838 in gross fixed assets. Table 2-32 and the subsequent narrative provide a more detailed explanation of the change in gross assets year over year. The change in accumulated amortization is a result of changes in capital additions, depreciation expense and disposals.

Approximately 91% of the increase in the 2020 working capital allowance can be attributed to the increase in cost of power expenses from 2019.

- **2019 Actual vs. 2018 Actual:**

Table 2 - 8: 2019 Actual vs. 2018 Actual Rate Base

Description	2019 Actual	2018 Actual	Variance from 2018 Actual
Gross Fixed Assets	133,293,031	127,363,833	5,929,198
Accumulated Depreciation	66,250,083	63,848,896	2,401,187
Net Book Value	67,042,948	63,514,937	3,528,011
Average Net Book Value	65,278,943	61,725,691	3,553,252
Working Capital	64,739,421	61,420,501	3,318,920
Working Capital Allowance	6,674,634	6,332,454	342,181
Rate Base	**71,953,577**	**68,058,144**	**3,895,433**

The rate base of $71,953,577 for 2019 Actual increased over 2018 Actual by $3,895,433. This increase is shown above and is driven significantly by an increase in the average net book value of $3,553,252. Distribution assets increased $5,701,978, general plant assets $710,262, offset by contributed capital of ($483,042) for a total change of $5,929,198 in gross fixed assets. Table 2-32 and the subsequent narrative provide a more detailed explanation of the change in gross assets year over year. The change in accumulated amortization is a result of changes in capital additions, depreciation expense and disposals.

The primary driver of the increase in working capital of $3,318,920 is related to an increase in the cost of power expense of $2,864,044. A summary of the cost of power expenses for 2015 through 2021 can be found in Table 2-35.

- **2018 Actual vs. 2017 Actual:**

Table 2 - 9: 2018 Actual vs. 2017 Actual Rate Base

Description	2018 Actual	2017 Actual	Variance from 2017 Actual
Gross Fixed Assets	127,363,833	121,322,449	6,041,384
Accumulated Depreciation	63,848,896	61,386,005	2,462,891
Net Book Value	63,514,937	59,936,444	3,578,493
Average Net Book Value	61,725,691	58,599,825	3,125,866
Working Capital	61,420,501	62,970,878	(1,550,377)
Working Capital Allowance	6,332,454	6,492,298	(159,844)
Rate Base	**68,058,144**	**65,092,123**	**2,966,022**

The rate base of $68,058,144 for 2018 Actual increased over 2017 Actual by $2,966,022. This increase is shown above and is made up of a change in average net assets of $3,578,493 as a result of capital expenditures. Distribution assets increased $6,356,003, general plant assets $243,998, offset by contributed capital of ($558,617) for a total change of $6,041,384 in gross fixed assets. Table 2-32 and the subsequent narrative provide a more detailed explanation of the change in gross assets year over year. The change in accumulated amortization is a result of changes in capital additions, depreciation expense and disposals.

The working capital allowance decreased by ($159,844). A summary of the cost of power expenses can be found in Table 2-35; ($140,321) of the change in the working capital allowance is related to the cost of power expenses.

- **2017 Actual vs. 2016 Actual:**

Table 2 - 10: 2017 Actual vs. 2016 Actual Rate Base

Description	2017 Actual	2016 Actual	Variance from 2016 Actual
Gross Fixed Assets	121,322,449	117,032,985	4,289,464
Accumulated Depreciation	61,386,005	59,769,779	1,616,226
Net Book Value	59,936,444	57,263,206	2,673,238
Average Net Book Value	58,599,825	55,971,127	2,628,699
Working Capital	62,970,878	69,286,042	(6,315,164)
Working Capital Allowance	6,492,298	7,143,391	(651,093)
Rate Base	**65,092,123**	**63,114,517**	**1,977,605**

The rate base of $65,092,123 for 2017 Actual increased over 2016 Actual by $1,977,605. This increase is shown above and is made up primarily of a change in average net assets of $2,628,699 as a result of capital expenditures. Distribution assets increased $4,720,378, general plant assets $297,123, offset by contributed capital of ($728,037) for a total change of $4,289,464 in gross fixed assets. Table 2-32 and the subsequent narrative provide a more detailed explanation of the change in gross assets year over year. The change in accumulated amortization is a result of changes in capital additions, depreciation expense and disposals.

The working capital allowance decreased by ($651,093); ($653,508) is a result of increased cost of power expenses, offset by other smaller O&M variances.

- **2016 Actual vs. 2015 Actual:**

Table 2 - 11: 2016 Actual vs. 2015 Actual Rate Base

Description	2016 Actual	2015 Actual	Variance from 2015 Actual
Gross Fixed Assets	117,032,985	112,354,333	4,678,652
Accumulated Depreciation	59,769,779	57,675,286	2,094,493
Net Book Value	57,263,206	54,679,047	2,584,159
Average Net Book Value	55,971,127	52,866,548	3,104,578
Working Capital	69,286,042	64,814,706	4,471,336
Working Capital Allowance	7,143,391	6,682,396	460,995
Rate Base	**63,114,517**	**59,548,944**	**3,565,573**

The rate base of $63,114,517 for 2016 Actual increased over 2015 Actual by $3,565,573. This increase is shown above and is made up of a change in average net assets of $3,104,578 as a result of capital expenditures. Distribution assets increased $4,389,055, general plant assets $641,918, offset by contributed capital of ($352,322) for a total change of $4,678,652 in gross fixed assets. Table 2-32 and the subsequent narrative provide a more detailed explanation of the change in gross assets year over year. The change in accumulated amortization is a result of changes in capital additions, depreciation expense and disposals.

The working capital allowance increased by $460,955. A summary of the cost of power expenses can be found in Table 2-35; $440,507 of the change in the working capital allowance is related to the cost of power expenses.

- **2015 Actual vs. 2015 Board Approved:**

Table 2 - 12: 2015 Actual vs. 2015 Board Approved Rate Base

Description	2015 Actual	2015 OEB Approved	Variance from 2015 OEB Approved
Gross Fixed Assets	112,354,333	113,541,517	(1,187,184)
Accumulated Depreciation	57,675,286	57,764,248	(88,962)
Net Book Value	54,679,047	55,777,269	(1,098,222)
Average Net Book Value	52,866,548	53,415,660	(549,112)
Working Capital	64,814,706	71,805,594	(6,990,888)
Working Capital Allowance	6,682,396	7,403,157	(720,761)
Rate Base	**59,548,944**	**60,818,817**	**(1,269,872)**

The rate base of $59,548,944 for 2015 Actual was lower than the 2015 Board Approved by $1,269,872.

Capital expenditures were lower than originally planned which contributed to the variance of ($1,098,222) in NBV. Distribution assets were lower by $907,498, general plant assets lower by $80,474, and contributed capital was lower by ($199,212) for a total change of ($1,187,184) in gross fixed assets. Table 2-32 and the subsequent narrative provide a more detailed explanation of the change in gross assets year over year. Table 2-38 provides the detail of 2015 capital spending as compared 2015 Board Approved amounts. The change in accumulated amortization is a result of changes in capital additions, depreciation expense and disposals.

Cost of power and OM&A expenses were also lower than Board Approved in 2015 which resulted in a decrease to the Board Approved working capital allowance of $720,761.

2.2.1.3 FIXED ASSET CONTINUITY SCHEDULES, INCLUDING WORK IN PROGRESS

Table 2-14 through Table 2-20 provide the Fixed Asset Continuity Schedules, including WIP for each of 2015 Actual, 2016 Actual, 2017 Actual, 2018 Actual, 2019 Actual, 2020 Bridge Year, and 2021 Test Year.

The total gross asset balances in NBHDL's Fixed Asset Continuity Statements do not balance to the opening and closing balances of gross assets used to calculate the fixed asset component of rate base. WIP has been removed from the fixed asset continuity schedule balances for rate base calculation purposes, as mandated by the Board. A reconciliation of year-end NBV by year is provided in Table 2-13 below. The opening and closing balances of accumulated depreciation used to calculate the fixed asset component of rate base correspond to the fixed asset continuity schedule. As such there is no reconciliation required for accumulated depreciation.

Table 2 - 13: Reconciliation of Opening and Closing Balances

Description	2015 OEB Approved	2015 Actual	2016 Actual	2017 Actual	2018 Actual	2019 Actual	2020 Bridge Year	2021 Test Year
Reporting Basis	**MIFRS**	**MIFRS**	**MIFRS**	**MIFRS**	**MIFRS**	**MIFRS**	**MIFRS**	**MIFRS**
Total Gross Assets for Rate Base	113,541,517	112,354,333	117,032,985	121,322,449	127,363,833	133,293,031	138,380,869	143,676,696
Work in Progress	340,717	896,580	1,628,390	2,611,071	2,286,359	1,334,696	1,674,802	1,904,252
Total Gross Assets, including WIP	**113,882,234**	**113,250,913**	**118,661,375**	**123,933,520**	**129,650,192**	**134,627,727**	**140,055,671**	**145,580,948**
Total Accumulated Depreciation for Rate Base	57,764,248	57,675,286	59,769,779	61,386,005	63,848,896	66,250,083	69,024,235	71,788,387
Total Accumulated Depreciation, including WIP	**57,764,248**	**57,675,286**	**59,769,779**	**61,386,005**	**63,848,896**	**66,250,083**	**69,024,235**	**71,788,387**
Total Net Book Value for Rate Base	55,777,269	54,679,047	57,263,206	59,936,444	63,514,937	67,042,948	69,356,634	71,888,309
Work in Progress	340,717	896,580	1,628,390	2,611,071	2,286,359	1,334,696	1,674,802	1,904,252
Total Net Book Value, including WIP	**56,117,986**	**55,575,627**	**58,891,596**	**62,547,515**	**65,801,296**	**68,377,644**	**71,031,436**	**73,792,561**

Table 2 - 14: Fixed Asset Continuity Schedule as at December 31, 2015, MIFRS

Fixed Asset Continuity Schedule (Distribution & Operations)
As at December 31, 2015

		Cost				Accumulated Depreciation				
OEB	**Description**	**Opening Balance**	**Additions**	**Disposals**	**Closing Balance**	**Opening Balance**	**Additions**	**Disposals**	**Closing Balance**	**Net Book Value**
		Balance	Additions				Additions			
1611	Computer Software	1,479,562	26,418	-	1,505,980	1,224,253	102,965	-	1,327,217	178,762
1805	Land	446,565	50,811	-	497,376	-	-	-	-	497,376
1806	Land Rights	-	-	-	-	-	-	-	-	-
1808	Buildings and Fixtures	1,830,506	-	-	1,830,506	391,450	**34,598**	-	426,048	1,404,458
1810	Leasehold Improvements		-	-	-	-	-	-	-	-
1815	Transformer Station Equipment - Normally Primary above 50 kV		-	-	-	-	-	-	-	-
1820	Distribution Station Equipment - Normally Primary below 50 kV	13,660,424	2,533,625	-	16,194,049	4,731,052	345,080	-	5,076,132	11,117,917
1825	Storage Battery Equipment	-	-	-	-	-	-	-	-	-
1830	Poles, Towers and Fixtures	23,050,282	1,143,597	363,805	23,830,074	11,545,406	367,145	318,544	11,594,008	12,236,066
1835	Overhead Conductors and Devices	17,046,356	802,077	141,079	17,707,354	8,872,695	234,828	122,806	8,984,717	8,722,637
1840	Underground Conduit	1,215,600	27,336	558	1,242,378	186,720	23,584	213	210,091	1,032,287
1845	Underground Conductors and Devices	7,414,450	51,130	23,324	7,442,256	4,698,051	102,260	21,549	4,778,762	2,663,494
1850	Line Transformers	17,009,344	539,716	81,586	17,467,474	9,625,190	264,023	77,482	9,811,730	7,655,743
1855	Services	18,555,183	626,962	-	19,182,145	7,334,179	421,757	-	7,755,936	11,426,209
1860	Meters	5,424,519	254,295	-	5,678,814	2,042,925	320,716	-	2,363,641	3,315,173
1865	Other Installations on Customer's Premises	-	-	-	-	-	-	-	-	-
1905	Land	86,551	-	-	86,551	-	-	-	-	86,551
1906	Land Rights	-	-	-	-	-	-	-	-	-
1908	Buildings and Fixtures	2,951,334	170,170	-	3,121,503	1,428,483	81,394	-	1,509,877	1,611,626
1910	Leasehold Improvements	-	-	-	-	-	-	-	-	-
1915	Office Furniture and Equipment	379,286	751	-	380,037	320,588	10,878	-	331,466	48,571
1920	Computer Equipment - Hardware	953,448	29,127	8,635	973,940	743,150	72,735	8,635	807,250	166,691
1930	Transportation Equipment	2,395,301	590,665	72,968	2,912,998	1,757,911	261,460	68,352	1,951,018	961,980
1935	Stores Equipment	75,196	-	-	75,196	75,196	-	-	75,196	-
1940	Tools, Shop and Garage Equipment	1,342,108	18,787	-	1,360,895	1,114,491	43,725	-	1,158,216	202,679
1945	Measurement and Testing Equipment	-	-	-	-	-	-	-	-	-
1950	Power Operated Equipment	-	-	-	-	-	-	-	-	-
1955	Communication Equipment	174,364	2,881	-	177,245	111,782	9,934	-	121,716	55,530
1960	Miscellaneous Equipment	21,010	-	-	21,010	16,087	1,765	-	17,853	3,157
1970	Load Management Controls - Customer Premises	403,931	-	-	403,931	403,931	-	-	403,931	-
1975	Load Management Controls - Utility Premises	165,151	-	-	165,151	165,151	-	-	165,151	-
1980	System Supervisory Equipment	1,433,558	28,272	-	1,461,830	1,165,765	51,458	-	1,217,223	244,607
1985	Sentinel Lighting Rentals	-	-	-	-	-	-	-	-	-
1990	Other Tangible Property	53,060	-	-	53,060	26,523	1,630	-	28,153	24,907
1995	Contributions and Grants	(9,298,809)	-	-	(9,298,809)	(2,168,528)	(214,846)	-	(2,383,374)	(6,915,435)
2440	Deferred Revenue	(1,415,412)	(703,198)	-	(2,118,610)	(13,636)	(43,035)	-	(56,671)	(2,061,939)
2005	Property under Capital Lease	-	-	-	-	-	-	-	-	-
	Total before Work in Process	**106,852,867**	**6,193,422**	**691,955**	**112,354,333**	**55,798,815**	**2,494,051**	**617,581**	**57,675,286**	**54,679,048**
	Work in Process	1,111,308	(214,728)	-	896,580	-	-	-	-	896,580
2070	Other Utility Plant - assets not in use	-	-	-	-	-	-	-	-	-
	Total after Work in Process	**107,964,175**	**5,978,694**	**691,955**	**113,250,913**	**55,798,815**	**2,494,051**	**617,581**	**57,675,286**	55,575,628

Table 2 - 15: Fixed Asset Continuity Schedule as at December 31, 2016, MIFRS

Fixed Asset Continuity Schedule (Distribution & Operations)
As at December 31, 2016

OEB	Description	Cost				Accumulated Depreciation				
		Opening Balance	Additions	Disposals	Closing Balance	Opening Balance	Additions	Disposals	Closing Balance	Net Book Value
1611	Computer Software	1,505,980	54,301	-	1,560,281	1,327,217	86,776	-	1,413,993	146,288
1805	Land	497,376	7,929	-	505,305	-	-	-	-	505,305
1806	Land Rights	-	-	-	-	-	-	-	-	-
1808	Buildings and Fixtures	1,830,506	7,829	-	1,838,335	426,048	35,235	-	461,283	1,377,052
1810	Leasehold Improvements	-	-	-	-	-	-	-	-	-
1815	Transformer Station Equipment - Normally Primary above 50 kV	-	-	-	-	-	-	-	-	-
1820	Distribution Station Equipment - Normally Primary below 50 kV	16,194,049	491,617	227,884	16,457,782	5,076,132	381,625	178,626	5,279,131	11,178,651
1825	Storage Battery Equipment	-	-	-	-	-	-	-	-	-
1830	Poles, Towers and Fixtures	23,830,074	1,052,727	16,955	24,865,846	11,594,008	378,557	13,613	11,958,952	12,906,893
1835	Overhead Conductors and Devices	17,707,354	597,960	5,489	18,299,824	8,984,717	197,336	4,946	9,177,107	9,122,717
1840	Underground Conduit	1,242,378	191,283	747	1,432,914	210,091	26,412	231	236,272	1,196,642
1845	Underground Conductors and Devices	7,442,256	155,327	13,022	7,584,561	4,778,762	102,783	10,242	4,871,303	2,713,258
1850	Line Transformers	17,467,474	574,025	67,075	17,974,425	9,811,730	265,810	55,237	10,022,304	7,952,120
1855	Services	19,182,145	1,359,878	-	20,542,023	7,755,936	444,576	-	8,200,512	12,341,511
1860	Meters	5,678,814	262,657	-	5,941,471	2,363,641	348,385	-	2,712,026	3,229,445
1865	Other Installations on Customer's Premises	-	-	-	-	-	-	-	-	-
1905	Land	86,551	-	-	86,551	-	-	-	-	86,551
1906	Land Rights	-	-	-	-	-	-	-	-	-
1908	Buildings and Fixtures	3,121,503	454,713	-	3,576,216	1,509,877	89,057	-	1,598,934	1,977,282
1910	Leasehold Improvements	-	-	-	-	-	-	-	-	-
1915	Office Furniture and Equipment	380,037	-	-	380,037	331,466	10,308	-	341,775	38,262
1920	Computer Equipment - Hardware	973,940	20,646	-	994,587	807,250	63,122	-	870,372	124,215
1930	Transportation Equipment	2,912,998	283,707	208,399	2,988,306	1,951,018	314,812	208,399	2,057,430	930,876
1935	Stores Equipment	75,196		-	75,196	75,196	-	-	75,196	-
1940	Tools, Shop and Garage Equipment	1,360,895	22,336	-	1,383,232	1,158,216	38,245	-	1,196,462	186,770
1945	Measurement and Testing Equipment	-	-	-	-	-	-	-	-	-
1950	Power Operated Equipment	-	-	-	-	-	-	-	-	-
1955	Communication Equipment	177,245	14,614	-	191,859	121,716	10,381	-	132,097	59,762
1960	Miscellaneous Equipment	21,010	-	-	21,010	17,853	834	-	18,687	2,323
1970	Load Management Controls - Customer Premises	403,931	-	-	403,931	403,931	-	-	403,931	-
1975	Load Management Controls - Utility Premises	165,151	-	-	165,151	165,151	-	-	165,151	-
1980	System Supervisory Equipment	1,461,830	18,996	-	1,480,826	1,217,223	31,102	-	1,248,325	232,502
1985	Sentinel Lighting Rentals	-	-	-	-	-	-	-	-	-
1990	Other Tangible Property	53,060	-	-	53,060	28,153	1,630	-	29,783	23,278
1995	Contributions and Grants	(9,298,809)	-	-	(9,298,809)	(2,383,374)	(212,507)	-	(2,595,881)	(6,702,928)
2440	Deferred Revenue	(2,118,610)	(352,322)	-	(2,470,932)	(56,671)	(48,694)	-	(105,365)	(2,365,567)
2005	Property under Capital Lease	-	-	-	-	-	-	-	-	-
	Total before Work in Process	**112,354,333**	**5,218,223**	**539,571**	**117,032,985**	**57,675,286**	**2,565,787**	**471,294**	**59,769,778**	**57,263,207**
	Work in Process	896,580	731,810	-	1,628,390	-	-	-	-	1,628,390
2070	Other Utility Plant - assets not in use	-	-	-	-	-	-	-	-	-
	Total after Work in Process	**113,250,913**	**5,950,033**	**539,571**	**118,661,375**	**57,675,286**	**2,565,787**	**471,294**	**59,769,778**	58,891,597

Table 2 - 16: Fixed Asset Continuity Schedule as at December 31, 2017, MIFRS

Fixed Asset Continuity Schedule (Distribution & Operations)
As at December 31, 2017

		Cost				Accumulated Depreciation				
OEB	**Description**	**Opening Balance**	**Additions Additions**	**Disposals**	**Closing Balance**	**Opening Balance**	**Additions**	**Disposals**	**Closing Balance**	**Net Book Value**
1611	Computer Software	1,560,281	24,273		1,584,554	1,413,993	67,371	- 7,400	1,488,764	95,790
1805	Land	505,305	-	-	505,305	-	-	-	-	505,305
1806	Land Rights	-	-	-	-	-	-	-	-	-
1808	Buildings and Fixtures	1,838,335	-	-	1,838,335	461,283	35,235	-	496,518	1,341,817
1810	Leasehold Improvements	-	-	-	-	-	-	-	-	-
1815	Transformer Station Equipment - Normally Primary above 50 kV	-	-	-	-	-	-	-	-	-
1820	Distribution Station Equipment - Normally Primary below 50 kV	16,457,782	976,174	354,667	17,079,289	5,279,131	394,259	227,880	5,445,510	11,633,779
1825	Storage Battery Equipment	-	-	-	-	-	-	-	-	-
1830	Poles, Towers and Fixtures	24,865,846	1,050,168	269,541	25,646,472	11,958,952	402,173	234,845	12,126,280	13,520,193
1835	Overhead Conductors and Devices	18,299,824	428,092	95,523	18,632,393	9,177,107	209,488	79,286	9,307,309	9,325,085
1840	Underground Conduit	1,432,914	577,360	3,020	2,007,253	236,272	33,920	1,154	269,037	1,738,215
1845	Underground Conductors and Devices	7,584,561	442,812	12,859	8,014,513	4,871,303	111,939	11,670	4,971,572	3,042,941
1850	Line Transformers	17,974,425	771,612	128,353	18,617,683	10,022,304	282,717	125,107	10,179,915	8,437,768
1855	Services	20,542,023	1,110,692	-	21,652,715	8,200,512	472,617	-	8,673,129	12,979,587
1860	Meters	5,941,471	192,116	-	6,133,587	2,712,026	359,729	-	3,071,755	3,061,832
1865	Other Installations on Customer's Premises	-	-	-	-	-	-	-	-	-
1905	Land	86,551	-	-	86,551	-	-	-	-	86,551
1906	Land Rights	-	-	-	-	-	-	-	-	-
1908	Buildings and Fixtures	3,576,216	18,476	-	3,594,692	1,598,934	105,795	-	1,704,730	1,889,962
1910	Leasehold Improvements	-	-	-	-	-		-	-	-
1915	Office Furniture and Equipment	380,037	29,130	30,100	379,067	341,775	22,760	30,100	334,435	44,632
1920	Computer Equipment - Hardware	994,587	98,480	-	1,093,067	870,372	51,769	7,400	914,741	178,326
1930	Transportation Equipment	2,988,306	408,727	280,274	3,116,759	2,057,430	262,156	280,274	2,039,312	1,077,447
1935	Stores Equipment	75,196	-	-	75,196	75,196	-	-	75,196	-
1940	Tools, Shop and Garage Equipment	1,383,232	23,405		1,406,636	1,196,462	38,414	-	1,234,876	171,760
1945	Measurement and Testing Equipment	-	-	-	-	-	-	-	-	-
1950	Power Operated Equipment	-	-	-	-	-	-	-	-	-
1955	Communication Equipment	191,859	5,006	-	196,865	132,097	11,045	-	143,142	53,723
1960	Miscellaneous Equipment	21,010	-	-	21,010	18,687	552	-	19,238	1,771
1970	Load Management Controls - Customer Premises	403,931	-	-	403,931	403,931	-	-	403,931	-
1975	Load Management Controls - Utility Premises	165,151	-	-	165,151	165,151	-	-	165,151	-
1980	System Supervisory Equipment	1,480,826	35,317	-	1,516,144	1,248,325	26,750	-	1,275,075	241,069
1985	Sentinel Lighting Rentals	-	-	-	-	-	-	-	-	-
1990	Other Tangible Property	53,060	-	-	53,060	29,783	1,630	-	31,412	21,648
1995	Contributions and Grants	(9,298,809)	-	-	(9,298,809)	(2,595,881)	(212,507)	-	(2,808,388)	(6,490,421)
2440	Deferred Revenue	(2,470,932)	(728,037)	-	(3,198,969)	(105,365)	(71,270)	-	(176,635)	(3,022,334)
2005	Property under Capital Lease	-	-	-	-	-	-	-	-	-
	Total before Work in Process	**117,032,985**	**5,463,803**	**1,174,339**	**121,322,449**	**59,769,778**	**2,606,542**	**990,317**	**61,386,004**	**59,936,445**
	Work in Process	1,628,390	982,681	-	2,611,071	-	-	-	-	2,611,071
2070	Other Utility Plant - assets not in use	-	-	-	-	-	-	-	-	-
	Total after Work in Process	**118,661,375**	**6,446,484**	**1,174,339**	**123,933,520**	**59,769,778**	**2,606,542**	**990,317**	**61,386,004**	62,547,517

Table 2 - 17: Fixed Asset Continuity Schedule as at December 31, 2018, MIFRS

Fixed Asset Continuity Schedule (Distribution & Operations)
As at December 31, 2018

OEB	Description	Cost				Accumulated Depreciation				
		Opening Balance	Additions	Disposals	Closing Balance	Opening Balance	Additions	Disposals	Closing Balance	Net Book Value
1611	Computer Software	1,584,554	32,812	-	1,617,366	1,488,764	48,628	-	1,537,392	79,975
1805	Land	505,305	-	-	505,305	-	-	-	-	505,305
1806	Land Rights	-	-	-	-	-	-	-	-	-
1808	Buildings and Fixtures	1,838,335	(872,145)	-	966,190	496,518	17,013	129,103	384,428	581,762
1810	Leasehold Improvements	-	-	-	-	-	-	-	-	-
1815	Transformer Station Equipment - Normally Primary above 50 kV	-	-	-	-	-	-	-	-	-
1820	Distribution Station Equipment - Normally Primary below 50 kV	17,079,289	3,264,424	-	20,343,713	5,445,510	485,912	- 129,106	6,060,528	14,283,185
1825	Storage Battery Equipment	-	-	-	-	-	-	-	-	-
1830	Poles, Towers and Fixtures	25,646,472	1,025,156	99,274	26,572,355	12,126,280	421,903	86,715	12,461,467	14,110,887
1835	Overhead Conductors and Devices	18,632,393	893,705	31,970	19,494,129	9,307,309	220,461	27,523	9,500,247	9,993,882
1840	Underground Conduit	2,007,253	208,073	3,343	2,211,982	269,037	41,246	1,468	308,816	1,903,166
1845	Underground Conductors and Devices	8,014,513	276,710	10,617	8,280,606	4,971,572	119,384	10,398	5,080,558	3,200,048
1850	Line Transformers	18,617,683	614,191	141,078	19,090,796	10,179,915	294,736	130,827	10,343,823	8,746,973
1855	Services	21,652,715	733,297	-	22,386,012	8,673,129	496,461	-	9,169,589	13,216,423
1860	Meters	6,133,587	123,522	-	6,257,109	3,071,755	376,109	-	3,447,865	2,809,244
1865	Other Installations on Customer's Premises	-	-	-	-	-	-	-	-	-
1905	Land	86,551	-	-	86,551	-	-	-	-	86,551
1906	Land Rights	-	-	-	-	-	-	-	-	-
1908	Buildings and Fixtures	3,594,692	13,278	-	3,607,970	1,704,730	109,312	-	1,814,041	1,793,929
1910	Leasehold Improvements	-	-	-	-	-	-	-	-	-
1915	Office Furniture and Equipment	379,067	7,298	-	386,365	334,435	10,191	-	344,626	41,739
1920	Computer Equipment - Hardware	1,093,067	73,098	-	1,166,165	914,741	60,634	-	975,375	190,790
1930	Transportation Equipment	3,116,759	74,349	53,766	3,137,342	2,039,312	267,239	53,766	2,252,784	884,558
1935	Stores Equipment	75,196	67,298	-	142,493	75,196	1,122	-	76,318	66,176
1940	Tools, Shop and Garage Equipment	1,406,636	25,442	-	1,432,078	1,234,876	36,396	-	1,271,272	160,807
1945	Measurement and Testing Equipment	-	-	-	-	-	-	-	-	-
1950	Power Operated Equipment	-	-	-	-	-	-	-	-	-
1955	Communication Equipment	196,865	4,189	-	201,054	143,142	11,629	-	154,771	46,283
1960	Miscellaneous Equipment	21,010	-	-	21,010	19,238	423	-	19,661	1,348
1970	Load Management Controls - Customer Premises	403,931	-	-	403,931	403,931	-	-	403,931	-
1975	Load Management Controls - Utility Premises	165,151	-	-	165,151	165,151	-	-	165,151	-
1980	System Supervisory Equipment	1,516,144	375,350	-	1,891,494	1,275,075	46,280	-	1,321,355	570,139
1985	Sentinel Lighting Rentals	-	-	-	-	-	-	-	-	-
1990	Other Tangible Property	53,060	-	-	53,060	31,412	1,630	-	33,042	20,019
1995	Contributions and Grants	(9,298,809)	-	-	(9,298,809)	(2,808,388)	(212,507)	-	(3,020,895)	(6,277,914)
2440	Deferred Revenue	(3,198,969)	(558,617)		(3,757,586)	(176,635)	(80,614)	-	(257,249)	(3,500,337)
2005	Property under Capital Lease	-	-	-	-	-	-	-	-	-
	Total before Work in Process	**121,322,449**	**6,381,431**	**340,047**	**127,363,833**	**61,386,004**	**2,773,585**	**310,693**	**63,848,896**	**63,514,937**
	Work in Process	2,611,071	(324,712)	-	2,286,359	-	-	-	-	2,286,359
2070	Other Utility Plant - assets not in use	-	-	-	-	-	-	-	-	-
	Total after Work in Process	**123,933,520**	**6,056,719**	**340,047**	**129,650,192**	**61,386,004**	**2,773,585**	**310,693**	**63,848,896**	65,801,296

Table 2 - 18: Fixed Asset Continuity Schedule as at December 31, 2019, MIFRS

Fixed Asset Continuity Schedule (Distribution & Operations)
As at December 31, 2019

		Cost				Accumulated Depreciation				
OEB	**Description**	**Opening Balance**	**Additions Additions**	**Disposals**	**Closing Balance**	**Opening Balance**	**Additions**	**Disposals**	**Closing Balance**	**Net Book Value**
1611	Computer Software	1,617,366	51,279	6,346	1,662,300	1,537,392	36,554	6,346	1,567,600	94,700
1805	Land	505,305	-	-	505,305	-	-	-	-	505,305
1806	Land Rights	-	-	-	-	-	-	-	-	-
1808	Buildings and Fixtures	966,190	-	-	966,190	384,428	17,923	-	402,351	563,839
1810	Leasehold Improvements	-	-	-	-	-	-	-	-	-
1815	Transformer Station Equipment - Normally Primary above 50 kV	-	-	-	-	-	-	-	-	-
1820	Distribution Station Equipment - Normally Primary below 50 kV	20,343,713	992,551	110,000	21,226,264	6,060,528	514,822	81,960	6,493,390	14,732,873
1825	Storage Battery Equipment	-	-	-	-	-	-	-	-	-
1830	Poles, Towers and Fixtures	26,572,355	1,286,786	206,430	27,652,711	12,461,467	445,813	112,545	12,794,735	14,857,976
1835	Overhead Conductors and Devices	19,494,129	1,129,147	180,172	20,443,104	9,500,247	236,897	113,818	9,623,326	10,819,778
1840	Underground Conduit	2,211,982	516,961	-	2,728,943	308,816	48,432	-	357,248	2,371,695
1845	Underground Conductors and Devices	8,280,606	352,214	23,736	8,609,085	5,080,558	127,214	22,296	5,185,476	3,423,609
1850	Line Transformers	19,090,796	808,474	76,166	19,823,104	10,343,823	315,905	67,253	10,592,475	9,230,630
1855	Services	22,386,012	1,045,593	-	23,431,606	9,169,589	517,138	-	9,686,727	13,744,878
1860	Meters	6,257,109	113,575	-	6,370,684	3,447,865	389,677	-	3,837,541	2,533,143
1865	Other Installations on Customer's Premises	-	-	-	-	-	-	-	-	-
1905	Land	86,551	-	-	86,551	-	-	-	-	86,551
1906	Land Rights	-	-	-	-	-	-	-	-	-
1908	Buildings and Fixtures	3,607,970	40,195	-	3,648,165	1,814,041	109,776	-	1,923,817	1,724,348
1910	Leasehold Improvements	-	-	-	-	-	-	-	-	-
1915	Office Furniture and Equipment	386,365	7,549	-	393,914	344,626	9,534	-	354,160	39,754
1920	Computer Equipment - Hardware	1,166,165	224,479	-	1,390,644	975,375	77,730	-	1,053,105	337,539
1930	Transportation Equipment	3,137,342	431,519	83,065	3,485,797	2,252,784	249,001	83,065	2,418,721	1,067,076
1935	Stores Equipment	142,493	-	-	142,493	76,318	2,692	-	79,010	63,484
1940	Tools, Shop and Garage Equipment	1,432,078	41,078	-	1,473,156	1,271,272	36,498	-	1,307,769	165,387
1945	Measurement and Testing Equipment	-	-	-	-	-	-	-	-	-
1950	Power Operated Equipment	-	-	-	-	-	-	-	-	-
1955	Communication Equipment	201,054	3,573	-	204,627	154,771	10,404	-	165,175	39,452
1960	Miscellaneous Equipment	21,010	-	-	21,010	19,661	293	-	19,954	1,055
1970	Load Management Controls - Customer Premises	403,931	-	-	403,931	403,931	-	-	403,931	-
1975	Load Management Controls - Utility Premises	165,151	-	-	165,151	165,151	-	-	165,151	-
1980	System Supervisory Equipment	1,891,494	53,180	-	1,944,674	1,321,355	64,127	-	1,385,483	559,191
1985	Sentinel Lighting Rentals	-	-	-	-	-	-	-	-	-
1990	Other Tangible Property	53,060	-	-	53,060	33,042	1,629	-	34,671	18,389
1995	Contributions and Grants	(9,298,809)	0	-	(9,298,809)	(3,020,895)	(230,216)	-	(3,251,111)	(6,047,698)
2440	Deferred Revenue	(3,757,586)	(483,042)	-	(4,240,628)	(257,249)	(93,372)	-	(350,621)	(3,890,007)
2005	Property under Capital Lease	-	-	-	-	-	-	-	-	-
	Total before Work in Process	**127,363,833**	**6,615,112**	**685,914**	**133,293,030**	**63,848,896**	**2,888,471**	**487,284**	**66,250,083**	**67,042,947**
	Work in Process	2,286,359	(951,663)	-	1,334,696	-	-	-	-	1,334,696
2070	Other Utility Plant - assets not in use	-	-	-	-	-	-	-	-	-
	Total after Work in Process	**129,650,192**	**5,663,449**	**685,914**	**134,627,726**	**63,848,896**	**2,888,471**	**487,284**	**66,250,083**	68,377,644

Table 2 - 19: Fixed Asset Continuity Schedule as at December 31, 2020, MIFRS

Fixed Asset Continuity Schedule (Distribution & Operations)
As at December 31, 2020

		Cost				Accumulated Depreciation				
OEB	**Description**	**Opening Balance**	**Additions Additions**	**Disposals**	**Closing Balance**	**Opening Balance**	**Additions**	**Disposals**	**Closing Balance**	**Net Book Value**
1611	Computer Software	1,662,300	1,250	-	1,663,550	1,567,600	30,531	-	1,598,131	65,419
1805	Land	505,305	-	-	505,305	-	-	-	-	505,305
1806	Land Rights	-	-	-	-	-	-	-	-	-
1808	Buildings and Fixtures	966,190	-	-	966,190	402,351	17,923	-	420,274	545,916
1810	Leasehold Improvements	-	-	-	-	-	-	-	-	-
1815	Transformer Station Equipment - Normally Primary above 50 kV	-	-	-	-	-	-	-	-	-
1820	Distribution Station Equipment - Normally Primary below 50 kV	21,226,264	473,587	-	21,699,851	6,493,390	558,933	-	7,052,323	14,647,527
1825	Storage Battery Equipment	-	-	-	-	-	-	-	-	-
1830	Poles, Towers and Fixtures	27,652,711	1,695,322	209,575	29,138,458	12,794,735	485,810	183,659	13,096,886	16,041,572
1835	Overhead Conductors and Devices	20,443,104	637,333	76,382	21,004,054	9,623,326	250,251	64,884	9,808,693	11,195,362
1840	Underground Conduit	2,728,943	499,206	3,321	3,224,828	357,248	56,511	1,259	412,500	2,812,328
1845	Underground Conductors and Devices	8,609,085	367,085	14,482	8,961,687	5,185,476	133,281	13,035	5,305,722	3,655,966
1850	Line Transformers	19,823,104	518,945	96,170	20,245,880	10,592,475	336,228	89,701	10,839,001	9,406,879
1855	Services	23,431,606	698,093	-	24,129,699	9,686,727	543,802	-	10,230,529	13,899,170
1860	Meters	6,370,684	142,738	-	6,513,422	3,837,541	399,556	-	4,237,097	2,276,325
1865	Other Installations on Customer's Premises	-	-	-	-	-	-	-	-	-
1905	Land	86,551	-	-	86,551	-	-	-	-	86,551
1906	Land Rights	-	-	-	-	-	-	-	-	-
1908	Buildings and Fixtures	3,648,165	295,509	-	3,943,674	1,923,817	120,184	-	2,044,001	1,899,673
1910	Leasehold Improvements	-	-	-	-	-	-	-	-	-
1915	Office Furniture and Equipment	393,914	31,455	-	425,369	354,160	10,061	-	364,221	61,148
1920	Computer Equipment - Hardware	1,390,644	348,220	-	1,738,864	1,053,105	119,161	-	1,172,266	566,598
1930	Transportation Equipment	3,485,797	89,396	-	3,575,193	2,418,721	269,718	-	2,688,439	886,754
1935	Stores Equipment	142,493	-	-	142,493	79,010	6,730	-	85,740	56,754
1940	Tools, Shop and Garage Equipment	1,473,156	58,614	-	1,531,770	1,307,769	39,613	-	1,347,382	184,388
1945	Measurement and Testing Equipment	-	-	-	-	-	-	-	-	-
1950	Power Operated Equipment	-	110,650	-	110,650	-	5,533	-	5,533	105,117
1955	Communication Equipment	204,627	-	-	204,627	165,175	9,296	-	174,471	30,156
1960	Miscellaneous Equipment	21,010		-	21,010	19,954	293	-	20,247	762
1970	Load Management Controls - Customer Premises	403,931	-	-	403,931	403,931	-	-	403,931	-
1975	Load Management Controls - Utility Premises	165,151	-	-	165,151	165,151	-	-	165,151	-
1980	System Supervisory Equipment	1,944,674	80,676	-	2,025,350	1,385,483	66,104	-	1,451,587	573,763
1985	Sentinel Lighting Rentals	-	-	-	-	-	-	-	-	-
1990	Other Tangible Property	53,060	-	-	53,060	34,671	1,630	-	36,301	16,759
1995	Contributions and Grants	(9,298,809)	-	-	(9,298,809)	(3,251,111)	(230,216)	-	(3,481,327)	(5,817,482)
2440	Deferred Revenue	(4,240,628)	(560,310)	-	(4,800,938)	(350,621)	(104,244)	-	(454,865)	(4,346,073)
2005	Property under Capital Lease	-	-	-	-	-	-	-	-	-
	Total before Work in Process	**133,293,030**	**5,487,769**	**399,929**	**138,380,870**	**66,250,083**	**3,126,688**	**352,538**	**69,024,233**	**69,356,637**
	Work in Process	1,334,696	340,106	-	1,674,802	-			-	1,674,802
2070	Other Utility Plant - assets not in use		-	-	-				-	-
	Total after Work in Process	**134,627,726**	**5,827,875**	**399,929**	**140,055,672**	**66,250,083**	**3,126,688**	**352,538**	**69,024,233**	71,031,439

Table 2 - 20: Fixed Asset Continuity Schedule as at December 31, 2021, MIFRS

Fixed Asset Continuity Schedule (Distribution & Operations)
As at December 31, 2021

		Cost				Accumulated Depreciation				
OEB	**Description**	**Opening Balance**	**Additions Additions**	**Disposals**	**Closing Balance**	**Opening Balance**	**Additions**	**Disposals**	**Closing Balance**	**Net Book Value**
1611	Computer Software	1,663,550	233,150	-	1,896,700	1,598,131	47,524	-	1,645,655	251,045
1805	Land	505,305	-	-	505,305	-	-	-	-	505,305
1806	Land Rights	-	-	-	-	-	-	-	-	-
1808	Buildings and Fixtures	966,190	-	-	966,190	420,274	17,923	-	438,197	527,993
1810	Leasehold Improvements	-	-	-	-	-	-	-	-	-
1815	Transformer Station Equipment - Normally Primary above 50 kV	-	-	-	-	-	-	-	-	-
1820	Distribution Station Equipment - Normally Primary below 50 kV	21,699,851	474,482	-	22,174,333	7,052,323	602,575	-	7,654,898	14,519,435
1825	Storage Battery Equipment	-	-	-	-	-	-	-	-	-
1830	Poles, Towers and Fixtures	29,138,458	2,033,907	191,201	30,981,164	13,096,886	494,552	153,252	13,438,186	17,542,978
1835	Overhead Conductors and Devices	21,004,054	555,555	90,847	21,468,762	9,808,693	260,192	69,676	9,999,209	11,469,554
1840	Underground Conduit	3,224,828	477,235	1,534	3,700,529	412,500	66,275	613	478,162	3,222,367
1845	Underground Conductors and Devices	8,961,687	190,084	16,711	9,135,060	5,305,722	140,246	15,231	5,430,737	3,704,324
1850	Line Transformers	20,245,880	653,474	98,852	20,800,503	10,839,001	350,883	91,181	11,098,703	9,701,800
1855	Services	24,129,699	940,570	-	25,070,268	10,230,529	562,944	-	10,793,473	14,276,796
1860	Meters	6,513,422	139,467	-	6,652,889	4,237,097	412,589	-	4,649,686	2,003,203
1865	Other Installations on Customer's Premises	-	-	-	-	-	-	-	-	-
1905	Land	86,551	-	-	86,551	-	-	-	-	86,551
1906	Land Rights	-	-	-	-	-	-	-	-	-
1908	Buildings and Fixtures	3,943,674	290,413	-	4,234,087	2,044,001	131,903	-	2,175,904	2,058,183
1910	Leasehold Improvements	-	-	-	-	-	-	-	-	-
1915	Office Furniture and Equipment	425,369	2,000	-	427,369	364,221	10,530	-	374,751	52,618
1920	Computer Equipment - Hardware	1,738,864	9,800	-	1,748,664	1,172,266	149,986	-	1,322,252	426,412
1930	Transportation Equipment	3,575,193	323,941	216,479	3,682,655	2,688,439	249,145	216,479	2,721,105	961,550
1935	Stores Equipment	142,493	-	-	142,493	85,740	6,730	-	92,469	50,024
1940	Tools, Shop and Garage Equipment	1,531,770	40,000	-	1,571,770	1,347,382	39,594	-	1,386,976	184,794
1945	Measurement and Testing Equipment	-	-	-	-	-	-	-	-	-
1950	Power Operated Equipment	110,650	-	-	110,650	5,533	11,065	-	16,598	94,052
1955	Communication Equipment	204,627	-	-	204,627	174,471	9,296	-	183,767	20,860
1960	Miscellaneous Equipment	21,010	-	-	21,010	20,247	293	-	20,540	469
1970	Load Management Controls - Customer Premises	403,931	-	-	403,931	403,931	-	-	403,931	-
1975	Load Management Controls - Utility Premises	165,151	-	-	165,151	165,151	-	-	165,151	-
1980	System Supervisory Equipment	2,025,350	98,517	-	2,123,867	1,451,587	73,811	-	1,525,398	598,469
1985	Sentinel Lighting Rentals	-	-	-	-	-	-	-	-	-
1990	Other Tangible Property	53,060	-	-	53,060	36,301	1,630	-	37,931	15,130
1995	Contributions and Grants	(9,298,809)	-	-	(9,298,809)	(3,481,327)	(212,507)	-	(3,693,834)	(5,604,975)
2440	Deferred Revenue	(4,800,938)	(551,144)		(5,352,082)	(454,865)	(116,593)	-	(571,458)	(4,780,624)
2005	Property under Capital Lease	-	-	-	-	-	-	-	-	-
	Total before Work in Process	**138,380,870**	**5,911,450**	**615,624**	**143,676,696**	**69,024,233**	**3,310,585**	**546,432**	**71,788,386**	**71,888,311**
	Work in Process	1,674,802	229,450	-	1,904,252	-	-	-	-	1,904,252
2070	Other Utility Plant - assets not in use		-	-	-	-	-	-	-	-
	Total after Work in Process	**140,055,672**	**6,140,900**	**615,624**	**145,580,949**	**69,024,233**	**3,310,585**	**546,432**	**71,788,386**	73,792,563

2.2.1.4 FIXED ASSET CONTINUITY SCHEDULES, EXCLUDING WORK IN PROGRESS

Table 2-21 through Table 2-27 below provide the Fixed Asset Continuity Schedules excluding WIP for each of 2015 Actual, 2016 Actual, 2017 Actual, 2018 Actual, 2019 Actual, 2020 Bridge Year, and 2021 Test Year and are consistent with Appendix 2-BA as required in the Filing Requirements.

The "CCA Class" for fixed assets agrees with the CCA Class used for tax purposes in NBHDL's tax returns. NBHDL has two asset classes that were different from those shown in Appendix 2-BA as provided by the Board. For tax purposes NBHDL has classified Computer Software and Computer Hardware as Class 50 with a CCA rate of 55%, incorporating a 50% rule in the year of acquisition.

For general financial reporting purposes under IFRS, NBHDL has accounted for the retirement of assets within its calculation of rate base for both the 2020 Bridge Year and the 2021 Test Year. The reclassification of losses to depreciation is disclosed separately and explained in further detail in the "Capitalization Policy" section of this Exhibit and Exhibit 4 – Operating Costs.

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Table 2 - 21: Fixed Asset Continuity Schedule as at December 31, 2015, MIFRS

Appendix 2-BA
Fixed Asset Continuity Schedule

Accounting Standard MIFRS
Year **2015**

			Cost				Accumulated Depreciation				
CCA Class [2]	OEB Account [3]	Description [3]	Opening Balance	Additions [4]	Disposals [6]	Closing Balance	Opening Balance	Additions	Disposals [6]	Closing Balance	Net Book Value
90	1609	Capital Contributions Paid	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
12	1611	Computer Software (Formally known as Account 1925)	$ 1,479,562	$ 26,418	$ -	$ 1,505,980	$ 1,224,253	$ 102,965	$ -	$ 1,327,217	$ 178,762
CEC	1612	Land Rights (Formally known as Account 1906)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
N/A	1805	Land	$ 446,565	$ 50,811	$ -	$ 497,376	$ -	$ -	$ -	$ -	$ 497,376
47	1808	Buildings	$ 1,830,506	$ -	$ -	$ 1,830,506	$ 391,450	$ 34,598	$ -	$ 426,048	$ 1,404,458
13	1810	Leasehold Improvements	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1815	Transformer Station Equipment >50 kV	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1820	Distribution Station Equipment <50 kV	$ 13,660,424	$ 2,533,625	$ -	$ 16,194,049	$ 4,731,052	$ 345,080	$ -	$ 5,076,132	$ 11,117,917
47	1825	Storage Battery Equipment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1830	Poles, Towers & Fixtures	$ 23,050,282	$ 1,143,597	-$ 363,805	$ 23,830,074	$ 11,545,406	$ 367,145	-$ 318,544	$ 11,594,008	$ 12,236,066
47	1835	Overhead Conductors & Devices	$ 17,046,356	$ 802,077	-$ 141,079	$ 17,707,354	$ 8,872,695	$ 234,828	-$ 122,806	$ 8,984,717	$ 8,722,637
47	1840	Underground Conduit	$ 1,215,600	$ 27,336	-$ 558	$ 1,242,378	$ 186,720	$ 23,584	-$ 213	$ 210,091	$ 1,032,287
47	1845	Underground Conductors & Devices	$ 7,414,450	$ 51,130	-$ 23,324	$ 7,442,256	$ 4,698,051	$ 102,260	-$ 21,549	$ 4,778,762	$ 2,663,494
47	1850	Line Transformers	$ 17,009,344	$ 539,716	-$ 81,586	$ 17,467,474	$ 9,625,190	$ 264,023	-$ 77,482	$ 9,811,730	$ 7,655,743
47	1855	Services (Overhead & Underground)	$ 18,555,183	$ 626,962	$ -	$ 19,182,145	$ 7,334,179	$ 421,757	$ -	$ 7,755,936	$ 11,426,209
47	1860	Meters	$ 1,557,487	$ -	$ -	$ 1,557,487	$ 916,090	$ 40,810	$ -	$ 956,900	$ 600,586
47	1860	Meters (Smart Meters)	$ 3,867,032	$ 254,295	$ -	$ 4,121,327	$ 1,126,835	$ 279,906	$ -	$ 1,406,740	$ 2,714,587
N/A	1905	Land	$ 86,551	$ -	$ -	$ 86,551	$ -	$ -	$ -	$ -	$ 86,551
1	1908	Buildings & Fixtures	$ 2,951,334	$ 170,170	$ -	$ 3,121,503	$ 1,428,483	$ 81,394	$ -	$ 1,509,877	$ 1,611,626
13	1910	Leasehold Improvements			$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	1915	Office Furniture & Equipment (10 years)	$ 379,286	$ 751	$ -	$ 380,037	$ 320,588	$ 10,878	$ -	$ 331,466	$ 48,571
8	1915	Office Furniture & Equipment (5 years)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
10	1920	Computer Equipment - Hardware	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -
45	1920	Computer Equip.-Hardware(Post Mar. 22/04)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
50	1920	Computer Equip.-Hardware(Post Mar. 19/07)	$ 953,448	$ 29,127	-$ 8,635	$ 973,940	$ 743,150	$ 72,735	-$ 8,635	$ 807,250	$ 166,691
10	1930	Transportation Equipment	$ 2,395,301	$ 590,665	-$ 72,968	$ 2,912,998	$ 1,757,911	$ 261,460	-$ 68,352	$ 1,951,018	$ 961,980
8	1935	Stores Equipment	$ 75,196		$ -	$ 75,196	$ 75,196	$ -	$ -	$ 75,196	$ -
8	1940	Tools, Shop & Garage Equipment	$ 1,342,108	$ 18,787	$ -	$ 1,360,895	$ 1,114,491	$ 43,725	$ -	$ 1,158,216	$ 202,679
8	1945	Measurement & Testing Equipment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	1950	Power Operated Equipment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	1955	Communications Equipment	$ 174,364	$ 2,881	$ -	$ 177,245	$ 111,782	$ 9,934	$ -	$ 121,716	$ 55,530
8	1955	Communication Equipment (Smart Meters)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	1960	Miscellaneous Equipment	$ 21,010	$ -	$ -	$ 21,010	$ 16,087	$ 1,765	$ -	$ 17,853	$ 3,157
47	1970	Load Management Controls Customer Premises	$ 403,931	$ -	$ -	$ 403,931	$ 403,931	$ -	$ -	$ 403,931	$ -
47	1975	Load Management Controls Utility Premises	$ 165,151	$ -	$ -	$ 165,151	$ 165,151	$ -	$ -	$ 165,151	$ -
50	1980	System Supervisor Equipment	$ 1,433,558	$ 28,272	$ -	$ 1,461,830	$ 1,165,765	$ 51,458	$ -	$ 1,217,223	$ 244,607
47	1985	Miscellaneous Fixed Assets	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1990	Other Tangible Property	$ 53,060	$ -	$ -	$ 53,060	$ 26,523	$ 1,630	$ -	$ 28,153	$ 24,907
47	1995	Contributions & Grants	-$ 9,298,809	$ -	$ -	-$ 9,298,809	-$ 2,168,528	-$ 214,846	$ -	-$ 2,383,374	-$ 6,915,435
47	2440	Deferred Revenue[5]	-$ 1,415,412	-$ 703,198	$ -	-$ 2,118,610	-$ 13,636	-$ 43,035	$ -	-$ 56,671	-$ 2,061,939
	2005	Property Under Finance Lease[7]	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Sub-Total	**$ 106,852,867**	**$ 6,193,422**	**-$ 691,955**	**$ 112,354,334**	**$ 55,798,815**	**$ 2,494,051**	**-$ 617,581**	**$ 57,675,286**	**$ 54,679,048**
		Less Socialized Renewable Energy Generation Investments (input as negative)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Less Other Non Rate-Regulated Utility Assets (input as negative)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Total PP&E	**$ 106,852,867**	**$ 6,193,422**	**-$ 691,955**	**$ 112,354,334**	**$ 55,798,815**	**$ 2,494,051**	**-$ 617,581**	**$ 57,675,286**	**$ 54,679,048**
		Depreciation Expense adj. from gain or loss on the retirement of assets (pool of like assets), if applicable[6]						$ -			
		Total						**$ 2,494,051**			

			Less: *Fully Allocated Depreciation*	
10		Transportation	Transportation	$ 152,941
8		Stores Equipment	Stores Equipment	$ -
47		Deferred Revenue	Deferred Revenue	-$ 43,035
			Net Depreciation	$ 2,384,145

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Table 2 - 22: Fixed Asset Continuity Schedule as at December 31, 2016, MIFRS

Appendix 2-BA

Fixed Asset Continuity Schedule [1]

Accounting Standard MIFRS
Year **2016**

			Cost				Accumulated Depreciation				
CCA Class [2]	**OEB Account [3]**	**Description [3]**	**Opening Balance**	**Additions [4]**	**Disposals [6]**	**Closing Balance**	**Opening Balance**	**Additions**	**Disposals [6]**	**Closing Balance**	**Net Book Value**
90	1609	Capital Contributions Paid	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
12	1611	Computer Software (Formally known as Account 1925)	$ 1,505,980	$ 54,301	$ -	$ 1,560,281	$ 1,327,217	$ 86,776	$ -	$ 1,413,993	$ 146,287
CEC	1612	Land Rights (Formally known as Account 1906	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
N/A	1805	Land	$ 497,376	$ 7,929	$ -	$ 505,305	$ -		$ -	$ -	$ 505,305
47	1808	Buildings	$ 1,830,506	$ 7,829	$ -	$ 1,838,335	$ 426,048	$ 35,235	$ -	$ 461,283	$ 1,377,052
13	1810	Leasehold Improvements	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1815	Transformer Station Equipment >50 kV	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1820	Distribution Station Equipment <50 kV	$ 16,194,049	$ 491,617	-$ 227,884	$ 16,457,782	$ 5,076,132	$ 381,625	-$ 178,626	$ 5,279,131	$ 11,178,651
47	1825	Storage Battery Equipment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1830	Poles, Towers & Fixtures	$ 23,830,074	$ 1,052,727	-$ 16,955	$ 24,865,846	$ 11,594,008	$ 378,557	-$ 13,613	$ 11,958,952	$ 12,906,894
47	1835	Overhead Conductors & Devices	$ 17,707,354	$ 597,960	-$ 5,489	$ 18,299,825	$ 8,984,717	$ 197,336	-$ 4,946	$ 9,177,107	$ 9,122,718
47	1840	Underground Conduit	$ 1,242,378	$ 191,283	-$ 747	$ 1,432,914	$ 210,091	$ 26,412	-$ 231	$ 236,272	$ 1,196,642
47	1845	Underground Conductors & Devices	$ 7,442,256	$ 155,327	-$ 13,022	$ 7,584,561	$ 4,778,762	$ 102,783	-$ 10,242	$ 4,871,303	$ 2,713,258
47	1850	Line Transformers	$ 17,467,474	$ 574,025	-$ 67,075	$ 17,974,424	$ 9,811,730	$ 265,810	-$ 55,237	$ 10,022,303	$ 7,952,120
47	1855	Services (Overhead & Underground)	$ 19,182,145	$ 1,359,878	$ -	$ 20,542,023	$ 7,755,936	$ 444,576	$ -	$ 8,200,512	$ 12,341,511
47	1860	Meters	$ 1,557,487	$ -	$ -	$ 1,557,487	$ 956,900	$ 48,430	$ -	$ 1,005,330	$ 552,157
47	1860	Meters (Smart Meters)	$ 4,121,327	$ 262,657	$ -	$ 4,383,984	$ 1,406,740	$ 299,956	$ -	$ 1,706,696	$ 2,677,288
N/A	1905	Land	$ 86,551	$ -	$ -	$ 86,551	$ -	$ -	$ -	$ -	$ 86,551
1	1908	Buildings & Fixtures	$ 3,121,503	$ 454,713	$ -	$ 3,576,216	$ 1,509,877	$ 89,057	$ -	$ 1,598,934	$ 1,977,282
13	1910	Leasehold Improvements	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	1915	Office Furniture & Equipment (10 years)	$ 380,037	$ -	$ -	$ 380,037	$ 331,466	$ 10,308	$ -	$ 341,774	$ 38,263
8	1915	Office Furniture & Equipment (5 years)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
10	1920	Computer Equipment - Hardware	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -
45	1920	Computer Equip.-Hardware(Post Mar. 22/04)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
50	1920	Computer Equip.-Hardware(Post Mar. 19/07)	$ 973,940	$ 20,646	$ -	$ 994,586	$ 807,250	$ 63,122	$ -	$ 870,372	$ 124,215
10	1930	Transportation Equipment	$ 2,912,998	$ 283,707	-$ 208,399	$ 2,988,306	$ 1,951,018	$ 314,812	-$ 208,399	$ 2,057,431	$ 930,875
8	1935	Stores Equipment	$ 75,196	$ -	$ -	$ 75,196	$ 75,196	$ -	$ -	$ 75,196	$ -
8	1940	Tools, Shop & Garage Equipment	$ 1,360,895	$ 22,336	$ -	$ 1,383,231	$ 1,158,216	$ 38,245	$ -	$ 1,196,461	$ 186,770
8	1945	Measurement & Testing Equipment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	1950	Power Operated Equipment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	1955	Communications Equipment	$ 177,245	$ 14,614	$ -	$ 191,859	$ 121,716	$ 10,381	$ -	$ 132,097	$ 59,763
8	1955	Communication Equipment (Smart Meters)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	1960	Miscellaneous Equipment	$ 21,010	$ -	$ -	$ 21,010	$ 17,853	$ 834	$ -	$ 18,687	$ 2,323
47	1970	Load Management Controls Customer Premises	$ 403,931	$ -	$ -	$ 403,931	$ 403,931	$ -	$ -	$ 403,931	$ -
47	1975	Load Management Controls Utility Premises	$ 165,151	$ -	$ -	$ 165,151	$ 165,151	$ -	$ -	$ 165,151	$ -
50	1980	System Supervisor Equipment	$ 1,461,830	$ 18,996	$ -	$ 1,480,826	$ 1,217,223	$ 31,102	$ -	$ 1,248,325	$ 232,501
47	1985	Miscellaneous Fixed Assets	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1990	Other Tangible Property	$ 53,060	$ -	$ -	$ 53,060	$ 28,153	$ 1,630	$ -	$ 29,783	$ 23,277
47	1995	Contributions & Grants	-$ 9,298,809	$ -	$ -	-$ 9,298,809	-$ 2,383,374	-$ 212,507	$ -	-$ 2,595,881	-$ 6,702,928
47	2440	Deferred Revenue[5]	-$ 2,118,610	-$ 352,322	$ -	-$ 2,470,932	-$ 56,671	-$ 48,694	$ -	-$ 105,365	-$ 2,365,567
	2005	Property Under Finance Lease[7]	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Sub-Total	**$ 112,354,334**	**$ 5,218,223**	**-$ 539,571**	**$ 117,032,986**	**$ 57,675,286**	**$ 2,565,785**	**-$ 471,294**	**$ 59,769,777**	**$ 57,263,209**
		Less Socialized Renewable Energy Generation Investments (input as negative)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Less Other Non Rate-Regulated Utility Assets (input as negative)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Total PP&E	**$ 112,354,334**	**$ 5,218,223**	**-$ 539,571**	**$ 117,032,986**	**$ 57,675,286**	**$ 2,565,785**	**-$ 471,294**	**$ 59,769,777**	**$ 57,263,209**
		Depreciation Expense adj. from gain or loss on the retirement of assets (pool of like assets), if applicable[6]						$ -			
		Total						**$ 2,565,785**			

Less: *Fully Allocated Depreciation*

10		Transportation	Transportation	$ 179,402
8		Stores Equipment	Stores Equipment	$ -
47		Deferred Revenue	Deferred Revenue	-$ 48,694
			Net Depreciation	$ 2,435,077

Table 2 - 23: Fixed Asset Continuity Schedule as at December 31, 2017, MIFRS

Appendix 2-BA

Fixed Asset Continuity Schedule [1]

Accounting Standard MIFRS
Year **2017**

			Cost				Accumulated Depreciation				
CCA Class [2]	**OEB Account [3]**	**Description [3]**	**Opening Balance**	**Additions [4]**	**Disposals [6]**	**Closing Balance**	**Opening Balance**	**Additions**	**Disposals [6]**	**Closing Balance**	**Net Book Value**
90	1609	Capital Contributions Paid	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
12	1611	Computer Software (Formally known as Account 1925)	$ 1,560,281	$ 24,273	$ -	$ 1,584,554	$ 1,413,993	$ 67,371	$ 7,400	$ 1,488,764	$ 95,790
CEC	1612	Land Rights (Formally known as Account 1906)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
N/A	1805	Land	$ 505,305	$ -	$ -	$ 505,305	$ -	$ -	$ -	$ -	$ 505,305
47	1808	Buildings	$ 1,838,335	$ -	$ -	$ 1,838,335	$ 461,283	$ 35,235	$ -	$ 496,518	$ 1,341,817
13	1810	Leasehold Improvements	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1815	Transformer Station Equipment >50 kV	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1820	Distribution Station Equipment <50 kV	$ 16,457,782	$ 976,174	-$ 354,667	$ 17,079,289	$ 5,279,131	$ 394,259	-$ 227,880	$ 5,445,510	$ 11,633,779
47	1825	Storage Battery Equipment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1830	Poles, Towers & Fixtures	$ 24,865,846	$ 1,050,168	-$ 269,541	$ 25,646,473	$ 11,958,952	$ 402,173	-$ 234,845	$ 12,126,279	$ 13,520,193
47	1835	Overhead Conductors & Devices	$ 18,299,825	$ 428,092	-$ 95,523	$ 18,632,394	$ 9,177,107	$ 209,488	-$ 79,286	$ 9,307,309	$ 9,325,085
47	1840	Underground Conduit	$ 1,432,914	$ 577,360	-$ 3,020	$ 2,007,253	$ 236,272	$ 33,920	-$ 1,154	$ 269,038	$ 1,738,215
47	1845	Underground Conductors & Devices	$ 7,584,561	$ 442,812	-$ 12,859	$ 8,014,513	$ 4,871,303	$ 111,939	-$ 11,670	$ 4,971,572	$ 3,042,942
47	1850	Line Transformers	$ 17,974,424	$ 771,612	-$ 128,353	$ 18,617,682	$ 10,022,303	$ 282,717	-$ 125,107	$ 10,179,914	$ 8,437,768
47	1855	Services (Overhead & Underground)	$ 20,542,023	$ 1,110,692	$ -	$ 21,652,715	$ 8,200,512	$ 472,617	$ -	$ 8,673,128	$ 12,979,587
47	1860	Meters	$ 1,557,487	$ -	$ -	$ 1,557,487	$ 1,005,330	$ 46,901	$ -	$ 1,052,231	$ 505,256
47	1860	Meters (Smart Meters)	$ 4,383,984	$ 192,116	$ -	$ 4,576,100	$ 1,706,696	$ 312,829	$ -	$ 2,019,525	$ 2,556,575
N/A	1905	Land	$ 86,551	$ -	$ -	$ 86,551	$ -	$ -	$ -	$ -	$ 86,551
1	1908	Buildings & Fixtures	$ 3,576,216	$ 18,476	$ -	$ 3,594,692	$ 1,598,934	$ 105,795	$ -	$ 1,704,729	$ 1,889,963
13	1910	Leasehold Improvements	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	1915	Office Furniture & Equipment (10 years)	$ 380,037	$ 29,130	-$ 30,100	$ 379,067	$ 341,774	$ 22,760	-$ 30,100	$ 334,435	$ 44,632
8	1915	Office Furniture & Equipment (5 years)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
10	1920	Computer Equipment - Hardware	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -
45	1920	Computer Equip.-Hardware(Post Mar. 22/04)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
50	1920	Computer Equip.-Hardware(Post Mar. 19/07)	$ 994,586	$ 98,480	$ -	$ 1,093,067	$ 870,372	$ 51,769	-$ 7,400	$ 914,741	$ 178,326
10	1930	Transportation Equipment	$ 2,988,306	$ 408,727	-$ 280,274	$ 3,116,759	$ 2,057,431	$ 262,156	-$ 280,274	$ 2,039,312	$ 1,077,447
8	1935	Stores Equipment	$ 75,196	$ -	$ -	$ 75,196	$ 75,196	$ -	$ -	$ 75,196	$ -
8	1940	Tools, Shop & Garage Equipment	$ 1,383,231	$ 23,405	$ -	$ 1,406,636	$ 1,196,461	$ 38,414	$ -	$ 1,234,876	$ 171,760
8	1945	Measurement & Testing Equipment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	1950	Power Operated Equipment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	1955	Communications Equipment	$ 191,859	$ 5,006	$ -	$ 196,865	$ 132,097	$ 11,045	$ -	$ 143,142	$ 53,723
8	1955	Communication Equipment (Smart Meters)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	1960	Miscellaneous Equipment	$ 21,010	$ -	$ -	$ 21,010	$ 18,687	$ 552	$ -	$ 19,238	$ 1,771
47	1970	Load Management Controls Customer Premises	$ 403,931	$ -	$ -	$ 403,931	$ 403,931	$ -	$ -	$ 403,931	$ -
47	1975	Load Management Controls Utility Premises	$ 165,151	$ -	$ -	$ 165,151	$ 165,151	$ -	$ -	$ 165,151	$ -
50	1980	System Supervisor Equipment	$ 1,480,826	$ 35,317	$ -	$ 1,516,144	$ 1,248,325	$ 26,750	$ -	$ 1,275,075	$ 241,068
47	1985	Miscellaneous Fixed Assets	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1990	Other Tangible Property	$ 53,060	$ -	$ -	$ 53,060	$ 29,783	$ 1,630	$ -	$ 31,413	$ 21,648
47	1995	Contributions & Grants	-$ 9,298,809	$ -	$ -	-$ 9,298,809	-$ 2,595,881	-$ 212,507	$ -	-$ 2,808,388	-$ 6,490,421
47	2440	Deferred Revenue[5]	-$ 2,470,932	-$ 728,037	$ -	-$ 3,198,969	-$ 105,365	-$ 71,270	$ -	-$ 176,635	-$ 3,022,334
	2005	Property Under Finance Lease[7]	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Sub-Total	**$ 117,032,986**	**$ 5,463,803**	**-$ 1,174,339**	**$ 121,322,451**	**$ 59,769,777**	**$ 2,606,542**	**-$ 990,317**	**$ 61,386,003**	**$ 59,936,448**
		Less Socialized Renewable Energy Generation Investments (input as negative)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Less Other Non Rate-Regulated Utility Assets (input as negative)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Total PP&E	**$ 117,032,986**	**$ 5,463,803**	**-$ 1,174,339**	**$ 121,322,451**	**$ 59,769,777**	**$ 2,606,542**	**-$ 990,317**	**$ 61,386,003**	**$ 59,936,448**
		Depreciation Expense adj. from gain or loss on the retirement of assets (pool of like assets), if applicable[6]						$ -			
		Total						**$ 2,606,542**			

			Less: *Fully Allocated Depreciation*	
10		Transportation	Transportation	$ 158,961
8		Stores Equipment	Stores Equipment	$ -
47		Deferred Revenue	Deferred Revenue	-$ 71,270
			Net Depreciation	$ 2,518,851

Table 2 - 24: Fixed Asset Continuity Schedule as at December 31, 2018, MIFRS

Appendix 2-BA

Fixed Asset Continuity Schedule [1]

Accounting Standard MIFRS
Year 2018

			Cost				Accumulated Depreciation				
CCA Class [2]	OEB Account [3]	Description [3]	Opening Balance	Additions [4]	Disposals [6]	Closing Balance	Opening Balance	Additions	Disposals [6]	Closing Balance	Net Book Value
90	1609	Capital Contributions Paid	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
12	1611	Computer Software (Formally known as Account 1925)	$ 1,584,554	$ 32,812	$ -	$ 1,617,366	$ 1,488,764	$ 48,628	$ -	$ 1,537,391	$ 79,974
CEC	1612	Land Rights (Formally known as Account 1906)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
N/A	1805	Land	$ 505,305	$ -	$ -	$ 505,305	$ -	$ -	$ -	$ -	$ 505,305
47	1808	Buildings	$ 1,838,335	-$ 872,145	$ -	$ 966,190	$ 496,518	$ 17,013	-$ 129,103	$ 384,428	$ 581,762
13	1810	Leasehold Improvements	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1815	Transformer Station Equipment >50 kV	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1820	Distribution Station Equipment <50 kV	$ 17,079,289	$ 3,264,424	$ -	$ 20,343,713	$ 5,445,510	$ 485,912	$ 129,106	$ 6,060,528	$ 14,283,185
47	1825	Storage Battery Equipment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1830	Poles, Towers & Fixtures	$ 25,646,473	$ 1,025,156	-$ 99,274	$ 26,572,355	$ 12,126,279	$ 421,903	-$ 86,715	$ 12,461,467	$ 14,110,888
47	1835	Overhead Conductors & Devices	$ 18,632,394	$ 893,705	-$ 31,970	$ 19,494,130	$ 9,307,309	$ 220,461	-$ 27,523	$ 9,500,247	$ 9,993,882
47	1840	Underground Conduit	$ 2,007,253	$ 208,073	-$ 3,343	$ 2,211,983	$ 269,038	$ 41,246	-$ 1,468	$ 308,817	$ 1,903,166
47	1845	Underground Conductors & Devices	$ 8,014,513	$ 276,710	-$ 10,617	$ 8,280,606	$ 4,971,572	$ 119,384	-$ 10,398	$ 5,080,558	$ 3,200,049
47	1850	Line Transformers	$ 18,617,682	$ 614,191	-$ 141,078	$ 19,090,795	$ 10,179,914	$ 294,736	-$ 130,827	$ 10,343,823	$ 8,746,973
47	1855	Services (Overhead & Underground)	$ 21,652,715	$ 733,297	$ -	$ 22,386,012	$ 8,673,128	$ 496,461	$ -	$ 9,169,589	$ 13,216,424
47	1860	Meters	$ 1,557,487	$ -	$ -	$ 1,557,487	$ 1,052,231	$ 45,724	$ -	$ 1,097,955	$ 459,532
47	1860	Meters (Smart Meters)	$ 4,576,100	$ 123,522	$ -	$ 4,699,622	$ 2,019,525	$ 330,385	$ -	$ 2,349,910	$ 2,349,712
N/A	1905	Land	$ 86,551	$ -	$ -	$ 86,551	$ -	$ -	$ -	$ -	$ 86,551
1	1908	Buildings & Fixtures	$ 3,594,692	$ 13,278	$ -	$ 3,607,970	$ 1,704,729	$ 109,312	$ -	$ 1,814,041	$ 1,793,929
13	1910	Leasehold Improvements	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	1915	Office Furniture & Equipment (10 years)	$ 379,067	$ 7,298	$ -	$ 386,365	$ 334,435	$ 10,191	$ -	$ 344,626	$ 41,739
8	1915	Office Furniture & Equipment (5 years)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
10	1920	Computer Equipment - Hardware	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -
45	1920	Computer Equip.-Hardware(Post Mar. 22/04)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
50	1920	Computer Equip.-Hardware(Post Mar. 19/07)	$ 1,093,067	$ 73,098	$ -	$ 1,166,165	$ 914,741	$ 60,634	$ -	$ 975,375	$ 190,790
10	1930	Transportation Equipment	$ 3,116,759	$ 74,349	-$ 53,766	$ 3,137,342	$ 2,039,312	$ 267,239	-$ 53,766	$ 2,252,785	$ 884,557
8	1935	Stores Equipment	$ 75,196	$ 67,298	$ -	$ 142,493	$ 75,196	$ 1,122	$ -	$ 76,318	$ 66,176
8	1940	Tools, Shop & Garage Equipment	$ 1,406,636	$ 25,442	$ -	$ 1,432,078	$ 1,234,876	$ 36,396	$ -	$ 1,271,271	$ 160,807
8	1945	Measurement & Testing Equipment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	1950	Power Operated Equipment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	1955	Communications Equipment	$ 196,865	$ 4,189	$ -	$ 201,054	$ 143,142	$ 11,629	$ -	$ 154,771	$ 46,283
8	1955	Communication Equipment (Smart Meters)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	1960	Miscellaneous Equipment	$ 21,010	$ -	$ -	$ 21,010	$ 19,238	$ 423	$ -	$ 19,661	$ 1,349
47	1970	Load Management Controls Customer Premises	$ 403,931	$ -	$ -	$ 403,931	$ 403,931	$ -	$ -	$ 403,931	$ -
47	1975	Load Management Controls Utility Premises	$ 165,151	$ -	$ -	$ 165,151	$ 165,151	$ -	$ -	$ 165,151	$ -
50	1980	System Supervisor Equipment	$ 1,516,144	$ 375,350	$ -	$ 1,891,494	$ 1,275,075	$ 46,280	$ -	$ 1,321,355	$ 570,139
47	1985	Miscellaneous Fixed Assets	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1990	Other Tangible Property	$ 53,060	$ -	$ -	$ 53,060	$ 31,413	$ 1,630	$ -	$ 33,042	$ 20,018
47	1995	Contributions & Grants	-$ 9,298,809	$ -	$ -	-$ 9,298,809	-$ 2,808,388	-$ 212,507	$ -	-$ 3,020,895	-$ 6,277,914
47	2440	Deferred Revenue[5]	-$ 3,198,969	-$ 558,617	$ -	-$ 3,757,586	-$ 176,635	-$ 80,614	$ -	-$ 257,249	-$ 3,500,337
	2005	Property Under Finance Lease[7]	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Sub-Total	**$ 121,322,451**	**$ 6,381,431**	**-$ 340,047**	**$ 127,363,834**	**$ 61,386,003**	**$ 2,773,585**	**-$ 310,693**	**$ 63,848,895**	**$ 63,514,939**
		Less Socialized Renewable Energy Generation Investments (input as negative)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Less Other Non Rate-Regulated Utility Assets (input as negative)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Total PP&E	**$ 121,322,451**	**$ 6,381,431**	**-$ 340,047**	**$ 127,363,834**	**$ 61,386,003**	**$ 2,773,585**	**-$ 310,693**	**$ 63,848,895**	**$ 63,514,939**
		Depreciation Expense adj. from gain or loss on the retirement of assets (pool of like assets), if applicable[6]						$ -			
		Total						**$ 2,773,585**			

			Less: *Fully Allocated Depreciation*	
10		Transportation	Transportation	$ 158,098
8		Stores Equipment	Stores Equipment	$ -
47		Deferred Revenue	Deferred Revenue	-$ 80,614
			Net Depreciation	$ 2,696,101

Table 2 - 25: Fixed Asset Continuity Schedule as at December 31, 2019, MIFRS

Appendix 2-BA

Fixed Asset Continuity Schedule [1]

Accounting Standard MIFRS
Year **2019**

			Cost				Accumulated Depreciation				
CCA Class [2]	**OEB Account [3]**	**Description [3]**	**Opening Balance**	**Additions [4]**	**Disposals [6]**	**Closing Balance**	**Opening Balance**	**Additions**	**Disposals [6]**	**Closing Balance**	**Net Book Value**
90	1609	Capital Contributions Paid	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
12	1611	Computer Software (Formally known as Account 1925)	$ 1,617,366	$ 51,279	-$ 6,346	$ 1,662,299	$ 1,537,391	$ 36,554	-$ 6,346	$ 1,567,599	$ 94,700
CEC	1612	Land Rights (Formally known as Account 1906)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
N/A	1805	Land	$ 505,305			$ 505,305	$ -	$ -	$ -	$ -	$ 505,305
47	1808	Buildings	$ 966,190			$ 966,190	$ 384,428	$ 17,923		$ 402,351	$ 563,839
13	1810	Leasehold Improvements	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1815	Transformer Station Equipment >50 kV	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1820	Distribution Station Equipment <50 kV	$ 20,343,713	$ 992,551	-$ 110,000	$ 21,226,264	$ 6,060,528	$ 514,822	-$ 81,960	$ 6,493,390	$ 14,732,874
47	1825	Storage Battery Equipment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1830	Poles, Towers & Fixtures	$ 26,572,355	$ 1,286,786	-$ 206,430	$ 27,652,711	$ 12,461,467	$ 445,813	-$ 112,545	$ 12,794,735	$ 14,857,976
47	1835	Overhead Conductors & Devices	$ 19,494,130	$ 1,129,147	-$ 180,172	$ 20,443,104	$ 9,500,247	$ 236,897	-$ 113,818	$ 9,623,326	$ 10,819,778
47	1840	Underground Conduit	$ 2,211,983	$ 516,961		$ 2,728,943	$ 308,817	$ 48,432		$ 357,249	$ 2,371,695
47	1845	Underground Conductors & Devices	$ 8,280,606	$ 352,214	-$ 23,736	$ 8,609,085	$ 5,080,558	$ 127,214	-$ 22,296	$ 5,185,475	$ 3,423,610
47	1850	Line Transformers	$ 19,090,795	$ 808,474	-$ 76,166	$ 19,823,103	$ 10,343,823	$ 315,905	-$ 67,253	$ 10,592,474	$ 9,230,630
47	1855	Services (Overhead & Underground)	$ 22,386,012	$ 1,045,593	$ -	$ 23,431,606	$ 9,169,589	$ 517,138	$ -	$ 9,686,727	$ 13,744,879
47	1860	Meters	$ 1,557,487	$ -	$ -	$ 1,557,487	$ 1,097,955	$ 44,857	$ -	$ 1,142,811	$ 414,676
47	1860	Meters (Smart Meters)	$ 4,699,622	$ 113,575	$ -	$ 4,813,197	$ 2,349,910	$ 344,820	$ -	$ 2,694,730	$ 2,118,467
N/A	1905	Land	$ 86,551	$ -	$ -	$ 86,551	$ -	$ -	$ -	$ -	$ 86,551
1	1908	Buildings & Fixtures	$ 3,607,970	$ 40,195	$ -	$ 3,648,165	$ 1,814,041	$ 109,776	$ -	$ 1,923,816	$ 1,724,349
13	1910	Leasehold Improvements	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -
8	1915	Office Furniture & Equipment (10 years)	$ 386,365	$ 7,549	$ -	$ 393,914	$ 344,626	$ 9,534	$ -	$ 354,160	$ 39,754
8	1915	Office Furniture & Equipment (5 years)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
10	1920	Computer Equipment - Hardware	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -
45	1920	Computer Equip.-Hardware(Post Mar. 22/04)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
50	1920	Computer Equip.-Hardware(Post Mar. 19/07)	$ 1,166,165	$ 224,479	$ -	$ 1,390,644	$ 975,375	$ 77,730	$ -	$ 1,053,105	$ 337,539
10	1930	Transportation Equipment	$ 3,137,342	$ 431,519	-$ 83,065	$ 3,485,797	$ 2,252,785	$ 249,001	-$ 83,065	$ 2,418,722	$ 1,067,075
8	1935	Stores Equipment	$ 142,493		$ -	$ 142,493	$ 76,318	$ 2,692	$ -	$ 79,010	$ 63,484
8	1940	Tools, Shop & Garage Equipment	$ 1,432,078	$ 41,078	$ -	$ 1,473,156	$ 1,271,271	$ 36,498	$ -	$ 1,307,769	$ 165,387
8	1945	Measurement & Testing Equipment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	1950	Power Operated Equipment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	1955	Communications Equipment	$ 201,054	$ 3,573	$ -	$ 204,627	$ 154,771	$ 10,404	$ -	$ 165,175	$ 39,452
8	1955	Communication Equipment (Smart Meters)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	1960	Miscellaneous Equipment	$ 21,010	$ -	$ -	$ 21,010	$ 19,661	$ 293	$ -	$ 19,954	$ 1,056
47	1970	Load Management Controls Customer Premises	$ 403,931	$ -	$ -	$ 403,931	$ 403,931	$ -	$ -	$ 403,931	$ -
47	1975	Load Management Controls Utility Premises	$ 165,151	$ -	$ -	$ 165,151	$ 165,151	$ -	$ -	$ 165,151	$ -
50	1980	System Supervisor Equipment	$ 1,891,494	$ 53,180	$ -	$ 1,944,674	$ 1,321,355	$ 64,127	$ -	$ 1,385,483	$ 559,191
47	1985	Miscellaneous Fixed Assets	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1990	Other Tangible Property	$ 53,060	$ -	$ -	$ 53,060	$ 33,042	$ 1,629	$ -	$ 34,671	$ 18,389
47	1995	Contributions & Grants	-$ 9,298,809	$ -	$ -	-$ 9,298,809	-$ 3,020,895	-$ 230,216	$ -	-$ 3,251,111	-$ 6,047,698
47	2440	Deferred Revenue[5]	-$ 3,757,586	-$ 483,042	$ -	-$ 4,240,628	-$ 257,249	-$ 93,372	$ -	-$ 350,621	-$ 3,890,007
	2005	Property Under Finance Lease[7]	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Sub-Total	**$ 127,363,834**	**$ 6,615,112**	**-$ 685,914**	**$ 133,293,032**	**$ 63,848,895**	**$ 2,888,471**	**-$ 487,284**	**$ 66,250,082**	**$ 67,042,950**
		Less Socialized Renewable Energy Generation Investments (input as negative)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Less Other Non Rate-Regulated Utility Assets (input as negative)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Total PP&E	**$ 127,363,834**	**$ 6,615,112**	**-$ 685,914**	**$ 133,293,032**	**$ 63,848,895**	**$ 2,888,471**	**-$ 487,284**	**$ 66,250,082**	**$ 67,042,950**
		Depreciation Expense adj. from gain or loss on the retirement of assets (pool of like assets), if applicable[6]						$ -			
		Total						**$ 2,888,471**			

			Less: *Fully Allocated Depreciation*	
10		Transportation	Transportation	$ 142,035
8		Stores Equipment	Stores Equipment	$ -
47		Deferred Revenue	Deferred Revenue	-$ 93,372
			Net Depreciation	$ 2,839,808

Table 2 - 26: Fixed Asset Continuity Schedule as at December 31, 2020, MIFRS

Appendix 2-BA

Fixed Asset Continuity Schedule [1]

Accounting Standard MIFRS
Year 2020

CCA Class [2]	OEB Account [3]	Description [3]	Cost: Opening Balance	Cost: Additions [4]	Cost: Disposals [6]	Cost: Closing Balance	Accumulated Depreciation: Opening Balance	Accumulated Depreciation: Additions	Accumulated Depreciation: Disposals [6]	Accumulated Depreciation: Closing Balance	Net Book Value
90	1609	Capital Contributions Paid	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
12	1611	Computer Software (Formally known as Account 1925)	$ 1,662,299	$ 1,250	$ -	$ 1,663,549	$ 1,567,599	$ 30,531	$ -	$ 1,598,130	$ 65,419
CEC	1612	Land Rights (Formally known as Account 1906)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
N/A	1805	Land	$ 505,305	$ -	$ -	$ 505,305	$ -	$ -	$ -	$ -	$ 505,305
47	1808	Buildings	$ 966,190		$ -	$ 966,190	$ 402,351	$ 17,923	$ -	$ 420,274	$ 545,916
13	1810	Leasehold Improvements	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1815	Transformer Station Equipment >50 kV	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1820	Distribution Station Equipment <50 kV	$ 21,226,264	$ 473,587	$ -	$ 21,699,851	$ 6,493,390	$ 558,933	$ -	$ 7,052,323	$ 14,647,528
47	1825	Storage Battery Equipment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1830	Poles, Towers & Fixtures	$ 27,652,711	$ 1,695,322	-$ 209,575	$ 29,138,458	$ 12,794,735	$ 485,810	-$ 183,659	$ 13,096,886	$ 16,041,573
47	1835	Overhead Conductors & Devices	$ 20,443,104	$ 637,333	-$ 76,382	$ 21,004,055	$ 9,623,326	$ 250,251	-$ 64,884	$ 9,808,693	$ 11,195,362
47	1840	Underground Conduit	$ 2,728,943	$ 499,206	-$ 3,321	$ 3,224,829	$ 357,249	$ 56,511	-$ 1,259	$ 412,501	$ 2,812,328
47	1845	Underground Conductors & Devices	$ 8,609,085	$ 367,085	-$ 14,482	$ 8,961,688	$ 5,185,475	$ 133,281	-$ 13,035	$ 5,305,721	$ 3,655,966
47	1850	Line Transformers	$ 19,823,103	$ 518,945	-$ 96,170	$ 20,245,879	$ 10,592,474	$ 336,228	-$ 89,701	$ 10,839,000	$ 9,406,879
47	1855	Services (Overhead & Underground)	$ 23,431,606	$ 698,093	$ -	$ 24,129,699	$ 9,686,727	$ 543,802	$ -	$ 10,230,529	$ 13,899,170
47	1860	Meters	$ 1,557,487	$ -	$ -	$ 1,557,487	$ 1,142,811	$ 43,679	$ -	$ 1,186,490	$ 370,997
47	1860	Meters (Smart Meters)	$ 4,813,197	$ 142,738	$ -	$ 4,955,935	$ 2,694,730	$ 355,877	$ -	$ 3,050,608	$ 1,905,327
N/A	1905	Land	$ 86,551	$ -	$ -	$ 86,551	$ -	$ -	$ -	$ -	$ 86,551
1	1908	Buildings & Fixtures	$ 3,648,165	$ 295,509	$ -	$ 3,943,674	$ 1,923,816	$ 120,184	$ -	$ 2,044,000	$ 1,899,674
13	1910	Leasehold Improvements	$ -		$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	1915	Office Furniture & Equipment (10 years)	$ 393,914	$ 31,455	$ -	$ 425,369	$ 354,160	$ 10,061	$ -	$ 364,221	$ 61,148
8	1915	Office Furniture & Equipment (5 years)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
10	1920	Computer Equipment - Hardware	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -
45	1920	Computer Equip.-Hardware(Post Mar. 22/04)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
50	1920	Computer Equip.-Hardware(Post Mar. 19/07)	$ 1,390,644	$ 348,220	$ -	$ 1,738,864	$ 1,053,105	$ 119,161	$ -	$ 1,172,266	$ 566,598
10	1930	Transportation Equipment	$ 3,485,797	$ 89,396	$ -	$ 3,575,193	$ 2,418,722	$ 269,718	$ -	$ 2,688,440	$ 886,753
8	1935	Stores Equipment	$ 142,493		$ -	$ 142,493	$ 79,010	$ 6,730	$ -	$ 85,740	$ 56,754
8	1940	Tools, Shop & Garage Equipment	$ 1,473,156	$ 58,614	$ -	$ 1,531,770	$ 1,307,769	$ 39,613	$ -	$ 1,347,382	$ 184,388
8	1945	Measurement & Testing Equipment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	1950	Power Operated Equipment	$ -	$ 110,650	$ -	$ 110,650	$ -	$ 5,533	$ -	$ 5,533	$ 105,117
8	1955	Communications Equipment	$ 204,627	$ -	$ -	$ 204,627	$ 165,175	$ 9,296	$ -	$ 174,471	$ 30,156
8	1955	Communication Equipment (Smart Meters)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	1960	Miscellaneous Equipment	$ 21,010	$ -	$ -	$ 21,010	$ 19,954	$ 293	$ -	$ 20,247	$ 763
47	1970	Load Management Controls Customer Premises	$ 403,931	$ -	$ -	$ 403,931	$ 403,931	$ -	$ -	$ 403,931	$ -
47	1975	Load Management Controls Utility Premises	$ 165,151	$ -	$ -	$ 165,151	$ 165,151	$ -	$ -	$ 165,151	$ -
50	1980	System Supervisor Equipment	$ 1,944,674	$ 80,676	$ -	$ 2,025,350	$ 1,385,483	$ 66,104	$ -	$ 1,451,587	$ 573,763
47	1985	Miscellaneous Fixed Assets	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1990	Other Tangible Property	$ 53,060	$ -	$ -	$ 53,060	$ 34,671	$ 1,630	$ -	$ 36,301	$ 16,759
47	1995	Contributions & Grants	-$ 9,298,809	$ -	$ -	-$ 9,298,809	-$ 3,251,111	-$ 230,216	$ -	-$ 3,481,327	-$ 5,817,482
47	2440	Deferred Revenue[5]	-$ 4,240,628	-$ 560,311	$ -	-$ 4,800,939	-$ 350,621	-$ 104,244	$ -	-$ 454,865	-$ 4,346,074
	2005	Property Under Finance Lease[7]	$ -	$ -	$ -	$ -			$ -	$ -	$ -
		Sub-Total	**$ 133,293,032**	**$ 5,487,768**	**-$ 399,929**	**$ 138,380,870**	**$ 66,250,082**	**$ 3,126,688**	**-$ 352,538**	**$ 69,024,232**	**$ 69,356,638**
		Less Socialized Renewable Energy Generation Investments (input as negative)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Less Other Non Rate-Regulated Utility Assets (input as negative)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Total PP&E	**$ 133,293,032**	**$ 5,487,768**	**-$ 399,929**	**$ 138,380,870**	**$ 66,250,082**	**$ 3,126,688**	**-$ 352,538**	**$ 69,024,232**	**$ 69,356,638**
		Depreciation Expense adj. from gain or loss on the retirement of assets (pool of like assets), if applicable[6]						47,391			
		Total						**$ 3,174,079**			

			Less: *Fully Allocated Depreciation*	
10		Transportation	Transportation	$ 158,027
8		Stores Equipment	Stores Equipment	$ -
47		Deferred Revenue	Deferred Revenue	-$ 104,244
			Net Depreciation	$ 3,120,296

Table 2 - 27: Fixed Asset Continuity Schedule as at December 31, 2021, MIFRS

Appendix 2-BA

Fixed Asset Continuity Schedule [1]

Accounting Standard MIFRS
Year 2021

CCA Class [2]	OEB Account [3]	Description [3]	Cost: Opening Balance	Cost: Additions [4]	Cost: Disposals [6]	Cost: Closing Balance	Accumulated Depreciation: Opening Balance	Accumulated Depreciation: Additions	Accumulated Depreciation: Disposals [6]	Accumulated Depreciation: Closing Balance	Net Book Value
90	1609	Capital Contributions Paid	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
12	1611	Computer Software (Formally known as Account 1925)	$ 1,663,549	$ 233,150	$ -	$ 1,896,699	$ 1,598,130	$ 47,524	$ -	$ 1,645,654	$ 251,045
CEC	1612	Land Rights (Formally known as Account 1906)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
N/A	1805	Land	$ 505,305	$ -	$ -	$ 505,305	$ -	$ -	$ -	$ -	$ 505,305
47	1808	Buildings	$ 966,190	$ -	$ -	$ 966,190	$ 420,274	$ 17,923	$ -	$ 438,197	$ 527,993
13	1810	Leasehold Improvements	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1815	Transformer Station Equipment >50 kV	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1820	Distribution Station Equipment <50 kV	$ 21,699,851	$ 474,482	$ -	$ 22,174,334	$ 7,052,323	$ 602,575	$ -	$ 7,654,898	$ 14,519,435
47	1825	Storage Battery Equipment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1830	Poles, Towers & Fixtures	$ 29,138,458	$ 2,033,907	-$ 191,201	$ 30,981,164	$ 13,096,886	$ 494,552	-$ 153,252	$ 13,438,186	$ 17,542,978
47	1835	Overhead Conductors & Devices	$ 21,004,055	$ 555,555	-$ 90,847	$ 21,468,763	$ 9,808,693	$ 260,192	-$ 69,676	$ 9,999,209	$ 11,469,554
47	1840	Underground Conduit	$ 3,224,829	$ 477,235	-$ 1,534	$ 3,700,530	$ 412,501	$ 66,275	-$ 613	$ 478,163	$ 3,222,367
47	1845	Underground Conductors & Devices	$ 8,961,688	$ 190,084	-$ 16,711	$ 9,135,061	$ 5,305,721	$ 140,246	-$ 15,231	$ 5,430,736	$ 3,704,324
47	1850	Line Transformers	$ 20,245,879	$ 653,474	-$ 98,852	$ 20,800,502	$ 10,839,000	$ 350,883	-$ 91,181	$ 11,098,702	$ 9,701,800
47	1855	Services (Overhead & Underground)	$ 24,129,699	$ 940,570	$ -	$ 25,070,268	$ 10,230,529	$ 562,944	$ -	$ 10,793,472	$ 14,276,796
47	1860	Meters	$ 1,557,487	$ -	$ -	$ 1,557,487	$ 1,186,490	$ 42,818	$ -	$ 1,229,308	$ 328,179
47	1860	Meters (Smart Meters)	$ 4,955,935	$ 139,467	$ -	$ 5,095,402	$ 3,050,608	$ 369,771	$ -	$ 3,420,378	$ 1,675,024
N/A	1905	Land	$ 86,551	$ -	$ -	$ 86,551	$ -	$ -	$ -	$ -	$ 86,551
1	1908	Buildings & Fixtures	$ 3,943,674	$ 290,413	$ -	$ 4,234,087	$ 2,044,000	$ 131,903	$ -	$ 2,175,903	$ 2,058,184
13	1910	Leasehold Improvements	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	1915	Office Furniture & Equipment (10 years)	$ 425,369	$ 2,000	$ -	$ 427,369	$ 364,221	$ 10,530	$ -	$ 374,751	$ 52,618
8	1915	Office Furniture & Equipment (5 years)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
10	1920	Computer Equipment - Hardware	$ -	$ -	$ -		$ -	$ -	$ -	$ -	$ -
45	1920	Computer Equip.-Hardware(Post Mar. 22/04)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
50	1920	Computer Equip.-Hardware(Post Mar. 19/07)	$ 1,738,864	$ 9,800	$ -	$ 1,748,664	$ 1,172,266	$ 149,986	$ -	$ 1,322,252	$ 426,412
10	1930	Transportation Equipment	$ 3,575,193	$ 323,941	-$ 216,479	$ 3,682,655	$ 2,688,440	$ 249,145	-$ 216,479	$ 2,721,106	$ 961,549
8	1935	Stores Equipment	$ 142,493		$ -	$ 142,493	$ 85,740	$ 6,730	$ -	$ 92,469	$ 50,024
8	1940	Tools, Shop & Garage Equipment	$ 1,531,770	$ 40,000	$ -	$ 1,571,770	$ 1,347,382	$ 39,594	$ -	$ 1,386,976	$ 184,794
8	1945	Measurement & Testing Equipment	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	1950	Power Operated Equipment	$ 110,650	$ -	$ -	$ 110,650	$ 5,533	$ 11,065	$ -	$ 16,598	$ 94,052
8	1955	Communications Equipment	$ 204,627	$ -	$ -	$ 204,627	$ 174,471	$ 9,296	$ -	$ 183,767	$ 20,860
8	1955	Communication Equipment (Smart Meters)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
8	1960	Miscellaneous Equipment	$ 21,010	$ -	$ -	$ 21,010	$ 20,247	$ 293	$ -	$ 20,540	$ 470
47	1970	Load Management Controls Customer Premises	$ 403,931	$ -	$ -	$ 403,931	$ 403,931	$ -	$ -	$ 403,931	$ -
47	1975	Load Management Controls Utility Premises	$ 165,151	$ -	$ -	$ 165,151	$ 165,151	$ -	$ -	$ 165,151	$ -
50	1980	System Supervisor Equipment	$ 2,025,350	$ 98,517	$ -	$ 2,123,867	$ 1,451,587	$ 73,811	$ -	$ 1,525,398	$ 598,469
47	1985	Miscellaneous Fixed Assets	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
47	1990	Other Tangible Property	$ 53,060	$ -	$ -	$ 53,060	$ 36,301	$ 1,630	$ -	$ 37,931	$ 15,129
47	1995	Contributions & Grants	-$ 9,298,809	$ -	$ -	-$ 9,298,809	-$ 3,481,327	-$ 212,507	$ -	-$ 3,693,834	-$ 5,604,975
47	2440	Deferred Revenue[5]	-$ 4,800,939	-$ 551,144	$ -	-$ 5,352,083	-$ 454,865	-$ 116,593	$ -	-$ 571,458	-$ 4,780,625
	2005	Property Under Finance Lease[7]	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Sub-Total	**$ 138,380,870**	**$ 5,911,450**	**-$ 615,624**	**$ 143,676,697**	**$ 69,024,232**	**$ 3,310,585**	**-$ 546,432**	**$ 71,788,385**	**$ 71,888,312**
		Less Socialized Renewable Energy Generation Investments (input as negative)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Less Other Non Rate-Regulated Utility Assets (input as negative)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
		Total PP&E	**$ 138,380,870**	**$ 5,911,450**	**-$ 615,624**	**$ 143,676,697**	**$ 69,024,232**	**$ 3,310,585**	**-$ 546,432**	**$ 71,788,385**	**$ 71,888,312**
		Depreciation Expense adj. from gain or loss on the retirement of assets (pool of like assets), if applicable[6]						69,192			
		Total						**$ 3,379,777**			

			Less: *Fully Allocated Depreciation*	
10		Transportation	Transportation	$ 148,259
8		Stores Equipment	Stores Equipment	$ -
47		Deferred Revenue	Deferred Revenue	-$ 116,593
			Net Depreciation	$ 3,348,111

Upon the date of IFRS adoption, customer contributions are no longer recorded in Account 1995 Contributions & Grants, but are recorded in Account 2440, Deferred Revenue. Historical contributions are netted against the assets they relate to. For purposes of cost allocation and continuity within this application, NBHDL has provided the following reconciliation between the historical 1995 and the current 2440 for both the 2020 Bridge year and the 2021 Test year in Table 2-28 below.

Table 2 - 28: Account 1995/2440 Breakdown

Account 1995 Breakdown for Financial Reporting Purposes	Cost			Accumulated Amortization			Net Book Value
	Opening	Additions	Closing Balance	Opening	Additions	Closing Balance	
December 31, 2020 - MIFRS:							
Acct 1830 - Poles, Towers & Fixtures	- 861,010	-	- 861,010	304,409	20,728	325,137	- 535,873
Acct 1835 - Overhead Conductor & Devices	- 1,155,175	-	- 1,155,175	351,168	20,857	372,025	- 783,150
Acct 1840 - Underground Conduit	- 743,549	-	- 743,549	261,308	16,110	277,418	- 466,131
Acct 1845 - Underground Conductors & Devices	- 1,467,466	-	- 1,467,466	518,714	39,744	558,458	- 909,008
Acct 1850 - Line Transformers	- 1,601,662	-	- 1,601,662	618,331	43,378	661,709	- 939,953
Acct 1855 - Services	- 3,371,009	-	- 3,371,009	1,149,010	84,788	1,233,798	- 2,137,211
Acct 1860 - Meters	- 98,938	-	- 98,938	48,169	4,610	52,779	- 46,159
Acct 2440 - Deferred Revenue	- 4,240,629	- 560,311	- 4,800,940	350,620	104,244	454,864	- 4,346,076
Amount Reported as Acct 1995/2440	**- 13,539,438**	**- 560,311**	**- 14,099,749**	**3,601,729**	**334,460**	**3,936,189**	**- 10,163,560**
December 31, 2021 - MIFRS:							
Acct 1830 - Poles, Towers & Fixtures	- 861,010	-	- 861,010	325,137	19,134	344,271	- 516,739
Acct 1835 - Overhead Conductor & Devices	- 1,155,175	-	- 1,155,175	372,025	19,253	391,278	- 763,897
Acct 1840 - Underground Conduit	- 743,549	-	- 743,549	277,418	14,871	292,289	- 451,260
Acct 1845 - Underground Conductors & Devices	- 1,467,466	-	- 1,467,466	558,458	36,687	595,145	- 872,321
Acct 1850 - Line Transformers	- 1,601,662	-	- 1,601,662	661,709	40,042	701,751	- 899,911
Acct 1855 - Services	- 3,371,009	-	- 3,371,009	1,233,798	78,266	1,312,064	- 2,058,945
Acct 1860 - Meters	- 98,938	-	- 98,938	52,779	4,255	57,034	- 41,904
Acct 2440 - Deferred Revenue	- 4,800,940	- 551,144	- 5,352,084	454,864	116,593	571,457	- 4,780,627
Amount Reported as Acct 1995/2440	**- 14,099,749**	**- 551,144**	**- 14,650,893**	**3,936,189**	**329,100**	**4,265,289**	**- 10,385,604**

2.2.2 GROSS ASSETS – PROPERTY PLANT AND EQUIPMENT AND ACCUMULATED DEPRECIATION

2.2.2.1 BREAKDOWN BY FUNCTION

Table 2-29 below categorizes NBHDL's assets into four categories; distribution plant, general plant, contributions and grants, and WIP. In accordance with the Uniform System of Accounts ("USoA"), NBHDL has included gross assets as follows:

- Distribution plant asset accounts include USoA 1805 to 1860 - this account includes assets such as substation equipment, poles, wires, transformers and meters;
- General plant asset accounts include USoA 1905 to 1990 and USoA 1611 - this account includes assets such as buildings, computer software and hardware, transportation equipment, and tools;
- Deferred Revenues account 2440 – this account includes all contributions in aid of capital that NBHDL has received or forecasted to be received as per the Distribution System Code ("DSC"); and
- WIP – this account includes all costs related to assets that are not considered in-service as of December 31st of the applicable fiscal year. Costs are transferred out of WIP and into the appropriate category above once designated in-service in the field.

Table 2 - 29: Gross Asset Breakdown by Function

Description	2015 OEB Approved	2015 Actual	2016 Actual	2017 Actual	2018 Actual	2019 Actual	2020 Bridge Year	2021 Test Year
Reporting Basis	MIFRS	MIFRS	MIFRS	MIFRS	MIFRS	MIFRS	MIFRS	MIFRS
Distribution Plant	111,611,680	111,072,426	115,442,485	120,127,545	126,108,197	131,756,995	136,389,374	141,455,003
General Plant	13,148,045	12,699,327	13,360,241	13,692,682	14,312,031	15,075,473	16,091,243	16,872,585
Contrbutions and Grants	(11,218,207)	(9,298,809)	(9,298,809)	(9,298,809)	(9,298,809)	(9,298,809)	(9,298,809)	(9,298,809)
Deferred Revenue	-	(2,118,610)	(2,470,932)	(3,198,969)	(3,757,586)	(4,240,628)	(4,800,938)	(5,352,082)
Total Excluding WIP	**113,541,517**	**112,354,333**	**117,032,985**	**121,322,449**	**127,363,833**	**133,293,030**	**138,380,870**	**143,676,696**
WIP	340,717	896,580	1,628,390	2,611,071	2,286,359	1,334,696	1,674,802	1,904,252
Total Including WIP	**113,882,234**	**113,250,913**	**118,661,375**	**123,933,520**	**129,650,192**	**134,627,726**	**140,055,672**	**145,580,949**

DETAILED BREAKDOWN BY MAJOR PLANT ACCOUNT

Table 2-30 below provides a detailed breakdown by major plant account for each functionalized plant item. Each plant item is accompanied by a description in accordance with the Board's USoA, including the 2021 Test Year. NBHDL has also included a breakdown of accumulated amortization in the same format in Table 2-31.

Table 2 - 30: Gross Assets - Detailed Breakdown by Major Plant Function

Description	2015 OEB Approved	2015 Actual	Variance from 2015 OEB Approved	2016 Actual	Variance from 2015 Actual	2017 Actual	Variance from 2016 Actual	2018 Actual	Variance from 2017 Actual	2019 Actual	Variance from 2018 Actual	2020 Bridge	Variance from 2019 Actual	2021 Test	Variance from 2020 Bridge
Reporting Basis	MIFRS	MIFRS		MIFRS		MIFRS		MIFRS		MIFRS		MIFRS		MIFRS	
Land and Buildings															
1805-Land	446,565	497,376	50,811	505,305	7,929	505,305	-	505,305	-	505,305	-	505,305	-	505,305	-
1808-Buildings and Fixtures	1,847,943	1,830,506	- 17,437	1,838,335	7,829	1,838,335	-	966,190	- 872,145	966,190	-	966,190	-	966,190	-
Sub-Total-Land and Buildings	2,294,508	2,327,882	33,374	2,343,640	15,758	2,343,640	-	1,471,495	- 872,145	1,471,495	-	1,471,495	-	1,471,495	-
Distribution Stations															
1820-Distribution Station Equipment - < 50 kV	15,863,475	16,194,049	330,574	16,457,782	263,733	17,079,289	621,506	20,343,713	3,264,424	21,226,264	882,551	21,699,851	1,356,138	22,174,333	474,482
Sub-Total-Distribution Stations	15,863,475	16,194,049	330,574	16,457,782	263,733	17,079,289	621,506	20,343,713	3,264,424	21,226,264	882,551	21,699,851	1,356,138	22,174,333	474,482
Poles and Wires															
1830-Poles, Towers and Fixtures	24,002,536	23,830,074	- 172,462	24,865,846	1,035,772	25,646,472	780,627	26,572,355	925,882	27,652,711	1,080,356	29,138,458	2,566,103	30,981,164	1,842,706
1835-Overhead Conductors and Devices	17,495,602	17,707,354	211,752	18,299,824	592,470	18,632,393	332,569	19,494,129	861,736	20,443,104	948,975	21,004,054	1,509,925	21,468,762	464,708
1840-Underground Conduit	1,416,489	1,242,378	- 174,111	1,432,914	190,536	2,007,253	574,339	2,211,982	204,730	2,728,943	516,961	3,224,828	1,012,846	3,700,529	475,701
1845-Underground Conductors and Devices	7,675,773	7,442,256	- 233,517	7,584,561	142,305	8,014,513	429,952	8,280,606	266,093	8,609,085	328,479	8,961,687	681,081	9,135,060	173,373
Sub-Total-Poles and Wires	50,590,400	50,222,062	- 368,338	52,183,144	1,961,082	54,300,632	2,117,487	56,559,072	2,258,441	59,433,842	2,874,770	62,329,028	5,769,956	65,285,515	2,956,487
Line Transformers															
1850-Line Transformers	17,594,089	17,467,474	- 126,616	17,974,425	506,951	18,617,683	643,258	19,090,796	473,113	19,823,104	732,308	20,245,880	1,155,084	20,800,503	554,623
Sub-Total-Line Transformers	17,594,089	17,467,474	- 126,616	17,974,425	506,951	18,617,683	643,258	19,090,796	473,113	19,823,104	732,308	20,245,880	1,155,084	20,800,503	554,623
Services and Meters															
1855-Services	19,629,805	19,182,145	- 447,660	20,542,023	1,359,878	21,652,715	1,110,692	22,386,012	733,297	23,431,606	1,045,593	24,129,699	1,743,686	25,070,268	940,570
1860-Meters	1,604,002	1,557,487	- 46,516	1,557,487	-	1,557,487	-	1,557,487	-	1,557,487	-	1,557,487	-	1,557,487	-
1860-Meters - Smart Meters	4,035,400	4,121,327	85,927	4,383,984	262,657	4,576,100	192,116	4,699,622	123,522	4,813,197	113,575	4,955,935	256,313	5,095,402	139,467
Sub-Total-Services and Meters	25,269,207	24,860,959	- 408,248	26,483,494	1,622,535	27,786,302	1,302,808	28,643,121	856,819	29,802,290	1,159,169	30,643,121	2,000,000	31,723,157	1,080,037
General Plant, Land and Buildings															
1905-Land	86,551	86,551	-	86,551	-	86,551	-	86,551	-	86,551	-	86,551	-	86,551	-
1908-Buildings and Fixtures	3,089,263	3,121,503	32,241	3,576,216	454,713	3,594,692	18,476	3,607,970	13,278	3,648,165	40,195	3,943,674	335,704	4,234,087	290,413
Sub-Total-General Plant, Land and Buildings	3,175,813	3,208,054	32,241	3,662,767	454,713	3,681,242	18,476	3,694,521	13,278	3,734,716	40,195	4,030,225	335,704	4,320,638	290,413
IT Assets															
1920-Computer Equipment - Hardware	1,040,248	973,940	- 66,307	994,587	20,646	1,093,067	98,480	1,166,165	73,098	1,390,644	224,479	1,738,864	572,699	1,748,664	9,800
1611-Computer Software	1,506,812	1,505,980	- 832	1,560,281	54,301	1,584,554	24,273	1,617,366	32,812	1,662,300	44,933	1,663,550	46,183	1,896,700	233,150
Sub-Total-IT Assets	2,547,060	2,479,920	- 67,140	2,554,868	74,948	2,677,621	122,754	2,783,532	105,910	3,052,944	269,412	3,402,414	618,882	3,645,364	242,950
Equipment															
1915-Office Furniture and Equipment	385,286	380,037	- 5,249	380,037	-	379,067	- 970	386,365	7,298	393,914	7,549	425,369	39,004	427,369	2,000
1930-Transportation Equipment	2,933,841	2,912,998	- 20,843	2,988,306	75,308	3,116,759	128,453	3,137,342	20,583	3,485,797	348,455	3,575,193	437,851	3,682,655	107,462
1935-Stores Equipment	75,196	75,196	-	75,196	-	75,196	-	142,493	67,298	142,493	-	142,493	-	142,493	-
1940-Tools, Shop and Garage Equipment	1,383,259	1,360,895	- 22,364	1,383,232	22,336	1,406,636	23,405	1,432,078	25,442	1,473,156	41,078	1,531,770	99,692	1,571,770	40,000
1950-Power Operated Equipment	-	-	-	-	-	-	-	-	-	-	-	110,650	110,650	110,650	-
1955-Communication Equipment	174,364	177,245	2,881	191,859	14,614	196,865	5,006	201,054	4,189	204,627	3,573	204,627	3,573	204,627	-
1960-Miscellaneous Equipment	21,010	21,010	-	21,010	-	21,010	-	21,010	-	21,010	-	21,010	-	21,010	-
Sub-Total-Equipment	4,972,956	4,927,381	- 45,575	5,039,638	112,258	5,195,533	155,894	5,320,342	124,809	5,720,997	400,655	6,011,112	690,770	6,160,574	149,462
Other Distribution Assets															
1970-Load Mgmt Controls - Customer Premises	403,931	403,931	-	403,931	-	403,931	-	403,931	-	403,931	-	403,931	-	403,931	-
1975-Load Mgmt Controls - Utility Premises	165,151	165,151	-	165,151	-	165,151	-	165,151	-	165,151	-	165,151	-	165,151	-
1980-System Supervisory Equipment	1,830,074	1,461,830	- 368,244	1,480,826	18,996	1,516,144	35,317	1,891,494	375,350	1,944,674	53,180	2,025,350	133,856	2,123,867	98,517
1990-Other Tangible Property	53,060	53,060	-	53,060	-	53,060	-	53,060	-	53,060	-	53,060	-	53,060	-
1995-Contributions and Grants - Credit	- 9,298,809	- 9,298,809	- 0	- 9,298,809	-	- 9,298,809	-	- 9,298,809	-	- 9,298,809	-	- 9,298,809	-	- 9,298,809	-
2440-Deferred Revenue	- 1,919,399	- 2,118,610	- 199,211	- 2,470,932	- 352,322	- 3,198,969	- 728,037	- 3,757,586	- 558,617	- 4,240,628	- 483,042	- 4,800,938	- 1,043,352	- 5,352,082	- 551,144
Sub-Total-Other Distribution Assets	- 8,765,991	- 9,333,447	- 567,455	- 9,666,772	- 333,326	- 10,359,492	- 692,720	- 10,542,758	- 183,267	- 10,972,621	- 429,862	- 11,452,255	- 909,496	- 11,904,882	- 452,627
WIP															
2055-Construction Work in Progress	340,717	896,580	555,863	1,628,390	731,810	2,611,071	982,681	2,286,359	- 324,712	1,334,696	- 951,663	1,674,802	- 611,557	1,904,252	229,450
Sub-Total-WIP	340,717	896,580	555,863	1,628,390	731,810	2,611,071	982,681	2,286,359	- 324,712	1,334,696	- 951,663	1,674,802	- 611,557	1,904,252	229,450
GROSS ASSET TOTAL	**113,882,234**	**113,250,913**	**- 631,321**	**118,661,375**	**5,410,462**	**123,933,520**	**5,272,145**	**129,650,192**	**5,716,672**	**134,627,726**	**4,977,535**	**140,055,672**	**10,405,480**	**145,580,949**	**5,525,277**

Table 2 - 31: Accumulated Amortization - Detailed Breakdown by Major Plant Function

Description	2015 OEB Approved	2015 Actual	Variance from 2015 OEB Approved	2016 Actual	Variance from 2015 Actual	2017 Actual	Variance from 2016 Actual	2018 Actual	Variance from 2017 Actual	2019 Actual	Variance from 2018 Actual	2020 Bridge	Variance from 2019 Actual	2021 Test	Variance from 2020 Bridge
Land and Buildings															
1805-Land	-		-	-	-	-	-	-	-	-	-	-	-	-	-
1808-Buildings and Fixtures	425,091	426,048	957	461,283	35,235	496,518	35,235	384,428	- 112,090	402,351	17,923	420,274	35,846	438,197	17,923
Sub-Total-Land and Buildings	425,091	426,048	957	461,283	35,235	496,518	35,235	384,428	- 112,090	402,351	17,923	420,274	35,846	438,197	17,923
Distribution Stations															
1820-Distribution Station Equipment - < 50 kV	4,914,714	5,076,132	161,418	5,279,131	202,999	5,445,510	166,379	6,060,528	615,018	6,493,390	432,862	7,052,323	991,795	7,654,898	602,575
Sub-Total-Distribution Stations	4,914,714	5,076,132	161,418	5,279,131	202,999	5,445,510	166,379	6,060,528	615,018	6,493,390	432,862	7,052,323	991,795	7,654,898	602,575
Poles and Wires															
1830-Poles, Towers and Fixtures	11,718,473	11,594,008	- 124,465	11,958,952	364,944	12,126,280	167,327	12,461,467	335,188	12,794,735	333,268	13,096,886	635,419	13,438,186	341,300
1835-Overhead Conductors and Devices	9,026,994	8,984,717	- 42,276	9,177,107	192,390	9,307,309	130,202	9,500,247	192,938	9,623,326	123,079	9,808,693	308,446	9,999,209	190,516
1840-Underground Conduit	212,040	210,091	- 1,948	236,272	26,180	269,037	32,766	308,816	39,779	357,248	48,432	412,500	103,684	478,162	65,662
1845-Underground Conductors and Devices	4,802,938	4,778,762	- 24,176	4,871,303	92,541	4,971,572	100,269	5,080,558	108,986	5,185,476	104,918	5,305,722	225,164	5,430,737	125,015
Sub-Total-Poles and Wires	25,760,445	25,567,578	- 192,867	26,243,634	676,056	26,674,197	430,564	27,351,088	676,891	27,960,784	609,696	28,623,800	1,272,712	29,346,293	722,493
Line Transformers															
1850-Line Transformers	9,803,587	9,811,730	8,143	10,022,304	210,574	10,179,915	157,610	10,343,823	163,909	10,592,475	248,651	10,839,001	495,178	11,098,703	259,702
Sub-Total-Line Transformers	9,803,587	9,811,730	8,143	10,022,304	210,574	10,179,915	157,610	10,343,823	163,909	10,592,475	248,651	10,839,001	495,178	11,098,703	259,702
Services and Meters															
1855-Services	7,761,658	7,755,936	- 5,723	8,200,512	444,576	8,673,129	472,617	9,169,589	496,461	9,686,727	517,138	10,230,529	1,060,940	10,793,473	562,944
1860-Meters	1,019,810	956,900	- 62,910	1,005,330	48,430	1,052,231	46,901	1,097,955	45,724	1,142,811	44,857	1,186,490	88,535	1,229,308	42,818
1860-Meters - Smart Meters	1,398,327	1,406,740	8,413	1,706,696	299,956	2,019,525	312,829	2,349,910	330,385	2,694,730	344,820	3,050,608	700,698	3,420,378	369,771
Sub-Total-Services and Meters	10,179,796	10,119,576	- 60,220	10,912,538	792,962	11,744,884	832,346	12,617,454	872,570	13,524,269	906,815	14,467,626	1,850,173	15,443,159	975,533
General Plant, Land and Buildings															
1905-Land	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1908-Buildings and Fixtures	1,510,580	1,509,877	- 703	1,598,934	89,057	1,704,730	105,795	1,814,041	109,312	1,923,817	109,776	2,044,001	229,960	2,175,904	131,903
Sub-Total-General Plant, Land and Buildings	1,510,580	1,509,877	- 703	1,598,934	89,057	1,704,730	105,795	1,814,041	109,312	1,923,817	109,776	2,044,001	229,960	2,175,904	131,903
IT Assets															
1920-Computer Equipment - Hardware	821,167	807,250	- 13,917	870,372	63,122	914,741	44,369	975,375	60,634	1,053,105	77,730	1,172,266	196,891	1,322,252	149,986
1611-Computer Software	1,316,213	1,327,217	11,004	1,413,993	86,776	1,488,764	74,771	1,537,392	48,628	1,567,600	30,208	1,598,131	60,739	1,645,655	47,524
Sub-Total-IT Assets	2,137,380	2,134,467	- 2,913	2,284,365	149,899	2,403,505	119,140	2,512,767	109,262	2,620,705	107,938	2,770,397	257,630	2,967,907	197,510
Equipment															
1915-Office Furniture and Equipment	331,712	331,466	- 246	341,775	10,308	334,435	- 7,340	344,626	10,191	354,160	9,534	364,221	19,595	374,751	10,530
1930-Transportation Equipment	1,933,130	1,951,018	17,887	2,057,430	106,412	2,039,312	- 18,118	2,252,784	213,473	2,418,721	165,936	2,688,439	435,654	2,721,105	32,666
1935-Stores Equipment	75,196	75,196	-	75,196	-	75,196	-	76,318	1,122	79,010	2,692	85,740	9,422	92,469	6,730
1940-Tools, Shop and Garage Equipment	1,159,773	1,158,216	- 1,557	1,196,462	38,245	1,234,876	38,414	1,271,272	36,396	1,307,769	36,498	1,347,382	76,111	1,386,976	39,594
1950-Power Operated Equipment	-	-	-	-	-	-	-	-	-	-	-	5,533	5,533	16,598	11,065
1955-Communication Equipment	120,973	121,716	742	132,097	10,381	143,142	11,045	154,771	11,629	165,175	10,404	174,471	19,700	183,767	9,296
1960-Miscellaneous Equipment	18,598	17,853	- 745	18,687	834	19,238	552	19,661	423	19,954	293	20,247	586	20,540	293
Sub-Total-Equipment	3,639,383	3,655,465	16,082	3,821,645	166,181	3,846,199	24,554	4,119,432	273,233	4,344,789	225,357	4,686,033	566,601	4,796,207	110,174
Other Distribution Assets															
1970-Load Mgmt Controls - Customer Premises	403,931	403,931	-	403,931	-	403,931	-	403,931	-	403,931	-	403,931	-	403,931	-
1975-Load Mgmt Controls - Utility Premises	165,151	165,151	-	165,151	-	165,151	-	165,151	-	165,151	-	165,151	-	165,151	-
1980-System Supervisory Equipment	1,222,038	1,217,223	- 4,815	1,248,325	31,102	1,275,075	26,750	1,321,355	46,280	1,385,483	64,127	1,451,587	130,231	1,525,398	73,811
1990-Other Tangible Property	28,153	28,153	0	29,783	1,630	31,412	1,630	33,042	1,630	34,671	1,629	36,301	3,259	37,931	1,630
1995-Contributions and Grants - Credit	- 2,383,374	- 2,383,374	- 0	- 2,595,881	- 212,507	- 2,808,388	- 212,507	- 3,020,895	- 212,507	- 3,251,111	- 230,216	- 3,481,327	- 460,432	- 3,693,834	- 212,507
2440-Deferred Revenue	- 42,626	- 56,671	- 14,045	- 105,365	- 48,694	- 176,635	- 71,270	- 257,249	- 80,614	- 350,621	- 93,372	- 454,865	- 197,616	- 571,458	- 116,593
Sub-Total-Other Distribution Assets	- 606,727	- 625,587	- 18,860	- 854,056	- 228,469	- 1,109,454	- 255,397	- 1,354,665	- 245,211	- 1,612,496	- 257,831	- 1,879,222	- 524,557	- 2,132,882	- 253,659
WIP															
2055-Construction Work in Progress	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-Total-WIP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ACCUMULATED AMORTIZATION TOTAL	**57,764,248**	**57,675,286**	**- 88,962**	**59,769,778**	**2,094,492**	**61,386,004**	**1,616,226**	**63,848,896**	**2,462,892**	**66,250,083**	**2,401,187**	**69,024,233**	**5,175,337**	**71,788,386**	**2,764,153**

2.2.2.2 VARIANCE ANALYSIS ON GROSS ASSETS

Table 2-32 below provides the same level of detail as Table 2-29, however, for the purposes of the variance analysis assets are categorized as Distribution Assets and General Plant and explanations on variances over NBHDL's materiality threshold are explained following the table.

Table 2 - 32: Variance on Gross Assets

Description	2015 OEB Approved	2015 Actual	Variance from 2015 OEB Approved	2016 Actual	Variance from 2015 Actual	2017 Actual	Variance from 2016 Actual	2018 Actual	Variance from 2017 Actual	2019 Actual	Variance from 2018 Actual	2020 Bridge	Variance from 2019 Actual	2021 Test	Variance from 2020 Bridge
Reporting Basis	MIFRS	MIFRS		MIFRS		MIFRS		MIFRS		MIFRS		MIFRS		MIFRS	
Distribution Assets:															
1805-Land	446,565	497,376	50,811	505,305	7,929	505,305	-	505,305	-	505,305	-	505,305	-	505,305	-
1808-Buildings and Fixtures	1,847,943	1,830,506	- 17,437	1,838,335	7,829	1,838,335	-	966,190	- 872,145	966,190	-	966,190	-	966,190	-
1820-Distribution Station Equipment - < 50 kV	15,863,475	16,194,049	330,574	16,457,782	263,733	17,079,289	621,506	20,343,713	3,264,424	21,226,264	882,551	21,699,851	473,587	22,174,333	474,482
1830-Poles, Towers and Fixtures	24,002,536	23,830,074	- 172,462	24,865,846	1,035,772	25,646,472	780,627	26,572,355	925,882	27,652,711	1,080,356	29,138,458	1,485,747	30,981,164	1,842,706
1835-Overhead Conductors and Devices	17,495,602	17,707,354	211,752	18,299,824	592,470	18,632,393	332,569	19,494,129	861,736	20,443,104	948,975	21,004,054	560,951	21,468,762	464,708
1840-Underground Conduit	1,416,489	1,242,378	- 174,111	1,432,914	190,536	2,007,253	574,339	2,211,982	204,730	2,728,943	516,961	3,224,828	495,885	3,700,529	475,701
1845-Underground Conductors and Devices	7,675,773	7,442,256	- 233,517	7,584,561	142,305	8,014,513	429,952	8,280,606	266,093	8,609,085	328,479	8,961,687	352,602	9,135,060	173,373
1850-Line Transformers	17,594,089	17,467,474	- 126,616	17,974,425	506,951	18,617,683	643,258	19,090,796	473,113	19,823,104	732,308	20,245,880	422,776	20,800,503	554,623
1855-Services	19,629,805	19,182,145	- 447,660	20,542,023	1,359,878	21,652,715	1,110,692	22,386,012	733,297	23,431,606	1,045,593	24,129,699	698,093	25,070,268	940,570
1860-Meters	1,604,002	1,557,487	- 46,516	1,557,487	-	1,557,487	-	1,557,487	-	1,557,487	-	1,557,487	-	1,557,487	-
1860-Meters - Smart Meters	4,035,400	4,121,327	85,927	4,383,984	262,657	4,576,100	192,116	4,699,622	123,522	4,813,197	113,575	4,955,935	142,738	5,095,402	139,467
1980-System Supervisory Equipment	1,830,074	1,461,830	- 368,244	1,480,826	18,996	1,516,144	35,317	1,891,494	375,350	1,944,674	53,180	2,025,350	80,676	2,123,867	98,517
1995-Contributions and Grants - Credit	- 9,298,809	- 9,298,809	- 0	- 9,298,809	-	- 9,298,809	-	- 9,298,809	-	- 9,298,809	-	- 9,298,809	-	- 9,298,809	-
2440-Deferred Revenue	- 1,919,399	- 2,118,610	- 199,211	- 2,470,932	- 352,322	- 3,198,969	- 728,037	- 3,757,586	- 558,617	- 4,240,628	- 483,042	- 4,800,938	- 560,310	- 5,352,082	- 551,144
2055-Construction Work in Progress	340,717	896,580	555,863	1,628,390	731,810	2,611,071	982,681	2,286,359	- 324,712	1,334,696	- 951,663	1,674,802	340,106	1,904,252	229,450
Sub-Total- Distribution Assets	102,564,263	102,013,417	- 550,846	106,781,960	4,768,544	111,756,982	4,975,022	117,229,655	5,472,673	121,496,928	4,267,273	125,989,779	4,492,852	130,832,231	4,842,452
General Plant															
1905-Land	86,551	86,551	-	86,551	-	86,551	-	86,551	-	86,551	-	86,551	-	86,551	-
1908-Buildings and Fixtures	3,089,263	3,121,503	32,241	3,576,216	454,713	3,594,692	18,476	3,607,970	13,278	3,648,165	40,195	3,943,674	295,509	4,234,087	290,413
1920-Computer Equipment - Hardware	1,040,248	973,940	- 66,307	994,587	20,646	1,093,067	98,480	1,166,165	73,098	1,390,644	224,479	1,738,864	348,220	1,748,664	9,800
1611-Computer Software	1,506,812	1,505,980	- 832	1,560,281	54,301	1,584,554	24,273	1,617,366	32,812	1,662,300	44,933	1,663,550	1,250	1,896,700	233,150
1915-Office Furniture and Equipment	385,286	380,037	- 5,249	380,037	-	379,067	- 970	386,365	7,298	393,914	7,549	425,369	31,455	427,369	2,000
1930-Transportation Equipment	2,933,841	2,912,998	- 20,843	2,988,306	75,308	3,116,759	128,453	3,137,342	20,583	3,485,797	348,455	3,575,193	89,396	3,682,655	107,462
1935-Stores Equipment	75,196	75,196	-	75,196	-	75,196	-	142,493	67,298	142,493	-	142,493	-	142,493	-
1940-Tools, Shop and Garage Equipment	1,383,259	1,360,895	- 22,364	1,383,232	22,336	1,406,636	23,405	1,432,078	25,442	1,473,156	41,078	1,531,770	58,614	1,571,770	40,000
1950-Power Operated Equipment	-	-	-	-	-	-	-	-	-	-	-	110,650	110,650	110,650	-
1955-Communication Equipment	174,364	177,245	2,881	191,859	14,614	196,865	5,006	201,054	4,189	204,627	3,573	204,627	-	204,627	-
1960-Miscellaneous Equipment	21,010	21,010	-	21,010	-	21,010	-	21,010	-	21,010	-	21,010	-	21,010	-
1970-Load Mgmt Controls - Customer Premises	403,931	403,931	-	403,931	-	403,931	-	403,931	-	403,931	-	403,931	-	403,931	-
1975-Load Mgmt Controls - Utility Premises	165,151	165,151	-	165,151	-	165,151	-	165,151	-	165,151	-	165,151	-	165,151	-
1990-Other Tangible Property	53,060	53,060	-	53,060	-	53,060	-	53,060	-	53,060	-	53,060	-	53,060	-
Sub-Total-General Plant	11,317,971	11,237,497	- 80,474	11,879,415	641,918	12,176,538	297,123	12,420,536	243,998	13,130,799	710,262	14,065,893	935,094	14,748,718	682,825
GROSS ASSET TOTAL	**113,882,234**	**113,250,913**	**- 631,321**	**118,661,375**	**5,410,462**	**123,933,520**	**5,272,145**	**129,650,192**	**5,716,672**	**134,627,726**	**4,977,535**	**140,055,672**	**5,427,946**	**145,580,949**	**5,525,277**

(i) 2015 Board Approved vs. 2015 Actual:

- Distribution Assets – ($550,846)

Distribution assets are less than the 2015 Board Approved amounts by $550,846. The Construction of MS22 exceeded the planned expenditure due to engineering and tendered contractor variances, however, these increases were significantly offset by lower costs related to underground projects; tendering and contractor delays pushed much of the work to the spring of the following year. Demand driven projects including primary and secondary services, subdivisions and road relocations were also higher than forecasted. Transformer costs were higher than forecasted due to the changes in planned and demand construction. 2015 capital contributions were forecasted by job type, however actual contributions collected by NBHDL are in accordance with the DSC and the provisions of NBHDL's Conditions of Service and vary by individual job. NBHDL uses the economic evaluation methodology from the DSC to determine the level of capital contribution for each project. Planned asset management activities did not proceed until 2016 which also contributes to the variance.

- General Assets - ($80,474)

General assets are less than the 2015 Board Approved amounts by $80,474 which is case primarily by IT expenditures. A revamped IT capital plan was subsequently developed and implemented and capital discrepancies addressed.

(ii) 2016 Actual vs. 2015 Actual:

- Distribution Assets - $4,768,544

Distribution assets are higher than the 2015 Actuals by $4,768,544. In 2016, NBHDL completed the bulk of a multipart underground rebuild in the North Bay burrow of Birchhaven. These projects contributed $1,425,689 to the increase over 2015. Further progress on a multi-year city wide voltage conversion project drove another $1,365,558. General Substation projects contributed to an additional $840,127, which included transformer replacements at both MS13 and MS15 ($218,152 and $222,259 respectively). Customer demand driven projects such as primary and secondary services, minor betterments, subdivisions and road relocations account for $947,590 in increases across the various distribution assets. Major betterment projects, transformer purchases, asset management and metering installations increased distribution assets by a further $899,485 and contributed capital offset distribution assets by ($352,322). SCADA upgrades and other

immaterial projects were offset by disposals related to the scrapping of transformers and other decommissioned equipment for a net increase to gross distribution assets of $325,911.

- General Assets - $641,918

General assets increased over 2015 Actuals by $641,918 in 2016. In 2016, NBHDL rebuilt its parking lot at a cost of $361,938. This was identified as a building need to replace an aging lot as well as provide a safer traffic flow of commercial and civilian vehicles. Fleet replacements drove a further $283,707. This included replacement of seven light vehicles including vans and pickup trucks. Other individual costs under NBHDL's materiality as well as the disposition of the above-mentioned vehicles contribute to the remaining increase on general assets of $204,672.

(iii) 2017 Actual vs. 2016 Actual:

- Distribution Assets - $4,975,022

Distribution assets are higher than the 2016 Actuals by $4,975,022. In 2017 NBHDL continued its work with another $459,865 on the multipart underground rebuild in the North Bay burrow of Birchhaven. In substations, a recloser replacement was completed at MS19 at a cost of $562,382. At MS16, rehabilitation began that included a new transformer as well as 44kV and 12kV switchgear replacements ($963,980). Other immaterial substation upgrades from multiple projects accounted for a further $175,771. Continued development on the city-wide voltage conversion drove another $1,923,880 in spending while an upgraded primary service at the municipal airport contributed $419,618. Customer demand driven projects such as primary and secondary services, minor betterments, subdivisions and road relocations account for $1,132,963 in increases across the various distribution assets. Major betterment projects, transformer purchases, asset management and switch replacement costs and metering installations, and other immaterial projects increased distribution assets by a further $928,573 and contributed capital offset distribution assets by ($728,037). Disposition that included the scrapping of substation transformers and other decommissioned equipment account for a decrease of distribution assets $863,972.

- General Assets - $297,123

General assets increased over 2016 Actuals by $297,123 in 2017. In accordance with NBHDL's fleet replacement schedule as well as wear and tear, a line truck was replaced at cost of $402,097 with an offsetting disposal of ($280,274). General IT upgrades contributed another $142,771, including costs related to a server replacement, general hardware and software upgrades, and

custom software related to the OESP program. Other individual costs under NBHDL's materiality and general asset dispositions contribute to the remaining increase in general assets of $32,559.

(iv) 2018 Actual vs. 2017 Actual:

- Distribution Assets - $5,472,674

Distribution assets are higher than the 2017 Actuals by $5,472,674. In 2018 NBHDL completed the construction of MS23. This was new substation required to service a first of its kind community microgrid. This substation, along with the required generation connection, accounted for $1,845,885 of the increase over 2017. Continued voltage conversion projects drove another $660,338 in increases. A rehabilitation at MS16, an asset originally built in 1975 and upgraded in 2013, accounted for $95,286. Major betterment jobs at McKeown, Fraser, Ski Club, Lees Road, and Lavase accounted for the bulk of the planned increases at $1,544,166. Projects driven by customer demand revolving around minor betterments, primary and secondary services, subdivisions, and road relocations contributed a total of $1,249,001 in increases. Other projects below the materiality threshold in major betterments, transformer purchases, switching, metering and WIP increases contributed a further $890,930. These investments were offset by contributed capital of ($558,617) and the disposal of decommissioned distribution equipment amounting to ($286,281). A review of MS20 costs resulted in the reclassification of costs out of Account 1808 and into Account 1820, however, no new costs were added to this station in 2018.

- General Assets - $243,998

General assets increased over 2017 Actuals by $243,998 in 2018. Fleet investment accounted for $147,067 of the incremental increase over 2017. This included two pickup truck replacements at a total of $74,349 and a new forklift at $67,298 that is expected to last 20 years. Smaller costs that are below the materiality include general office and building upgrades, tool requirements, and IT investments including general software, hardware, bill printer, smart board and servers. These investments as well as a fleet disposition offset the total by $150,697.

(v) 2019 Actual vs. 2018 Actual:

- Distribution Assets - $4,267,273

Distribution assets are higher than the 2018 Actuals by $4,267,273. The continued system wide voltage conversion project drove $218,412 in increases over the previous year. This project is in the final stages of a multi-year undertaking and is expected to complete in 2020. NBHDL began major work on a multi-year rehabilitation of the Ski Club region of North Bay. This project accounted

for $926,218 in increases over 2018. Other significant major betterment projects at Sage Road, McKay and McKeown accounted for $155,611, $150,476, and $198,738 respectively. There were numerous key substation investments made in 2019. MS14 underwent a transformer replacement at $302,694 and disposal ($110,000). MS11 and MS13 both underwent rehabilitations for $415,742 and $233,087 respectively, the latter of which will be completed in 2020. Finally, MS10 underwent a further investment of $229,820 to address grounding and an RTU replacement. Customer demand driven projects such as primary and secondary services, minor betterments, subdivisions and road relocations account for $2,042,612 in increases across the various distribution assets. Major betterment projects, transformer purchases, asset management, switch replacement costs, metering installations, and other immaterial projects increased distribution assets by a further $945,846 and contributed capital offset distribution assets by ($483,042). NBHDL reclassified $428,270 from WIP in 2019 as costs recorded in 2018 were a deposit related to the connection of MS23. Dispositions of other decommissioned equipment and WIP account for the remaining decrease of distribution assets $530,671.

- General Assets - $710,262

General assets increased over 2018 Actuals by $710,262 in 2019. Fleet replacement accounted for the bulk of investment ($426,099) which included two pickup truck replacements as well as a line truck. A major server replacement took place at a cost of $174,074. This investment replaced other equipment that had reached end of life while also allowing for greater capacity that is required for future disaster recovery planning and infrastructure. The remaining increase of $110,090 includes further smaller investments in IT hardware and software, tools, general building and property, communication equipment, WIP, and disposals related to replacement investments.

(vi) 2020 Bridge vs. 2019 Actual:

- Distribution Assets - $4,492,581

Distribution assets are higher than the 2019 Actuals by $4,492,581. NBHDL continues the multi-part renewal of Ski Club Rd, with the planned completion of Phase 2 and beginning in Phase 3 which accounts for $783,662 of the distribution asset increases. A major underground project on Lovell Ave. accounts for a further $897,396. Other major betterment renewals at Norman Ave., Shore Acres, L5H, Chapais and Abbot account for $239,415, $388,037, $334,688, $210,784 and $82,988 respectively. The final stages of the multi-year system voltage conversion are being completed at cost of $165,807. This marks a major milestone for NBHDL as this project dates back to before NBHDL's last Cost of Service Application. The rehabilitation of MS13 is to be completed at a cost of $287,710 while the rehabilitation at MS15 is expected to start in 2020 with initial costs

of $82,583 and targeted completion in 2021. Minor betterments, primary and secondary services, subdivisions, and road relocations will be performed at an increase of $1,431,404. Smaller major betterments and subdivisions projects, transformer purchases, and metering installations are expected to account for $453,761 of the 2020 investment increases. These investments are offset by contributed capital of ($560,311) with dispositions of other decommissioned equipment, and changes in WIP related to in-service dates of projects accounting for the remaining decrease of distribution assets ($305,073).

- General Assets - $935,094

General assets increase over 2019 Actuals by $935,094 in 2020. A renovation of the building garage mezzanine took place at a cost of $200,000 that will accommodate increased capacity to an aging building as the needs of the business continue to change. Two pickup trucks are being purchased at a cost of $89,396, as well as the main body of a line truck for $109,857. Two line tensioners are to be retrofitted with new engines for $110,650. This was a cost saving measure as NBHDL had the opportunity to replace the engines of otherwise good condition frames for well below what wholesale replacements would cost. A major IT investment of a disaster recovery (DR) environment contributes a further $171,000. Other IT investments (hardware, software), tools, and general office and building expenditures account for another $349,048. Activity in WIP accounts for the remaining decrease of ($94,857).

(vii) 2021 Test vs. 2020 Bridge:

- Distribution Assets - $4,842,452

Distribution assets are higher than the 2020 actuals by $4,842,452. The final leg of the Ski Club road renewal will be completed with a further investment of $201,271 over 2020. Other major betterment renewals at MacBeth, Highway 11, Montrose Ave**.**, Wallace Road, Gertrude, Dane, and a line rebuild from MS10 to Highway 11 account for $949,317, $337,164, $105,930, $811,240, $106,113, $177,414, and $629,884 respectively. The completion of the MS15 rehabilitation accounts for $424,402 in investment increases while the start of the MS18 rehabilitation accounts for another $82,619. Further details of these major betterment and substation investments can be found in Appendix 2-A and within the DSP. Customer demand driving work in minor betterments, primary and secondary services, subdivisions, and road relocations is budgeted at an increase of $1,368,859. Major betterment projects, transformer purchases, metering installations, and other immaterial projects increase distribution assets by a further $461,252 and contributed capital offsets distribution assets by ($551,144). Dispositions of other decommissioned equipment and WIP account for the remaining decrease of distribution assets ($389,350).

- General Assets - $682,825

General assets increase over 2020 actuals by $682,825 in 2021. NBHDL will be installing a partial rear yard cover which contributes $136,947 to general asset increases. The upper body and boom device will of the line truck acquired in the prior year will be received in 2021. In line with the fleet schedule, another line truck will be ordered in 2021, with the cab and chassis included in 2021 spending and the upper body and boom device being completed the following year in a similar manner. IT has set goals to meet its obligations of compliance with the OEB Cyber Security Framework, provide platforms for growth, and provide services that will ensure that the business can meet its goals. To achieve these goals, IT will continue on its modernization plan, ensuring that cyber security, asset renewal, privacy, communications, planning, value-add services, and customer-focus continues to be the priority, which will drive the IT capital plan. For example, a $75,000 online customer portal will contribute to the increase over 2020. This investment will further enable customers to engage with NBHDL with respect to usage, customer service and other communication needs. Other small items below the identified materiality threshold in IT, tools, and building accounts for $363,416. Fleet disposal and WIP activity account for the remaining decrease of ($226,271).

2.2.2.3 SUMMARY OF INCREMENTAL CAPITAL MODULE ADJUSTMENT

NBHDL confirms that it has not applied for nor received any ICM adjustments as part of a previous IRM application.

2.2.2.4 RECONCILIATION OF CONTINUITY STATEMENTS TO CALCULATED DEPRECIATION EXPENSES

NBHDL confirms that the depreciation expenses in the fixed asset continuity statements reconcile to the calculated depreciation expenses under Section 2.4.4 in Exhibit 4 and are presented by account. As such there are no reconciling items between the fixed asset continuity statements in this Exhibit and the calculated depreciation expense in Section 2.4.4.4 in Exhibit 4.

NBHDL completed the transition to MIFRS in 2015 and recorded the transitional impact of losses on disposal in Account 1575 at that time; the rate rider to account for this expired in June 2017. There are no further transitional impacts to include in the 2021 Test Year in this deferral account. Losses on disposals are included in the 2020 Bridge Year and 2021 Test Year continuity schedules. For illustrative purposes, historical loss on disposals from 2015 through 2019 Actuals are provided in Exhibit 4, within the Section 2.4.4.

2.2.3 WORKING CAPITAL CALCULATION

2.2.3.1 OVERVIEW

The Filing Requirements permit applicants to take one of two approaches for the calculation of the allowance for working capital; the 7.5% Allowance Approach or the filing of a lead/lag study. Using the 7.5% Allowance Approach, the working capital allowance is calculated to be 7.5% of the sum of Cost of Power ("COP") and controllable expenses (Operations, Maintenance, Billing and Collecting, Community Relations, Administration and General).

In 2015, NBHDL committed to undertaking a comprehensive review of all of its processes and systems underlying its working capital requirements prior to its next cost of service application. In 2020, NBHDL hired Navigant to provide an updated Lead/Lag study and provide a review of best practices on areas of NBHDL's working capital that differed significantly from a benchmarking group. The primary driver of NBHDL's difference from other LDCs, as referenced in the Navigant report, is the average number of billing days. This specific area has ability to drive the most material reductions in working capital for NBHDL. Billing days is defined as the time between the meter read date and the billing date. NBHDL has an average billing lag of just under 24 days at 23.99, similar to the results of the 2014 Lead/Lag study. At first glance, this compares poorly to an average of 15.02 days as evidenced in the benchmarking group utilized by Navigant. On average, in all other material respects, NBHDL is comparable to other LDCs.

What fundamentally drives this billing lag is NBHDL's decision to maintain a calendar month billing schedule, which has been in place since September 2010. Because of this decision, NBHDL must wait 13-16 days in order to have the IESO daily pricing for the last day of the meter read (ex; pricing for the 31st day of the service month is released by the IESO on the 15th day of the subsequent month). This process specifically was an area of much discussion in the submissions of Board Staff, intervenors, and NBHDL on the working capital allowance approved in the 2015 COS with suggestions that the significant lag was a result of NBHDL being offside with assumed best practices. In 2020, NBHDL staff reached out informally to five LDCs to review their billing practices, with the primary focus around the window of time between meter read, the release of IESO daily pricing, and the timing of bill issuance. All LDCs interviewed wait until the IESO releases its daily pricing before beginning the billing process, regardless of whether the customer is on RPP or hourly pricing. This delay is required in order to complete IESO settlement transactions with respect to commodity and global adjustment.

The only material difference in billing process and timing that NBHDL observed was that, with the exception of one LDC who has not done an independent lead/lag study, all others were on a daily meter read cycle not calendar month. While rationale was suggested in 2015 that RPP invoices could be issued within days

of a meter read (as prices are set by the OEB), LDCs are required to complete complex true-ups between amounts billed and the actual cost of power (both commodity and global adjustment). This process itself requires actual data from the billing system that effectively calculates the hourly cost of power for RPP customers.

In theory, NBHDL could revamp its billing systems to allow for calendar month billing while releasing RPP customer invoices within days of the meter read, however, this would require extensive parallel programming/reporting in order to complete settlement processes for IESO submission. In addition, it's not an insignificant fact that NBHDL bills approximately 24,000 customers a month with a staff of two full-time employees. In the 2021 test year, as with the 2015 test year, NBHDL is maintaining that staffing level and the current processes support this staffing level; changes to the process would require additional resourcing and IT support, increasing overall costs. NBHDL would argue that calendar month billing by default experiences a higher billing lag unless all billing was completed in a window of a few days which is impractical at best.

NBHDL also believes that calendar month billing provides more relevance to a customer. There are other benefits that NBHDL realizes from this billing schedule, however, NBHDL made the decision to move, and stay, with calendar month billing independent of the Lead/Lag study.

The updated Navigant study quantifies NBHDL's WCA at 10.38%. The impact on revenue requirement between the OEB's allowance of 7.5% as compared to NBHDL's actual WCA of 10.38% is $103,222. NBHDL has chosen to utilize the OEB's WCA of 7.5%, foregoing the revenue requirement result. NBHDL has not engaged customers to determine if they would be willing to pay the incremental costs that are incurred by maintaining the calendar month billing schedule. This question, and the impacts, will be put forward to customers through the annual engagement process, however, at the time of this filing NBHDL is maintaining current practices. The management team will continue to review billing processes and schedules and will be naturally incented to make changes to further reduce the billing lag with the proposed 7.5% WCA rate.

The working capital allowance for the 2021 Test Year is based upon 7.5% of the COP and controllable expenses. In calculating the working capital allowance for 2015 to 2019 actual and for the 2020 Bridge Year, NBHDL used the Board's previously approved 10.31% allowance approach.

Table 2-33 provides a summary of NBHDL's COP and controllable expenses used to the calculate working capital allowance for 2015 Board Approved, 2015 Actual, 2016 Actual, 2017 Actual, 2018 Actual, 2019 Actual, 2020 Bridge Year and the 2021 Test Year.

Table 2 - 33: Summary of Working Capital Allowance

Description	2015 OEB Approved	2015 Actual	2016 Actual	2017 Actual	2018 Actual	2019 Actual	2020 Bridge Year	2021 Test Year
Cost of Power	**65,289,289**	**58,509,961**	**62,782,581**	**56,443,994**	**55,082,974**	**57,947,018**	**65,901,255**	**66,051,805**
Controllable Expenses:								
Operations	1,016,405	629,042	775,642	737,777	645,453	925,842	830,091	1,028,903
Maintenance	1,486,331	1,739,889	1,724,297	1,632,098	1,652,475	1,829,166	2,151,753	2,613,186
Billing & Collecting	1,233,810	1,109,424	1,186,321	1,204,043	1,258,639	1,142,030	1,413,651	1,328,174
Community Relations	2,200	44,252	334	0	0	0	0	0
Administration & General Expense	2,690,983	2,690,602	2,720,350	2,857,176	2,683,244	2,791,843	3,057,332	3,595,675
Donations - LEAP	16,700	14,550	16,700	15,560	15,560	15,560	15,560	18,823
Property Taxes	69,876	76,986	79,817	80,230	82,155	87,960	93,665	96,944
Total Controllable Expenses	**6,516,305**	**6,304,745**	**6,503,461**	**6,526,884**	**6,337,527**	**6,792,403**	**7,562,052**	**8,681,705**
Working Capital	**71,805,594**	**64,814,706**	**69,286,042**	**62,970,878**	**61,420,501**	**64,739,421**	**73,463,307**	**74,733,510**
Working Capital Allowance Rates	10.31%	10.31%	10.31%	10.31%	10.31%	10.31%	10.31%	7.50%
Working Capital Allowance	**7,403,157**	**6,682,396**	**7,143,391**	**6,492,298**	**6,332,454**	**6,674,634**	**7,574,067**	**5,605,013**

As shown in Table 2-33, the 2021 working capital allowance has decreased ($1,798,143) or 24% in comparison to the 2015 Board Approved Year. This overall decrease between the 2021 Test Year and the 2015 Board Approved Year is are result of both increases in cost of power and increases in controllable expenses. However, this is offset by the decrease in the working capital allowance percentage from the previously approved 10.31% to the current 7.5%. Table 2-34 provides a summary of the decrease between the 2021 Test Year and 2015 Board Approved working capital allowance.

Table 2 - 34: Summary of Changes in Working Capital Allowance

Description	2015 OEB Approved	2021 Test Year	Change	Working Capital Allowance Factor	Working Capital Allowance
Cost of Power (COP)	65,289,289	66,051,805	762,516	10.31%	78,615
Total Controllable Expenses	6,516,305	8,681,705	2,165,400	10.31%	223,253
Working Capital	**71,805,594**	**74,733,510**	**2,927,916**		**301,868**
COP & Controllable Expenses		74,733,510		7.50%	5,605,013
		74,733,510		10.31%	7,705,025
Decrease in Working Capital Allowance					**(2,100,012)**
Net Working Capital Allowance					**(1,798,143)**

Approximately 26% of the working capital increase of $2,927,916 is related to cost of power. Controllable OM&A expenses represent 74% of the increase over the 2015 Board-Approved amounts for working capital. Together these two components would account for an increase in working capital allowance of $301,868 at previously Board approved rates. When factoring in the Board's prescribed 7.5% working

capital allowance, the effect is an overall decrease in working capital of ($1,798,143). Details on the expenses can be found in Exhibit 4 – Operating Expenses.

2.2.3.2 COST OF POWER CALCULATIONS

NBHDL has calculated COP for the 2021 Test Year based upon the 2021 load forecast, adjusted for the impact of Conservation and Demand Management activities and in accordance with the Board's filing requirements. A summary of the total COP expenses is provided in Table 2-35.

Table 2 - 35: Summary of Total Cost of Power Expenses

Description	2015 OEB Approved	2015 Actual	2016 Actual	2017 Actual	2018 Actual	2019 Actual	2020 Bridge Year	2021 Test Year
Cost of Power Expenses								
Power Purchased	55,579,329	49,921,515	54,246,727	48,718,707	47,267,110	49,651,646	58,070,368	56,978,617
Wholesale Market Service Charges	2,919,955	2,053,846	2,358,146	1,938,702	1,421,714	1,870,880	1,617,796	1,983,722
Network Charges	3,713,092	3,516,847	3,234,511	3,008,660	3,212,768	3,207,041	3,139,843	3,582,806
Connection Charges	2,831,928	2,767,682	2,686,322	2,527,240	3,002,438	3,013,409	2,875,385	3,273,741
Low Voltage Charges	20,008	26,789	34,093	28,294	34,267	44,472	41,921	68,752
Smart Meter Entity Charges	224,977	223,282	222,783	222,392	144,677	159,570	155,942	164,167
Total COP Expenses	**65,289,289**	**58,509,961**	**62,782,581**	**56,443,994**	**55,082,974**	**57,947,018**	**65,901,255**	**66,051,805**

(a) Commodity Prices

In accordance with the Filing Requirements, the commodity price estimate used to calculate COP was determined in a way that bases the split between Regulated Price Plan ("RPP") and non-RPP customers on actual data and uses the most current RPP price. The calculation also includes the impact of the Ontario Electricity Rebate of 21.2% on the total bill.

The RPP and non-RPP price was obtained from the Regulated Price Plan Price Report for the period of November 1, 2020 through October 31, 2021 published by the Board October 13, 2020. For the purposes of calculating the 2021 Test Year, NBHDL has used an estimate of $.13358 per kWh for RPP customers. For non-RPP customers, NBHDL has used $.13034/kWh which includes $.02087 per kWh for the Wholesale Electricity Price and $.10947 per kWh for Global Adjustment charges. Chapter 2 Filing Appendices 2-ZA and 2-ZB are attached as Appendix 2-B to this exhibit.

For the 2021 Test year, the Cost of Power is shown in the following Table 2-36:

Table 2 - 36: 2021 Test year Cost of Power

2021 Test Year - Cost of Power	
4705 -Power Purchased	$ 42,905,782
4707- Global Adjustment	$ 23,291,550
4708-Charges-WMS	$ 1,983,722
4714-Charges-NW	$ 3,582,806
4716-Charges-CN	$ 3,273,741
4750-Charges-LV	$ 68,752
4751-IESO SME	$ 164,167
Misc A/R or A/P	$ (9,218,715)
TOTAL	**$ 66,051,805**

2.2.4 CAPITAL EXPENDITURES

2.2.4.1 PLANNING OVERVIEW

In accordance with the Filing Requirements, NBHDL is filing its consolidated DSP as a stand-alone document which includes all elements of the DSP as Appendix 2-A of this Exhibit. NBHDL has organized the information contained in the DSP using the headings indicated in Chapter Five of the Board's *Filing Requirements for Electricity Distribution and Transmission Applications*, *Consolidated Distribution System Plan Filing Requirements.* The DSP incorporates matters pertaining to asset management, regional planning, and renewable energy generation.

All categories of system investments, including system renewal, system access, system service, and general plant have been addressed and consolidated in NBHDL's capital expenditure plan. NBHDL has provided historical spending by material capital project in the categories mentioned for 2015 Actual, 2016 Actual, 2017 Actual, 2018 Actual, 2019 Actual, 2020 Bridget and 2021 Test Year. NBHDL has assigned all historical and future construction projects to the new categories as required by the Board. The DSP provides the suggested spending level, as determined through an asset condition assessment performed by METSCO, for 2021 through 2025; NBHDL has levelized the plan to address pacing and affordability.

NBHDL belongs to the "North/East of Sudbury Region" for which HONI is the lead transmitter. The first cycle of Regional Planning was completed in 2017. The next cycle of regional planning with HONI is scheduled to begin in Q1/Q2 2021, however, the process is not expected to have material impacts on NBHDL's DSP and the proposed investments as there are no transmission capacity constraints to deter new connection.

Based on the evaluation of the distribution system to accept green energy generation connections NBHDL is not proposing any capital investments for capacity upgrades to accommodate applications for the connection of renewable energy generation plant over the next five years (2021 to 2025) as no constraints have been identified in the system preventing the connection of such installations.

NBHDL assets fall into two broad categories – distribution plant, which includes assets such as wires, overhead and underground electricity distribution infrastructure, transformers, meters and substations; and general plant which includes assets such as the office building, SCADA, equipment and tools. For internal budgeting purposes, NBHDL has categorized all spending to align with the new DSP categories of system renewal, system access, system service and general plant, however, internal projects are further categorized as follows.

(i) Major Betterments:

These are major line and engineering related projects that NBHDL undertakes and involve the following:

The rehabilitation or expansion of HV lines required to service new large users and GS>1000kW (greater than 5 poles)

These projects involve the rehabilitation or the extension of HV lines to new customers to meet customer service obligations in accordance with the Board's DSC and NBHDL's Conditions of Service.

Large Renewal Projects (greater than 5 poles)

These projects involve the renewal of assets that reach end of life and must be replaced. NBHDL completes visual inspections of its plant and performs predictive testing on certain assets where such testing is available, and replaces assets based on these inspection and testing activities if warranted. In some cases the projects involve spot replacement of assets; in others, the projects involve complete asset replacement within a geographic area. New assets require less maintenance, deliver better reliability and reduce safety risks to the general public.

Capacity/Redundancy Projects

Load growth caused by new customer connections and increased demand of existing customers over time can result in a need for capacity improvements on the system. Projects can take the form of new or upgraded feeders, and feeder ingress and egress for a new substation. These projects are not customer-specific, but rather, they benefit many customers. These projects also consider the probability and impact of asset failure at peak load to determine the risk a possible failure creates. In these cases, projects are

developed to add switching devices or create a backup feeder supply to reduce the risk to typical restoration times for NBHDL.

Underground Rebuilds

Investments in this category are driven by the requirement to replace end of life assets that are in poor or very poor condition as determined by the Asset Condition Asset Report. Investments in this category are aimed at ensuring reliability is maintained, but more importantly ensuring that O&M costs are controlled. Cable failures, especially cables that are direct buried which are a characteristic of cables in this age demographic, are extremely costly to repair as excavation in built up urban areas is very expensive. The program is aimed to proactively replace cables to avoid the high customer impact that is associated with their failure.

Where possible, capital contributions toward the cost of these projects are collected by NBHDL in accordance with the DSC and the provisions of its Conditions of Service. NBHDL uses the economic evaluation methodology from the DSC to determine the level of capital contribution for each project and those levels are injected into the annual capital budget

(ii) Voltage Conversion:

Voltage Conversion projects involved all line construction work relating to the preparation to convert, or actual conversion of, NBHDL's previous 22kV subtransmission system to 44kV and the 4.16/2.4kV system to 12.47/7.2kV. The 22 kV and 4.16kV systems were the oldest in NBHDL's service territory and therefore most plant was at the end of its useful life. Since the last DSP was put forward, these systems have been replaced. Voltage conversion projects not only prepared to convert the voltage to 12.47/7.2kV but also renewed NBHDL's oldest assets to current standards. Voltage conversion projects lead to the harmonization of the distribution system voltage, lower line losses, eliminate safety hazards to the public and NBHDL employees, and lower future maintenance costs. This category of spending is no longer included in the DSP, however, the description is provided as a reference for historical spending.

(iii) Minor Betterments:

These are minor lines and engineering related projects that NBHDL undertakes and involve the following:

The rehabilitation or expansion of HV lines required to service new residential and general service customers (5 or less poles)

These projects involve the rehabilitation or extension of HV lines to new customers to meet customer service obligations in accordance with the Board's DSC and NBHDL's Conditions of Service.

Small Renewal Projects (5 or less poles)

These projects involve the renewal of assets that reach end of life and must be replaced. NBHDL completes visual inspections of its plant and performs predictive testing on certain assets where such testing is available, and replaces assets based on these inspection and testing activities if warranted. In all cases the projects involve spot replacement of assets; new assets require less maintenance, deliver better reliability and reduce safety risks to the general public.

Where possible, capital contributions toward the cost of these projects are collected by NBHDL in accordance with the DSC and the provisions of its Conditions of Service. NBHDL uses the economic evaluation methodology from the DSC to determine the level of capital contribution for each project.

(iv) Secondary Services:

This category represents the capital work required to upgrade existing or to install new secondary service wires, overhead and underground, from distribution plant located on the municipal street or in easements on private property to customer's premises. The majority of the work involves the services to the residential class. Costs are recovered as per NBHDL's Conditions of Service.

(v) Subdivisions:

This project represents the capital work required in subdivisions due to developer driven demand. The expenditure represents cost to provide material to developers, and NBHDL labour to install transformers and make primary and secondary connections. Where possible, capital contributions toward the cost of these projects are collected by NBHDL in accordance with the DSC and the provisions of its Conditions of Service. NBHDL uses the economic evaluation methodology from the DSC to determine the level of capital contribution for each project and those levels are injected into the annual capital budget.

(vi) Transformer Purchases:

This category represents the purchase of new overhead and underground distribution transformers used for the following reasons;

- *Asset Renewal & Rehabilitation*
- *New/Upgraded Services*
- *Special Projects.*

Although NBHDL maintains a small stock due to long lead times, backup, and emergency use, distribution transformers are for the most part ordered as required.

(vii) Metering:

Capital expenditures in this pool include meter installations, meter upgrades, and the capital components of wholesale and retail meter verification activities.

(viii) Road Relocations:

This category represents capital expenditures required to comply with statutory obligations related to the relocation of overhead and underground facilities installed within municipal or provincial owned road allowances. Based on a legislated cost sharing formula, the City of North Bay or MTO, contribute 50% of all labour, labour saving devices, and equipment costs. In the case where the governing body directs NBHDL to replace overhead plant with underground plant the governing body funds the cost differential between overhead and underground.

(ix) Primary Services:

This category represents the capital work necessary to rehabilitate and/or expand plant to service new customers or maintain existing customers, residential and general service, over the 400A threshold. Costs are recovered as per NBHDL's Conditions of Service.

(x) Substations:

This category represents investments that are undertaken to improve or maintain reliability to a large number of customers, to maintain security and safety at the substations, and to renew or replace end of life substation equipment.

(xi) General Plant:

This category represents investments in the NBHDL office building and fixtures, land, office furniture / equipment, computer hardware / software, fleet, stores equipment, tools, shop and garage equipment, communication equipment, SCADA and load management controls.

(xii) Budget

The following comments provide an overview of NBHDL's capital budgeting process.

The budget is prepared annually by management and is reviewed and approved by the NBHDL Board of Directors. The budget is prepared before the start of each fiscal year. Once approved, it does not change, but provides a plan against which actual results may be evaluated.

NBHDL has been, and continues to be, focused on maintaining the adequacy, reliability, and quality of service to its distribution customers through effective capital spending. The capital budget is a critical component of NBHDL's business plan.

2021 Major Betterments were estimated in co-operation with the Engineering, Operations and Finance departments. After field inspection, a high-level design of the project is done by the Engineering department. Labour hours and 3rd party contracting costs are then estimated based on discussions with the Operations department and known civil contractor costs. Anticipated costs, including materials, are then broken down by category or 'job' and applied accordingly within a project estimate. Each job category is linked to a specific GL # within NBHDL's accounting system which is in turn mapped to the appropriate USoA #.

All other categories (Minor Betterments, Primary Services, etc.) within the distribution assets are budgeted based on a 5-year average of historical spending and were mapped to the appropriate USoA category using 2018 historical spending. General Plant assets were mapped according to their nature.

2020 forecasted spending is based on the assumption that NBHDL will hit the capital spending targets included the approved 2020 capital spending budget.

2.2.4.2 REQUIRED INFORMATION

(a) SUMMARY OF CAPITAL EXPENDITURES

Table 2-37 below provides a summary of historical capital expenditures for the past five historical years, 2015 through 2019, projections for the 2020 Bridge Year and 2021 Test Year, as well as projections for the period 2022 through 2025. This table is consistent with Board Appendix 2-AB. NBHDL has made its best efforts to categorize historical projects into the DSP categories. The annual capital expenditures include all new spending in the fiscal period. Costs for projects that are considered WIP at the end of a fiscal year are captured in the year spent, not the year the asset is transferred into service. The variance between the annual capital expenditure totals in the table and the total 'additions' in the continuity schedules are those applicable to WIP, and contributed capital.

Figure 2-1 shows the percentage of the cumulative gross capital expenditures incurred by NBHDL for the period 2015 through 2020 in each of the investment categories which represents total gross capital spending of $39,751,456. Figure 2-2 shows the percentage of the cumulative gross capital expenditures

forecasted by NBHDL for the period 2021 through 2025 in each of the investment categories for a total forecasted amount of $31,268,262.

Table 2 - 37: Capital Expenditure Summary – 2015-2025

CATEGORY	Historical Period (previous plan[1] & actual)																		Forecast Period (planned)				
	2015			2016			2017			2018			2019			2020			2021	2022	2023	2024	2025
	Plan	Actual	Var	Plan	Actual	Var	Plan	Actual	Var	Plan	Actual	Var	Plan	Actual	Var	Plan	Actual[2]	Var					
	$ '000		%	$ '000		%	$ '000		%	$ '000		%	$ '000		%	$ '000		%	$ '000				
System Access	779	966	24.0%	1,167	725	-37.9%	1,190	778	-34.6%	1,214	1,306	7.6%	1,238	1,757	41.9%		966	--	951	969	987	1,006	1,025
System Renewal	5,187	4,448	-14.2%	4,180	4,412	5.5%	4,236	5,109	20.6%	4,266	3,141	-26.4%	4,054	3,788	-6.6%		3,986	--	4,544	4,008	4,057	4,154	4,221
System Service	364	554	52.2%	215	342	58.9%	127	681	436.2%	89	1,839	1965.8%	136	273	100.7%		407	--	288	294	299	305	311
General Plant	772	714	-7.5%	373	824	120.9%	549	607	10.6%	351	330	-6.0%	642	771	20.1%		1,030	--	909	587	666	1,041	649
TOTAL EXPENDITURE	7,102	6,682	-5.9%	5,935	6,302	6.2%	6,102	7,175	17.6%	5,920	6,615	11.7%	6,070	6,589	8.6%	-	6,388	--	6,692	5,858	6,010	6,505	6,206
Capital Contributions		(703)	--		(352)	--		(728)	--		(559)	--		(483)	--		(560)	--	(551)	(562)	(572)	(583)	(594)
Net Capital Expenditures		5,979	--		5,950	--		6,447	--		6,056	--		6,106	--		5,828	--	6,141	5,296	5,438	5,922	5,612
System O&M		2,369	--		2,500	--		2,370	--		2,298	--		2,755	--		2,982	--	3,642	3,713	3,785	3,859	3,935

Figure 2 - 1: Cumulative Gross Capital Expenditures 2015 – 2020

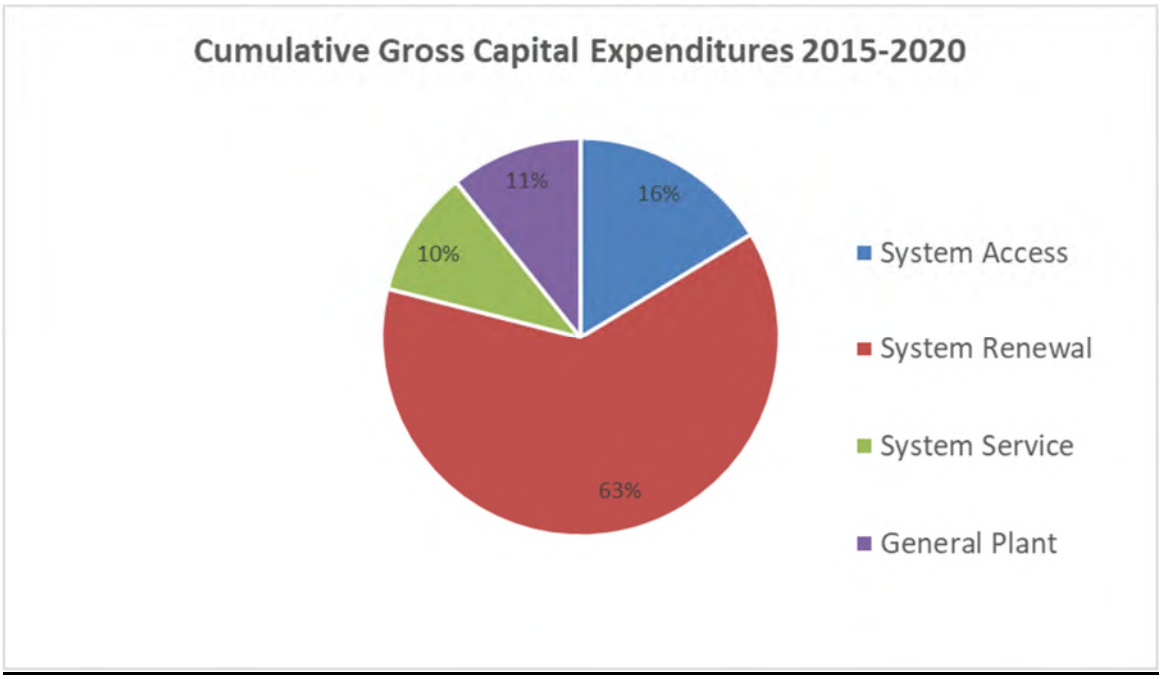
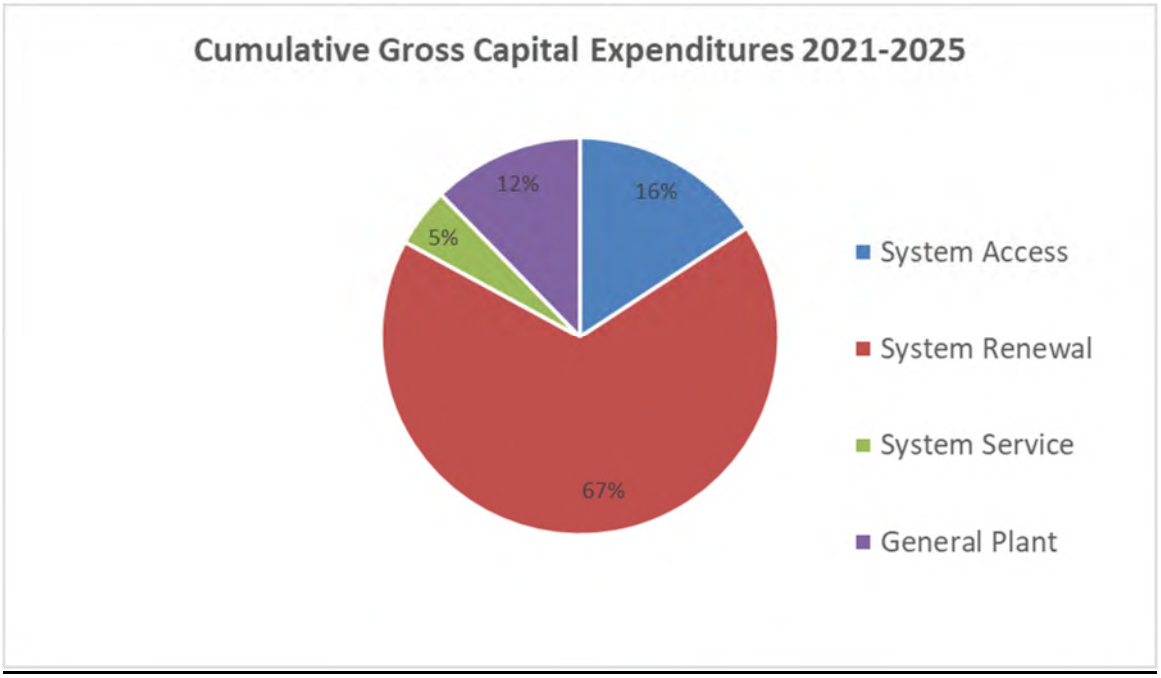


Figure 2 - 2: Cumulative Gross Capital Expenditures 2021 – 2025



As shown in the above table and charts, NBHDL's main infrastructure focus is on renewal; this has been the driver of historical spending and is the driver of future spending.

(b) VARIANCE OF YEAR OVER YEAR CATEGORY SPENDING

See Table 2-38 for a summary, by spending category, of 2015 actual project costs compared to 2015 Board-Approved amounts, along with an explanation of the material variances.

An analysis of year over year trending for historical costs within the DSP categories are provided in Tables 2-39 to 2-44 below along with explanations. See Table 2-45 for a 2022 – 2025 trending analysis.

(i) 2015 Actual vs 2015 Board Approved

Table 2 - 38: 2015 Actual vs. 2015 Board Approved (000s)

Description	2015 Board Approved	2015 Actual	Variance from 2015 Board Approved
System Access	779	966	187
System Renewal	5,187	4,448	(739)
System Service	364	554	190
General Plant	772	714	(58)
Total Capital Expenditure	**7,102**	**6,682**	**(420)**

(1) System Access – this variance represents a 24% increase year over year. System access expenditures are primarily made up of customer demand work and as such are subject to greater variability.

(2) System Renewal - the variance is 14% lower than the Board Approved amount. The primary driving factor is a multitude of projects that experienced late 2015 project starts and subsequently continued into 2016.

(3) System Service – this variance is a 52% higher than the 2015 Board Approved. This is primarily due to a SCADA Radio Replacement project that was originally classed as System Renewal but upon engineering review, was categorized as System Service.

(4) General Plant – the variance is below the materiality threshold and therefore deemed immaterial.

(ii) 2016 Actual vs. 2015 Actual

Table 2 - 39: 2016 Actual vs. 2015 Actual (000s)

Description	2015 Actual	2016 Actual	Variance from 2015 Actual
System Access	966	725	(241)
System Renewal	4,448	4,412	(36)
System Service	554	342	(212)
General Plant	714	824	110
Total Capital Expenditure	**6,682**	**6,302**	**(380)**

(1) System Access – this variance represents a 25% decrease year over year. System access expenditures are primarily made up of customer demand work and as such are subject to greater variability. The 2016 decrease was driven primarily by a $117,793 decrease in subdivision demand work and a $92,576 decrease in minor betterment demand work. An increase in primary services demand of $92,337 was largely offset by decreases in road relocations and secondary services.

(2) System Renewal - the variance is below the materiality threshold and therefore deemed immaterial.

(3) System Service – this variance is a 38% reduction over 2015. This reduction is due in part to ($112,902) less spending in substations and ($103,437) less in voltage conversion. 2016 saw the completion of a SCADA radio replacement that began and had the majority of costs take place 2015, driving the reduction in substations.

(4) General Plant – the variance of $110,001 is being driven by two main areas. In 2015 NBHDL purchased a line truck and other smaller vehicles, while in 2016 NBHDL only invested in smaller trucks and vans, contributing to a fleet investment reduction of ($187,578). This is offset by a major parking lot upgrade in 2016 that drove a variance of $300,070 in facility upgrades. This expenditure was identified as a safety investment to improve the overall traffic flow as well and a renewal of a lot that was in overall disrepair.

(iii) 2017 Actual vs. 2016 Actual

Table 2 - 40: 2017 Actual vs. 2016 Actual (000s)

Description	2016 Actual	2017 Actual	Variance from 2016 Actual
System Access	725	778	53
System Renewal	4,412	5,109	697
System Service	342	681	339
General Plant	824	607	(217)
Total Capital Expenditure	**6,302**	**7,175**	**873**

(1) System Access - the variance is below the materiality threshold and therefore deemed immaterial.

(2) System Renewal – a major contributor to the 2017 variance over 2016 was the lack of a major substation project in 2016 while there were two such projects in 2017. Both MS16 and MS19 had major rehabilitation work done to drive a yearly variance of $877,804 in substations. Voltage conversion work increased by $463,369 to further drive the annual increase. 2017 was the most substantial year for investment in the multi-year system wide voltage conversion. Primary services increased by $468,868 and is considered a peak year as costs were primarily driven by a renewal service at the municipal airport. These increases were partially offset by a reduction of the resource allocation available for the planned jobs that drive major betterments, resulting in a $1,101,844 reduction.

(3) System Service – 2017 showed an approximate doubling of service investment over 2016. Major betterment investment increases were primarily responsible for this increase at $173,236, with major projects associated with 44kv switching and a new line to the municipal microgrid being the main contributors. A variance in voltage conversion service investment drove another $94,953 with smaller fluctuations in substations, metering, and minor betterments being the other main contributors.

(4) General Plant - the 2017 variance over 2016 is a decrease of ($216,108). The main contributor is the parking lot investment made in 2016. Without any major investments in the general facility there was ($427,124) less spent in 2017. This

decrease was offset by a fleet investment increase of $124,020, with a line truck purchase driving the variance. An increase in IT investment further contributes to the offset with a $94,536 variance which included the purchase of a new AS400 server, a mail inserter, and software upgrades to accommodate a provincial low-income program.

(iv) 2018 Actual vs. 2017 Actual

Table 2 - 41: 2018 Actual vs. 2017 Actual (000s)

Description	2017 Actual	2018 Actual	Variance from 2017 Actual
System Access	778	1,306	528
System Renewal	5,109	3,141	(1,968)
System Service	681	1,839	1,158
General Plant	607	330	(277)
Total Capital Expenditure	**7,175**	**6,615**	**(560)**

(1) System Access - this variance represents a 68% increase year over year. System access expenditures are primarily made up of customer demand work and as such are subject to greater variability. However, the variance in 2018 over 2017 primarily relates to generation connection work at a municipal community microgrid facility. This project accounted for $537,900 of the annual variance.

(2) System Renewal – the voltage conversion project became less of a focus in 2018 as it neared its final stages, driving a ($1,167,707) decrease over the prior year. Substations drove a further ($1,568,413) reduction over the prior year as no major substation work was performed in the renewal category. Primary services returned back to an average level, versus 2017 when a single major project drove the spending, resulting in a decrease over 2017 of ($390,420). These reductions were offset by a return to planned major betterment projects, creating a $1,025,904 increase over a lower year in 2017.

(3) System Service – 2018 is an outlier year for system service investment, showing a 165% increase over 2017. This is primarily due to a single project, MS23, a new construction required to service a first of its kind municipal microgrid project which drove an overall substations variance of $1,269,794 Smaller fluctuations in

metering, minor betterments, voltage conversion, and major betterments further contributed to the year over year variance.

(4) General Plant – the 2018 reduction is due primarily to the line truck replacement in 2017 and only two smaller vehicles and a forklift replaced in 2019, creating an annual fleet variance of (261,660).

(v) 2019 Forecast vs. 2018 Actual

Table 2 - 42: 2019 Forecast vs. 2018 Actual (000s)

Description	2018 Actual	2019 Actual	Variance from 2013 Actual
System Access	1,306	1,757	451
System Renewal	3,141	3,788	647
System Service	1,839	273	(1,566)
General Plant	330	771	441
Total Capital Expenditure	**6,615**	**6,589**	**(26)**

(1) System Access - this variance represents a 34% increase year over year. System access expenditures are primarily made up of customer demand work and as such are subject to greater variability. The 2019 increase is made up of a variety of variances in underlying customer demand categories. Generation connections decreased by $486,737, owing mostly to an outlier 2018 year as explained in the above sections. Road relocations drove an increase of $341,942 which was a peak year, being driven by a City of North Bay construction project in the Cassels Street region of the city. Increases in subdivisions, primary services, and minor betterments drove increases of $115,469, $249,305 and $104,207 respectively.

(2) System Renewal – in 2019 system renewal expenditures increased by 21%. This increase was primarily driven by a return to renewal substation investments. Four major projects at MS10, MS11, MS13 and MS14 drove an overall yearly increase of $1,107,988. This was offset by a reduction in voltage conversion work of ($531,762) as the system wide project reaches its final stages.

(3) System Service – the reduction of ($1,552,689) represents an 84% decrease in the prior year, owing to the fact that 2019 is the lowest of the historical period and

2018 is the highest. Substations drove the majority of the variance with ($1,350,524) as there was no major construction as was the case in 2018. Annual fluctuations in metering, voltage conversion, minor and major betterments were the main contributors to the remainder of the annual reduction.

(4) General Plant - owing to NBHDL's desire to balance fleet spending and the replacement of larger vehicles in offsetting years, the fleet variance of $279,032 is driven by the purchase of a line truck in 2019. Further significant investments in IT contributed another $172,836 to the year over variance, with a server offering increased capacity and redundancy being the major source of investment.

(vi) 2020 Forecast vs. 2019 Actual

Table 2 - 43: 2020 Forecast vs. 2019 Actual (000s)

Description	2019 Actual	2020 Bridge	Variance from 2019 Actual
System Access	1,757	966	(791)
System Renewal	3,788	3,986	198
System Service	273	407	134
General Plant	771	1,030	259
Total Capital Expenditure	**6,589**	**6,388**	**(201)**

(1) System Access - this variance represents a 45% decrease year over year. System access expenditures are primarily made up of customer demand work and as such are subject to greater variability. Road relocations decreased by $285,152, primarily driven by 2019's municipal project. Primary services decreased by $308,079; 2019 was the largest investment year over the last 5 years and the 2020 forecast was dropped back to more average level of spending. Further decreases in subdivisions, secondary services, and generation connections account for the remainder of the yearly reduction.

(2) System Renewal – the two largest variance drivers in 2020 are in the planned major betterments category and substations. Major betterments increased by $1,273,517 driven primarily by a large underground project on Lovell Ave. and by the continuation of a multi stage project on Ski Club Road, with these two projects accounting for over half the total major betterment investment. This is offset by a

reduction in substations of ($871,414) owing mostly to less rehabilitation work being done in 2020 as compared to 2019.

(3) System Service - the variance can be attributed to the SCADA and RTU investment in substations, driving a $56,305 increase, metering exchanges and upgrades contributing a further $36,173, and minor betterments and voltage conversion contributing lesser amounts.

(4) General Plant – increases in IT and facility investment are offset by a reduction in fleet investment to create an overall increase of $259,257 over 2019. 2020 is an important year for IT investment with expenditures to support a disaster recovery environment being the main contributor to the annual variance of $75,724. A building renovation of the garage mezzanine, an outdoor storage facility, and a smaller internal office renovation account for an increase in facility expenditures of $287,789. Offsetting this is a reduction in fleet investment of ($116,196) which is a result of the costs of a line truck replacement being spread over 2020 and 2021 with 2020 costs included in WIP.

(vii) 2021 Forecast vs. 2020 Forecast

Table 2 - 44: 2021 Forecast vs. 2020 Forecast (000s)

Description	2020 Bridge	2021 Test	Variance from 2020 Bridge
System Access	966	951	(15)
System Renewal	3,986	4,544	558
System Service	407	288	(119)
General Plant	1,030	909	(121)
Total Capital Expenditure	**6,388**	**6,692**	**304**

(1) System Access - the variance is below the materiality threshold and therefore deemed immaterial.

(2) System Renewal - the main driver of the increased spending in 2021 compared to 2020 can be explained by an increase in substations and increase in major betterments. The completed rehabilitation at MS15 and the start of one at MS18 drive the overall increase of $136,727, while major betterments work drives a

further $394,162. Major projects at MacBeth and Wallace Road are major contributors.

(3) System Service – the main contributor is the completion of the multistage voltage conversion project in 2020. With no voltage conversion service investment in 2021 this variance accounts for a ($127,270) reduction.

(4) General Plant – 2021 is a relatively stable investment year with the reduction of ($120,855) being driving primarily by lower IT investment in 2021. Disaster recovery investments in 2020 meant higher investment the previous year while 2021 reflects mostly software investments that include a customer app, Microsoft licensing, a customer web portal, and a financial reporting application.

(viii) 2022 – 2025 Trending

Table 2 - 45: 2022 – 2025 Trending (000s)

Description	2022 Forecast	2023 Forecast	2024 Forecast	2025 Forecast
System Access	969	987	1,006	1,025
System Renewal	4,008	4,057	4,154	4,221
System Service	294	299	305	311
General Plant	587	666	1,041	649
Total Capital Expenditure	**5,858**	**6,010**	**6,505**	**6,206**

(1) System Access - forecasted expenditures in the System Access category are based strictly on average historical costs and as such the system access category has been forecasted to increase each year through 2025 by an inflation factor of 1.9% per year. System Access costs are driven by customer demand and NBHDL does expect fluctuations year over year in this category, however, the total envelope of dollars is anticipated to be within an acceptable tolerance range for accuracy.

(2) System Renewal - full substation replacements or major rehabilitations were the focus of NBHDL from 2010 to 2015, with smaller substation rehabilitation projects the focus from 2016-2020. As a result of these investments, the overall average health of NBHDL's substations, the backbone of our distribution system, are now assessed in good or very good condition. Although the overall health of the

substations is strong, there are components at some stations that are still classified as fair to very poor. Based on this assessment, NBHDL will focus its capital investments on specific components of substations that have shorter lifespans, such as remote terminal units, or that have components reaching their end of service life, such as relays and reclosers. The substation investment forecast is lower than the prior 5-year period and will be relatively flat with these component-based expenditures; this levelized spending is required in order to maintain the substations in proper operating condition. Renewal spending on the remaining infrastructure of NBHDL's system is reflective of recommended replacement levels that address NBHDL resourcing capacity, a smooth pacing level, and recognizes that affordability is a significant concern for customers and also a consideration for NBHDL in terms of business planning and financing capacity. Pole renewals reflect pole replacement needs while considering the resource constraints of NBHDL to replace a specific number of assets. Underground replacement projects will continue to progress at a pace that enables NBHDL to maintain its overall assets over the long-term. The forecasted allocations provide opportunities for prudent, consistent, and paced capital funding that ensures a safe and reliable distribution system.

(3) System Service - forecasted expenditures in the System Service category are based strictly on average historical costs and as such the system service category has been forecasted to increase each year through 2025 by an inflation factor of 1.9% per year. With the exception of 2018, System Service investments have made up a very small portion of the historical period expenditures and will continue to make up a very small portion of total capital expenditures over the forecast period. The demand work has been levelized over the forecast period with the use of a historical average. NBHDL does expect fluctuations year over year in this category, however, the total envelope of dollars is anticipated to be within an acceptable tolerance range for accuracy.

(4) General Plant - expenditures over the forecast period will for the most part vary based on the fleet replacement strategy and a 5-year IT strategy, which is documented throughout the DSP found in Appendix E and G respectively of Appendix 2-A. The bulk of the items related to the building and property are minor expenditures, individually, and remain relatively consistent through to 2025. Tool expenditures have been inflated at 1.9% annually, starting at $40,000 in 2022. Fleet expenditures going forward will continue to follow a fleet replacement

strategy informed by the Fleet Assessment and NBHDL's knowledge of its assets which will cause changes year to year. IT expenditure will follow a 5-year cycle in which IT infrastructure and other assets will be renewed including licenses, network devices, workstations, physical servers, and disaster recovery hardware. This renewal will ensure that systems are reliable, supportable, secure, and responsive; thus, enabling IT to meet the needs of the business, customers, board of directors, and other stakeholders like the OEB. All other general plant expenditures will remain fairly consistent throughout the filing period.

NBHDL is forecasting to spend $1,801,304 less over the 2021-2025 forecast period than what was spent during the 2016-2020 historical period with respect to capital expenditures.

(c) CAPITAL PROJECT SUMMARY

Tables 2-46 and 2-47 provides a summary of all capital projects for the years 2015 through 2019, the 2020 Bridge Year and the 2021 Test Year. All projects above NBHDL's materiality threshold of $75,000 have been listed individually within the DSP categories and all individual projects below the threshold have been grouped together as miscellaneous within the applicable category. NBHDL's DSP, found in Appendix 2-A, provides capital project summaries that provides a full description and justification of all individual material projects listed in the table for the 2021 Test Year. These summaries are found in Appendix I of Appendix 2-A. Tables 2-46 and 2-47 are consistent with the Board's Appendix 2-AA, Capital Projects Table and, when contributed capital is removed, reconciles to Table 2-32 above.

Table 2 - 46: Capital Projects Table – 2015 – 2021

Appendix 2-AA
Capital Projects Table

Projects	2015	2016	2017	2018	2019	2020 Bridge Year	2021 Test Year
Reporting Basis	**MIFRS**	**MIFRS**	**MIFRS**	**MIFRS**	**MIFRS**	**MIFRS**	**MIFRS**
System Renewal:							
Transformer Purchases - Various Jobs	247,628	187,250	289,585	149,515	265,374	141,975	229,240
Major Betterment Projects							
Norman Ave	99,701	-	-	-	-	-	-
Lake Heights Rd	97,146	-	-	-	-	-	-
Birchaven Area - Misc. Costs and Provisional Items	88,747	-	-	-	-	-	-
Macbeth Cres Backlot Elimination	-	-	-	-	1,183	19,116	949,317
Lovell Ave	-	651	-	194	12,659	897,396	-
Ski Club Rd Part 1 - South Portal to Johnston Rd	-	-	1,534	380,622	524,334	-	-
Wallace Road	-	-	3,016	3,318	303	-	811,240
Marshall Ave (MS10) to Highway 11 South	-	-	-	-	473	13,093	629,884
Ski Club Part 2A - Johnston Rd to Bolton Rd	-	-	541	2,029	401,884	175,633	-
Sylvan Cres - Civil	235	365,997	130,982	-	-	-	-
Shore Acres Blvd	-	-	-	1,158	22,333	388,037	-
Ski Club Rd Part 3 - Chapais St to O'Brien St	-	-	703	533	10,619	204,195	201,271
Ski Club Rd Part 2B - Bolton Rd to Chapais St	-	-	-	-	-	403,834	-
Madelena Dr - Electrical	600	45,247	334,131	(740)	-	-	-
Fraser St South - Electrical	-	-	-	295,924	69,258	-	-
McKeown Ave East	357	126	4,790	350,425	118	-	-
Lamorie St	-	-	-	1,059	-	334,688	-
Madelena Dr - Civil	-	277,268	53,961	-	-	-	-
Highway 11 North - Sunshine Lane to Berkely Blvd	-	-	-	-	1,441	-	337,164
Sylvan Cres - Electrical	-	126,258	135,701	1,775	-	-	-
Lavase Rd - Civil	-	-	-	257,141	642	-	-
Norman Ave Backlot Elimination	-	-	2,957	906	10,852	239,415	-
Birchaven Area - Civil	52,709	236,799	-	-	-	-	-
Melina Close - Civil	81,567	217,399	-	-	-	-	-
Chapais St	-	-	-	-	1,351	210,784	-
McKeown Ave East	-	-	-	6,380	198,738	-	-
Lees Rd (South Section)	-	-	572	197,087	843	-	-
Dane Ave	-	-	-	-	1,127	7,987	177,414
Elmwood Ave & Browning St	4,960	164,028	1,433	-	-	-	-
Sage Road	75,017	347	-	-	155,611	-	-
McKay Ave	-	-	908	136	150,476	-	-
Melina Close - Electrical	144	137,944	3,741	1,043	-	-	-
Montrose Ave	-	-	-	-	1,279	8,510	105,930
Birchaven Area - Electrical	-	-	26,119	11,375	68,224	-	-
Gertrude St East	-	-	746	340	405	-	106,113
Abbott St	-	-	-	-	337	82,988	-

Voltage Conversion Projects							
Ferguson St North	331	204,290	303,362	1,775	-	-	-
Main St West	308,892	-	-	-	-	-	-
Fourth Ave	145,872	-	-	-	-	-	-
First Ave	136,467	-	-	-	-	-	-
Fifth Ave	120,379	-	-	-	-	-	-
King St - Wyld St to Cassells St	109,498	-	-	-	-	-	-
Hardy St	103,761	-	-	-	-	-	-
Fraser St South	995	886	438,900	5,955	106	-	-
McIntyre St West	-	20,987	212,109	118,479	15,771	-	-
Ferguson St South - Civil	920	1,198	41,570	306,237	177	-	-
Wyld St South	349	4,344	270,555	30,537	990	-	-
Ferguson St South - Electrical	-	-	41,103	146,377	91,098	-	-
McIntyre St West	96,989	239,567	27,893	5,803	-	-	-
Sherbrooke St	166	41,960	192,866	159	-	-	-
Oak St East	746	221,727	-	-	-	-	-
Fraser St North	-	8,458	154,898	2,334	992	-	-
McIntyre St East	-	123,324	-	-	-	-	-
Regina St South	3,254	122,134	182	-	-	-	-
Fifth Ave - Wyld St to Fisher St	3,654	96,131	-	-	-	-	-
Princess St West - Police Station	-	85,575	3,255	-	-	-	-
Minor Betterment Projects	186,255	281,979	290,965	363,998	347,969	311,490	295,359
Porcelain Switch & Insulator Replacement	-	52,711	1,064	129,941	1,179	-	-
Distribution Substation Improvements & Rehabilitation							
MS10 - Rehabilitation	-	-	-	12,559	229,820	-	-
MS11 - Rehabilitation	-	-	-	-	415,742	-	-
MS13 - Rehabilitation	-	-	-	-	-	287,710	-
MS13 - Transformer Replacement	-	221,019	45,024	-	(3,390)	-	-
MS13 - Station Improvements	-	-	-	-	233,087	-	-
MS14 - Transformer Replacement	-	-	-	-	302,694	-	-
MS15 - Transformer Replacement	-	225,181	2,098	-	-	-	-
MS15 - Rehabilitation	-	-	-	-	-	82,583	424,402
MS16 - Transformer and Switchgear Replacement	-	-	963,980	95,286	5,008	-	-
MS18 - Rehabilitation	-	-	-	-	-	-	82,619
MS19 - Recloser Replacement	-	95,398	562,382	85	-	-	-
MS22 - Construction of New Substation to Replace MS9	2,132,313	147,378	-	-	-	-	-
Primary Services	-	-	478,882	38,381	79,073	137,877	132,411
Misc. Projects <$75k on Individual Project Basis	348,429	458,106	86,344	222,619	168,191	38,538	61,503
Sub-Total	**4,448,079**	**4,411,667**	**5,108,850**	**3,140,744**	**3,788,368**	**3,985,848**	**4,543,867**

Table 2 - 47: Capital Projects Table – 2015 – 2021 Cont'd

Projects	2015	2016	2017	2018	2019	2020 Bridge Year	2021 Test Year
Reporting Basis	**MIFRS**	**MIFRS**	**MIFRS**	**MIFRS**	**MIFRS**	**MIFRS**	**MIFRS**
System Service:							
Transformer Purchases - Various Jobs	31,617	15,423	37,818	94,559	19,220	25,279	40,816
Sub-Transmission Switching Improvements	-	363	131,146	113,910	-	-	-
Fraser Street - New Sub-Transmission Line	-	-	53,162	43,393	-	-	-
WIMAX (SCADA Wireless Radio Replacement)	114,455	8,116	42,508	27,646	-	-	-
MS23 - Community Energy Park	-	-	-	1,307,985	-	-	-
18F3 Voltage Conversion	-	94	55,828	(376)	32,712	-	-
Minor Betterment Projects	-	-	-	-	-	54,016	51,219
Meters Installs and Upgrades	251,727	261,721	192,817	92,327	105,655	142,738	130,134
Misc. Projects <$75k on Individual Project Basis	156,321	56,475	167,337	159,202	115,804	184,517	65,979
Sub-Total	**554,120**	**342,191**	**680,617**	**1,838,646**	**273,391**	**406,550**	**288,148**
System Access:							
Transformer Purchases - Various Jobs	53,052	29,552	43,435	64,875	126,677	37,817	61,061
Booth Road - MS22 Egress	90,264	-	-	-	-	-	-
Gordon Dr Subdivision	101,468	-	-	-	-	-	-
Minor Betterment Projects	183,635	211,159	315,714	63,115	167,322	223,679	212,096
Primary Services Projects							
Pinewood Park Dr	-	-	-	-	85,777	-	-
McIntyre St West	-	-	-	-	134,582	-	-
Primary Services Projects - General	-	-	-	-	-	203,532	198,457
Secondary Services	311,613	262,233	337,984	259,093	309,997	284,691	296,183
Subdivisions	56,423	40,094	3,846	50,745	166,214	111,006	83,757
Road Relocations Projects							
Metcalfe St	-	-	-	-	98,161	-	-
Cassells St	-	-	-	-	233,173	-	-
Community Energy Park - General Connection	-	-	-	537,900	51,313	-	-
Misc. Projects <$75k on Individual Project Basis	169,635	181,853	76,584	330,489	383,490	105,113	99,378
Sub-Total	**966,088**	**724,891**	**777,563**	**1,306,217**	**1,756,707**	**965,838**	**950,932**
General Plant							
Parking Lot upgrades	117,767	361,938	-	-	-	-	-
Server - Cisco	-	-	-	-	174,074	-	-
Mezzanine Renovation	-	-	-	-	-	200,000	-
DR Environment	-	-	-	-	-	171,000	-
Rear Yard Cover	-	-	-	-	-	-	136,947
General Building Work (asphalt, windows, masonry, doors, etc.)	-	-	-	-	-	-	130,300
Customer Portal	-	-	-	-	-	-	75,000
Building & General Office Upgrades, Including Furniture	36,877	92,775	27,589	48,322	19,175	149,784	26,766
Fleet Replacement - Bucket Trucks, Radial Boom Devices & Trailer	355,821	-	402,611	-	324,244	109,857	333,733
Fleet Replacement - Small Vehicles	108,001	283,707	-	79,769	101,855	89,396	-
Servers, PC, Other Hardware	15,036	16,100	98,354	83,531	59,480	97,150	8,200
Software	33,971	32,135	24,273	22,379	45,192	27,200	158,150
Work Equipment	46,133	36,950	54,670	95,728	46,675	185,564	40,000
Sub-Total	713,604	823,605	607,497	329,730	770,694	1,029,951	909,096
Contributed Capital from Customers	**(703,198)**	**(352,323)**	**(728,037)**	**(558,617)**	**(483,042)**	**(560,311)**	**(540,176)**
Total	**5,978,693**	**5,950,031**	**6,446,490**	**6,056,720**	**6,106,117**	**5,827,877**	**6,151,867**
Less Renewable Generation Facility Assets and Other Non-Rate-Regulated Utility Assets *(input as negative)*							
Total	**5,978,693**	**5,950,031**	**6,446,490**	**6,056,720**	**6,106,117**	**5,827,877**	**6,151,867**

(d) TREATMENT OF PROJECTS

(i) Life Cycle Greater than One Year

NBHDL's accounting policy is to include projects in fixed assets when they are completed. Capital projects which are not yet completed are included in WIP. Capital projects with a life cycle greater than one year will be carried over from one year to the next in WIP. Once completed, expenditures are removed from WIP and capitalized to fixed assets at which point they begin depreciating.

(ii) Treatment of Cost of Funds

NBHDL's accounting policy is to expense borrowing costs. It does not capitalize interest on capital projects.

(e) COMPONENTS OF OTHER CAPITAL EXPENDITURES

NBHDL does not have other capital expenditures, such as non-distribution activities, for which it needs to provide components.

2.2.4.3 CAPITALIZATION POLICY

(a) CAPITALIZATION POLICY OVERVIEW

NBHDLs current capitalization policies and principles are based on IFRS, and guidelines set out by the Ontario Energy Board, where applicable. NBHDL converted to IFRS January 1, 2015 and as such the capitalization policy is in effect for all of the historical and forecast years in this application. There have been no changes to the capitalization policy since NBHDL's last COS.

PP&E include expenditures that are directly attributable to the acquisition of the asset. The cost of self-constructed assets includes the cost of materials, direct labour and other costs directly attributable to bringing the asset to a working condition for its intended use.

Assets with a cost in excess of $500 expected to provide future economic benefit greater than one year will be capitalized. Expenditures that create a physical betterment or improvement of an asset will be capitalized.

(i) Guidelines for Capitalization

Capital Assets include property, plant, and equipment that are held for use in the production or supply of goods and services and provide a benefit lasting beyond one year. Capital expenditures also include the improvement or "betterment" of existing assets. Intangible assets are also considered capital assets and are defined as assets that lack physical substance. They include goodwill, patents, copyrights and computer software.

(ii) **Betterment -** a "betterment" is a cost which enhances the service potential of a capital asset and/or increases its value, and is therefore capitalized. A betterment includes expenditures which increase the capacity of the asset, lower associated operating costs of the asset, improve the quality of output or extend the asset's useful life. A betterment does not include general maintenance-related actions that seek to sustain an asset's current value.

(iv) **Repairs** - a repair is a cost incurred to maintain the service potential of a capital asset. Expenditures for repairs are expensed to the current operating period. Expenditures for repairs and/or maintenance designed to maintain an asset in its original state are not capital expenditures and are charged to an operating account.

(v) Capitalization by Component

When parts or components of an item of property, plant and equipment have different useful lives, they are accounted for as individual items (major components) of property, plant and equipment. Component costs must be significant in relation to the total cost of the item and depreciated separately over the component's useful life. Components are those which: a) are significant in relation to the total cost of the item and b) have different depreciation methods or useful life.

Components with similar useful lives and depreciation methods are grouped in determining the depreciation charge. Parts of the item that are not individually significant (remainder of the items) are combined and categorized as a single component best suited for the sum of the parts.

(vi) Depreciation

Depreciation is recognized on a straight-line basis over the estimated useful life of each significant identifiable component of an item of property, plant and equipment. Land is not depreciated. Construction in progress assets are not depreciated until the project is complete and in service.

NBHDL has used the Typical Useful Life provided in the Kinectrics Report as its basis for assigning the estimated service life to assets. Depreciation of an asset begins in the year when it is available for use, i.e. when it is in the location and condition necessary for it to be capable of operating in the manner intended. For rate setting purposes, in the first year of service, depreciation is calculated using the ½ year rule. Depreciation of an asset ceases when the asset is retired from active use, sold or is fully depreciated.

(vii) Overhead Policy

NBHDL's overhead policy has been reviewed by both its external auditors and the consulting services branch of the firm's Risk Advisory Services and has been deemed IFRS compliant. There have been no changes to the policy since NBHDL's last COS.

Included in NBHDL's labour costs are those costs that are generally considered labour 'burden'. NBHDL's burden costs include vacation, statutory holidays, sick time, CPP, EI, OMERS contributions, health care and other employee benefits. Burden rates are forecasted by individual employee and are set-up in NBHDL's payroll system accordingly. Through the timesheet process, employees track their hours by work order which designates whether the work is expensed or capitalized. Labour costs, including burden, are then directly charged to specific project by employee based on the work executed in the field.

The overhead policy addresses what NBHDL considers as five service departments; the Stores department (which includes facility costs, inventory and purchasing costs, and fleet costs), the Engineering department, and the Operations Administration department. Costs of these departments are allocated to the departments that are served – Lines, Substations, Metering, and Customer Service – and directly impact construction activities.

(viii) **Facility** - the costs to operate the building are charged out to the various functional departments based on the square footage of each department. Costs are allocated to Administration, IT, HR, Finance, Engineering and Operations Administration.

(ix) **Inventory and Purchasing** – the costs of this function are related to the labour associated with employee managing the warehouse and all inventory processing. As part of the budget process, NBHDL determines the material that is forecasted to flow through the warehouse and a rate is determined as a % of total costs. Material anticipated to be issued out to O&M is based on the previous historical year and capital is based on individual project estimates that include inventory as well has a historical average for customer demand jobs. The inventory overhead is assigned directly to the materials signed out of the warehouse by

employees against specific work orders through the automated inventory and work order system.

(x) **Fleet Costs** - these costs include the costs associated with maintaining NBHDL's fleet of pick-up trucks, bucket trucks with aerial devices, and trailers. These costs include fuel costs, repairs, parts, insurance, depreciation and all other items of expense necessary to keep the fleet in service. A fleet rate is determined on an annual basis for each vehicle group by estimating the run time of each category of vehicle and allocating the costs accordingly. When a vehicle is used for a capital project, a fleet rate is charged based on the type of vehicle used multiplied by hourly usage of the vehicle. These costs are expensed or capitalized directly to the specific project through the timesheet process by work order.

(xi) **Engineering and Operations Administration** - the Engineering and Operations Administration departments follow a similar methodology for the calculation of overheads and the determination of what can be directly attributable to capital and therefore included in the capital costs of a project. There are two steps involved in the calculation of the overhead rate for each department, noting that in the determination of the overhead rate for Engineering, Operations Administration is considered a department supported by Engineering:

(1) Employees in both departments allocate their time directly to O&M and capital through the timesheet process by work order. Based on this forecast, all other costs in the departments are determined to be in support of capital or O&M work based on the actual allocation of labour.

(2) The labour costs for the departments that Engineering and Operations Administration support - Lines, Substations, Metering and Customer Service - are forecasted by capital and O&M. Capital labour hours are based on individual project estimates. This calculation forms the base of the hourly overhead rate as the overhead rate is expressed as a % of labour hours for the departments that are served. For example, if it is determined that there is $50,000 in Engineering costs that are related to the support of the capital program, and the forecast of direct capital labour for Operations Administration, Lines, Substations, and Metering is $740,000, the hourly Engineering overhead rate for capital would be 7.8%.

Once the overhead rates are determined, the costs are charged to the capital and O&M projects directly through the timesheet process by work order. Using the example above, for every labour dollar allocated to a capital or O&M project by an employee through the timesheet process, 7.8 cents for every dollar is also directly attributed to the specific project. For example, when a line crew is working on a specific job, the hours worked on the job are processed through payroll and the automated work order system then multiplies those hours by the overhead rate to attach the cost directly to the job.

(b) CHANGES TO CAPITALIZATION POLICY

NBHDL confirms that there have been no changes in respect to capitalization policies since the last cost of service application.

2.2.4.4 CAPITALIZATION OF OVERHEAD

(a) OVERVIEW

NBHDL's overhead policy has been reviewed by its external auditors and has been deemed IFRS compliant. There have been no changes to the overhead policy since NBHDL's last COS.

Table 2-48 provided below, which is consistent with Board Appendix 2-D, has been completed to show NBHDL's OM&A costs prior to the allocation of costs for the Engineering and Operations Administration departments, fleet and inventory (Stores) to capital construction projects.

(b) BURDEN RATES

Table 2-49 below summarizes the historical and forecasted overhead rates related to the capitalization of costs on self-constructed assets. The rates are changed and updated periodically to reflect actual costs or changed circumstances.

NBHDL has four types of overhead costs that are capitalized; (i) Engineering; (ii) Operations Administration; (iii) Fleet; and (iv) Stores. NBHDL also capitalizes payroll benefits for applicable employees in the Engineering and Operations department (consisting of Operations Administration, Lines, Substations, and Metering), however, these costs are directly allocated to capital through a burden rate in the payroll system. NBHDL has refined its burden calculation by budgeting payroll benefits by individual employee and attaching an individual burden rate by employee within the payroll system.

As described previously, NBHDL does not allocate any indirect costs associated with Finance, Human Resources, Information Systems Technology, or the Administration department.

Table 2 - 48: Summary of Capitalized Overhead

Appendix 2-D
Overhead Expense

Applicants are to provide a breakdown of OM&A before capitalization in the below table. OM&A before capitalization may be broken down by cost center, program, drivers or another format best suited to focus on capitalized vs. uncapitalized OM&A.

OM&A Before Capitalization	2015 Historical Year	2016 Historical Year	2017 Historical Year	2018 Historical Year	2019 Historical Year	2020 Bridge Year	2021 Test Year
Administration	$ 1,375,466	$ 1,390,945	$ 1,518,521	$ 1,466,908	$ 1,468,999	$ 1,771,030	$ 1,914,528
Finance	$ 1,643,732	$ 1,773,511	$ 1,861,438	$ 1,765,996	$ 1,726,311	$ 1,813,628	$ 2,087,779
Human Resources	$ 401,608	$ 335,130	$ 390,226	$ 355,030	$ 425,210	$ 531,809	$ 618,202
Engineering	$ 442,691	$ 487,895	$ 481,888	$ 458,751	$ 521,282	$ 565,054	$ 599,257
Operations Administration	$ 404,419	$ 465,757	$ 365,904	$ 346,983	$ 438,727	$ 432,137	$ 587,515
Operations - Lines, Substations, Metering, Customer Service, Fleet, Stores	$ 2,387,669	$ 2,486,364	$ 2,322,083	$ 2,380,108	$ 2,601,432	$ 2,866,515	$ 3,305,973
Total OM&A Before Capitalization (B)	**$ 6,655,585**	**$ 6,939,602**	**$ 6,940,060**	**$ 6,773,776**	**$ 7,181,960**	**$ 7,980,173**	**$ 9,113,253**

Applicants are to provide a breakdown of capitalized OM&A in the below table. Capitalized OM&A may be broken down using the categories listed in the table below if possible. Otherwise, applicants are to provide its own break down of capitalized OM&A.

Capitalized / Recoverable OM&A	2015 Historical Year	2016 Historical Year	2017 Historical Year	2018 Historical Year	2019 Historical Year	2020 Bridge Year	2021 Test Year	Directly Attributable? (Yes/No)	Explanation for Change in Overhead Capitalized
Administration	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
Finance	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
Human Resources	$ -	$ -	$ -	$ -	$ -	$ -	$ -		
Engineering	$ 91,171	$ 61,378	$ 58,910	$ 49,374	$ 58,671	$ 66,550	$ 54,788	Y	Changes based on required labour to complete annual capital program
Operations Administration	$ 79,679	$ 114,687	$ 166,176	$ 199,459	$ 141,560	$ 156,646	$ 131,914	Y	Changes based on required labour to complete annual capital program
Stores Issues and Facility Costs	$ 94,404	$ 179,397	$ 99,227	$ 124,210	$ 106,672	$ 145,244	$ 192,074	Y	Changes based on required labour to complete annual capital program and changes in annual fleet costs
Fleet Costs	$ 177,121	$ 177,195	$ 184,653	$ 160,921	$ 186,176	$ 158,907	$ 168,539	Y	Changes based on material requirements of capital projects each year
Total Capitalized OM&A (A)	**$ 442,375**	**$ 532,657**	**$ 508,966**	**$ 533,964**	**$ 493,079**	**$ 527,347**	**$ 547,315**		
% of Capitalized OM&A (=A/B)	**6.65%**	**7.68%**	**7.33%**	**7.88%**	**6.87%**	**6.61%**	**6.01%**		

Total Costs - OM&A	2015 Historical Year	2016 Historical Year	2017 Historical Year	2018 Historical Year	2019 Historical Year	2020 Bridge Year	2021 Test Year
Administration	$ 1,375,466	$ 1,390,945	$ 1,518,521	$ 1,466,908	$ 1,468,999	$ 1,771,030	$ 1,914,528
Finance	$ 1,643,732	$ 1,773,511	$ 1,861,438	$ 1,765,996	$ 1,726,311	$ 1,813,628	$ 2,087,779
Human Resources	$ 401,608	$ 335,130	$ 390,226	$ 355,030	$ 425,210	$ 531,809	$ 618,202
Engineering	$ 351,520	$ 426,517	$ 422,978	$ 409,377	$ 462,611	$ 498,504	$ 544,469
Operations Administration	$ 324,740	$ 351,070	$ 199,728	$ 147,524	$ 297,167	$ 275,491	$ 455,601
Operations - Lines, Substations, Metering, Customer Service, Fleet, Stores	$ 2,116,144	$ 2,129,772	$ 2,038,203	$ 2,094,977	$ 2,308,584	$ 2,562,364	$ 2,945,360
Total OM&A	**$ 6,213,210**	**$ 6,406,945**	**$ 6,431,094**	**$ 6,239,812**	**$ 6,688,882**	**$ 7,452,827**	**$ 8,565,938**

2.2.4.5 COSTS OF ELIGIBLE INVESTMENTS FOR THE CONNECTION OF QUALIFYING GENERATION FACILITIES

As noted in the Filing Requirements under section 2.2.2.7 "For any costs incurred to make investments that are eligible for rate protection as described in section 79.1 of the *Ontario Energy Board Act, 1998* (OEB Act) and O.Reg. 330/09 under the OEB Act, including any facilities forecast to enter service beyond the test year, the distributor may seek approval to recover the rate protection component of the costs."

NBHDL has not identified any material eligible investments for which rate protection is required. As such NBHDL has not completed Appendices 2-FA through 2-FC.

2.2.4.6 POLICY OPTIONS FOR THE FUNDING OF CAPITAL

NBHDL has not used either the ICM or ACM for incremental capital investments.

2.2.4.7 ADDITION OF ICM ASSETS TO RATE BASE

NBHDL has not applied for approval of ICM Assets and therefore has no such assets added to its rate base.

2.2.4.8 SERVICE QUALITY AND RELIABILITY PERFORMANCE

NBHDL follows the Board's Reporting and Record Keeping Requirements Guideline to report its service quality indicators annually. In accordance with the Filing Requirements, Table 2-49 is provided below and is consistent with Board Appendix 2-G, Service Quality Indicators. The table provides the performance measurements for the last five (5) historical years – 2015 through 2019.

NBHDL's performance results over the 2015 to 2019 period meet or exceed the Board's approved standards. NBHDL's performance is within the range of acceptable performance over the previous five years and no corrective action is required.

Table 2 - 49: Service Quality and Reliability Performance

Appendix 2-G
Service Reliability and Quality Indicators
2015-2019

Service Reliability

Index	Including outages caused by loss of supply					Excluding outages caused by loss of supply					Excluding Major Event Days				
	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019	2015	2016	2017	2018	2019
SAIDI	1.100	2.370	1.330	2.200	1.750	1.100	2.290	1.110	1.950	1.160	1.100	2.290	1.110	1.950	1.160
SAIFI	0.880	2.010	1.120	1.570	3.850	0.880	1.980	0.940	1.400	1.350	0.880	1.980	0.940	1.400	1.350

5 Year Historical Average

SAIDI		1.750		1.522		1.522
SAIFI		1.886		1.310		1.310

SAIDI = System Average Interruption Duration Index
SAIFI = System Average Interruption Frequency Index

Service Quality

Indicator	OEB Minimum	2015	2016	2017	2018	2019
Low Voltage Connections	90.0%	100.0%	100.0%	100.0%	100.0%	100.0%
High Voltage Connections	90.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Telephone Accessibility	65.0%	82.1%	83.6%	86.6%	91.1%	95.7%
Appointments Met	90.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Written Response to Enquires	80.0%	100.0%	100.0%	99.9%	100.0%	100.0%
Emergency Urban Response	80.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Emergency Rural Response	80.0%	100.0%	100.0%	100.0%	NA	NA
Telephone Call Abandon Rate	10.0%	8.0%	6.6%	6.1%	4.9%	5.6%
Appointment Scheduling	90.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Rescheduling a Missed Appointment	100.0%	NA	NA	100.0%	NA	NA
Reconnection Performance Standard	85.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Step 1: **2021 Forecasted Commodity Prices**

Forecasted Commodity Prices	Table 1: Average RPP Supply Cost Summary*	**non-RPP**	**RPP**
HOEP ($/MWh)	Load-Weighted Price for RPP Consumers	$20.87	$20.87
Global Adjustment ($/MWh)	Impact of the Global Adjustment	$109.47	$109.47
Adjustments ($/MWh)			$3.24
TOTAL ($/MWh)	Average Supply Cost for RPP Consumers		**$133.58**

Step 2: **Commodity Expense**

(volumes for the bridge and test year are loss adjusted)

Commodity — **2021 Test Year**

Customer		**Revenue**	**Expense**							
Class Name	UoM	USA #	USA #	Class A Non-RPP Volume**		Class B Non-RPP Volume**	Class B RPP Volume**	Average HOEP	Average RPP Rate	Amount
Residential	kWh	4006	4705			10,635,396	198,904,757	$ 0.02087	$ 0.13358	$26,791,658
GS<50	kWh	4010	4705			11,285,165	70,820,760	$ 0.02087	$ 0.13358	$9,695,759
GS>50	kWh	4035	4705	29,897,744		154,993,697	16,330,088	$ 0.02087	$ 0.13358	$6,040,058
GS>3000<4999	kWh	4010	4705	15,016,547				$ 0.02087	$ 0.13358	$313,395
Sent	kWh	4025	4705			8,988	113,003	$ 0.02087	$ 0.13358	$15,283
Street Light	kWh	4025	4705			2,115,470		$ 0.02087	$ 0.13358	$44,150
UMSL	kWh	4025	4705				41,024	$ 0.02087	$ 0.13358	$5,480
	kWh	4025	4705					$ 0.02087	$ 0.13358	$0
	kWh	4025	4705					$ 0.02087	$ 0.13358	$0
TOTAL				**44,914,291**		**179,038,716**	**286,209,633**			**$42,905,782**

Class A - non-RPP Global Adjustment — **2021**

Customer		**Revenue**	**Expense**	**Amount**	**kWh Volume**	**Hist. Avg GA/kWh *** **	**Amount**
GS>50		4035	4707	2,718,374.03	29,897,744.00	0.09092	$2,718,374
GS>3000<4999		4010	4707	973,807.62	15,016,547.00	0.06485	$973,808
		4010	4707				
				3,692,182	44,914,291		**$3,692,182**

Class B - non-RPP Global Adjustment — **2021**

Customer		**Revenue**	**Expense**							Amount
Class Name	UoM	USA #	USA #			Class B Non-RPP Volume			GA Rate/kWh	
Residential	kWh	4006	4707			10,635,396			$ 0.10947	$1,164,257
GS<50	kWh	4010	4707			11,285,165			$ 0.10947	$1,235,387
GS>50	kWh	4035	4707			154,993,697			$ 0.10947	$16,967,160
GS>3000<4999	kWh	4010	4707			0			$ 0.10947	$0
Sent	kWh	4025	4707			8,988			$ 0.10947	$984
Street Light	kWh	4025	4707			2,115,470			$ 0.10947	$231,580
UMSL	kWh	4025	4707							$0
	kWh	4025	4707							$0
Total Volume						**179,038,716**				
TOTAL										**$19,599,368**

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		2021 Test Year	RPP		2021 Test Year	non-RPP		Total
Electricity Commodity	**Units**	Volume	Rate	$	Volume	Rate	$	$
Class per Load Forecast				-				
Residential	kWh	198,904,757		26,569,697	10,635,396		221,961	
GS<50	kWh	70,820,760		9,460,237	11,285,165		235,521	
GS>50	kWh*	16,330,088		2,181,373	184,891,441		3,858,684	
GS>3000<4999	kWh*	0		-	15,016,547		313,395	
Sent	kWh	113,003		15,095	8,988		188	
Street Light	kWh	0		-	2,115,470		44,150	
USML	kWh	41,024		5,480	0		-	
SUB-TOTAL		286,209,633		38,231,883	223,953,007		4,673,899	$ 42,905,782

Global Adjustment non-RPP	**Units**							
Class per Load Forecast		Volume	Rate	$	Volume	Rate	$	Total
Residential				0			1,164,257	
GS<50				0			1,235,387	
GS>50				0			19,685,534	
GS>3000<4999				0			973,808	
Sent				0			984	
Street Light				0			231,580	
USML				0			-	
SUB-TOTAL		0		0			23,291,550	$ 23,291,550

Transmission - Network								
Class per Load Forecast		Volume	Rate	$	Volume	Rate	$	Total
Residential	kWh	198,904,757	0.0072	1,432,114	10,635,396	0.0072	76,575	
GS<50	kWh	70,820,760	0.0069	488,663	11,285,165	0.0069	77,868	
GS>50	kW	41,729	2.7533	114,892	472,461	2.7533	1,300,828	
GS>3000<4999	kW	-	2.9206	-	27,098	2.9206	79,143	
Sent	kW	276	2.0868	577	22	2.0868	46	
Street Light	kW	-	2.0766	-	5,690	2.0766	11,816	
USML	kWh	41,024	0.0069	283	-		-	
SUB-TOTAL				2,036,530			1,546,276	3,582,806

Transmission - Connection								
Class per Load Forecast		Volume	Rate	$	Volume	Rate	$	Total
Residential	kWh	198,904,757	0.0069	1,372,443	10,635,396	0.0069	73,384	
GS<50	kWh	70,820,760	0.0061	432,007	11,285,165	0.0061	68,840	
GS>50	kW	41,729	2.4178	100,892	472,461	2.4178	1,142,317	
GS>3000<4999	kW	-	2.6719	-	27,098	2.6719	72,404	
Sent	kW	276	1.9080	527	22	1.9080	42	
Street Light	kW	-	1.8689	-	5,690	1.8689	10,635	
USML	kWh	41,024	0.0061	250	-	0.0061	-	
SUB-TOTAL				1,906,119			1,367,621	3,273,741

Wholesale Market Service								
Class per Load Forecast		Volume	Rate	$	Volume	Rate	$	Total
Residential	kWh	198,904,757	0.0030	596,714	10,635,396	0.0030	31,906	
GS<50	kWh	70,820,760	0.0030	212,462	11,285,165	0.0030	33,855	
GS>50	kWh	16,330,088	0.0030	48,990	184,891,441	0.0030	554,674	
GS>3000<4999	kWh	-	0.0030	-	15,016,547	0.0030	45,050	
Sent	kWh	113,003	0.0030	339	8,988	0.0030	27	
Street Light	kWh	-	0.0030	-	2,115,470	0.0030	6,346	
USML	kWh	41,024	0.0030	123	-	0.0030	-	
SUB-TOTAL				858,629			671,859	1,530,488

CBR								
Class per Load Forecast		Volume	Rate	$	Volume	Rate	$	Total
Residential	kWh	198,904,757	0.0004	79,562	10,635,396	0.0004	4,254	
GS<50	kWh	70,820,760	0.0004	28,328	11,285,165	0.0004	4,514	
GS>50	kWh	16,330,088	0.0004	6,532	154,993,697	0.0004	61,997	
GS>3000<4999	kWh	-	0.0004	-	-	0.0004	-	
Sent	kWh	113,003	0.0004	45	8,988	0.0004	4	
Street Light	kWh	-	0.0004	-	2,115,470	0.0004	846	
USML	kWh	41,024	0.0004	16	-	0.0004	-	
SUB-TOTAL				114,484			71,615	186,099

Class A CBR								
Class per Load Forecast		Volume	Rate	$	Volume	Rate	$	Total

Residential	kWh			-			-	
GS<50	kWh			-			-	
GS>50	kWh*			-	29,897,744	0.00031	9,130	
GS>3000<4999	kWh*			-	15,016,547	0.00019	2,923	
Sent				-			-	
Street Light				-			-	
USML				-			-	
SUB-TOTAL				-			12,054	12,054
RRRP								
Class per Load Forecast		Volume	Rate	$	Volume	Rate	$	Total
Residential	kWh	198,904,757	0.0005	99,452	10,635,396	0.0005	5,318	
GS<50	kWh	70,820,760	0.0005	35,410	11,285,165	0.0005	5,643	
GS>50	kWh	16,330,088	0.0005	8,165	184,891,441	0.0005	92,446	
GS>3000<4999	kWh	-	0.0005	-	15,016,547	0.0005	7,508	
Sent	kWh	113,003	0.0005	57	8,988	0.0005	4	
Street Light	kWh	-	0.0005	-	2,115,470	0.0005	1,058	
USML	kWh	41,024	0.0005	21	-	0.0005	-	
SUB-TOTAL				143,105			111,977	255,081
Low Voltage - No TLF adjustmen								
Class per Load Forecast		Volume	Rate	$	Volume	Rate	$	Total
Residential	kWh**	191,467,390	0.00015	28374.32092	10,237,722	0.00015	1517.16904	
GS<50	kWh**	68,172,659	0.00013	8931.44309	10,863,195	0.00013	1423.209925	
GS>50	kW	41,729	0.05193	2166.905881	472,461	0.05193	24533.99815	
GS>3000<4999	kW	-	0.05739	0	27,098	0.05739	1555.045765	
Sent	kW	276	0.04014	11.09233749	22	0.04014	0.882246154	
Street Light	kW	-	0.04098	0	5,690	0.04098	233.1812236	
USML	kWh**	39,490	0.00013	5.173628524		0.00013	0	
SUB-TOTAL		259,721,543		39,489			29,263	68,752
Smart Meter Entity Charge								
Class per Load Forecast		Customers	Rate	$	Customers	Rate	$	Total
Residential		20,268	0.57	138,635	1,084	0.57	7,413	
GS<50		2,285	0.57	15,630	364	0.57	2,489	
Seasonal				-				
SUB-TOTAL				154,265			9,902	164,167
SUB- TOTAL				43,484,503			31,786,017	75,270,520
ORECA CREDIT	21.20%			(9,218,715)			0	(9,218,715)
TOTAL				**34,265,789**			**31,786,017**	**66,051,805**

***The ORECA Credit of 21.2% will only apply to RPP proportion of the listed components. Impacts on distribution charges are excluded for the purpose of calculating the cost of power.

**** Class A CBR: use the average CBR per kWh, similar to how the Class A GA cost is calculated

2021 Test Year - Cop		
4705 -Power Purchased	$	42,905,782
4707- Global Adjustment	$	23,291,550
4708-Charges-WMS	$	1,983,722
4714-Charges-NW	$	3,582,806
4716-Charges-CN	$	3,273,741
4750-Charges-LV	$	68,752
4751-IESO SME	$	164,167
Misc A/R or A/P	$	(9,218,715)
TOTAL	**$**	**66,051,805**

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APPENDIX 2-A: DISTRIBUTION SYSTEM PLAN

Distribution System Plan

Developed in accordance with:

"Ontario Energy Board – Filing Requirements for Electricity Transmission and Distribution Applications"

Chapter 5

Consolidated System Plan Filing Requirements

Historical Period:

2015 - 2020

Forecast Period:

2021 - 2025

22 December 2020

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GLOSSARY

AIP	Asset Investment Planning
AM	Asset Management
AMI	Advanced Metering Infrastructure
CDM	Continuous Diagnostics and Mitigation
CHI	Customer Hours Interrupted
CI	Customers Interrupted
CSA	Canadian Standard Association
DART	Development and Review Team
DGA	Dissolved Gas Analysis
DSC	Distribution System Code
DSP	Distribution System Plan
EDO	Economic Development Office
ESA	Electrical Safety Authority
FIT	Feed-In-Tariff
GIS	Geographic Information System
GUP	Good Utility Practices
HONI	Hydro One Networks Inc.
IESO	Independent Electricity System Operator
IR	Infrared
IT	Information Technology
kW	Kilowatt
LDC	Local Distribution Company
LOS	Loss of Supply
MED	Major Event Day
METSCO	METSCO Energy Solutions Inc.
MINBET	Minor Betterment Projects
NBHDL	North Bay Hydro Distribution Limited
O&M	Operations and Maintenance
OEB	Ontario Energy Board

OM&A	Operating, Maintenance and Administration
OMS	Outage Management System
REG	Renewable Energy Generation
RIP	Regional Infrastructure Plan
RRF	Renewed Regulatory Framework
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SCADA	Supervisory Control and Data Acquisition
the Application	Cost of Service Application
the City	The City of North Bay
the Filing Requirements	Chapter 5 Consolidated Distribution System Plan Filing Requirements
TOU	Time-Of-Use
TS	Transmission Stations
WPF	Worst Performing Feeders

1 INTRODUCTION

North Bay Hydro Distribution Limited ("NBHDL") has prepared this Distribution System Plan ("DSP") in accordance with the Ontario Energy Board's ("OEB's") *Chapter 5 Consolidated Distribution System Plan Filing Requirements* dated 14 May 2020 ("the Filing Requirements") as part of its 2020 Cost of Service Application ("the Application"). NBHDL retained METSCO Energy Solutions Inc. ("METSCO") to advise on and assist with the preparation of this DSP.

1.1 OBJECTIVES & SCOPE OF WORK

The NBHDL DSP is a stand-alone document and is filed in support of NBHDL's Application. NBHDL's DSP describes and substantiates NBHDL's Asset Management ("AM") processes and capital expenditure plan for the 2021-2025 period. The DSP documents the practices, policies and processes that are in place to ensure that investment decisions support NBHDL's desired outcomes in a cost-effective manner and provide value to customers.

NBHDL's DSP is formulated to support the achievement of the four key OEB established Renewed Regulatory Framework ("RRF") performance outcomes:

1. ***Customer Focus:*** *services are provided in a manner that responds to identified customer preferences.*
2. ***Operational Effectiveness:*** *continuous improvement in productivity and cost performance is achieved, and utilities deliver on system reliability and quality objectives.*
3. ***Public Policy Responsiveness:*** *utilities deliver on obligations mandated by government (e.g. in legislation and regulatory requirements imposed further to Ministerial directives to the Board).*
4. ***Financial Performance:*** *financial viability is maintained, and savings from operational effectiveness are sustainable.*

1.2 OUTLINE OF REPORT

This is NBHDL's second DSP prepared in accordance with OEB's Filing Requirements. This DSP describes how NBHDL has developed, managed, and maintained its distribution system equipment to provide a safe, secure, reliable, efficient, and cost-effective service to its customers. The DSP identifies major initiatives and projects to be undertaken over the filed planning period. The DSP spans eleven years, with the historical period covering 2015-2020 (2020 being the Bridge Year) and the forecast period of 2021-2025 (2021 being the Test Year).

The report contains four sections, including this introductory Section 1. Section 2 provides a high-level overview of the DSP, including coordinated planning with third parties and performance measurement for continuous improvement. Section 3 provides an overview of NBHDL's AM practices. Section 4 provides a summary of NBHDL's capital expenditure plan, including an overview of the capital expenditure planning process, an assessment of the system capability for Renewable Energy Generation ("REG"), and justification of material projects (above the materiality threshold of $75,000).

NBHDL's DSP is focused on providing the most viable, value-added operating environment possible for its consumers over the long term, with a short-term focus on the continuation of reliable and safe service. NBHDL intends to execute its capital expenditure plan in full within the timeframe presented. The projects comprising the plan have been prioritized within the context of an overall investment strategy.

Where relevant, the DSP is organized using the same section headings indicated in the OEB's Filing Requirements and addresses the information outlined in each section. Other relevant information is included in separately identified sections and is intended to complement the prescribed data.

1.3 DESCRIPTION OF THE UTILITY COMPANY

NBHDL is an electricity distributor licensed by the OEB. In accordance with its Distribution License ED-2003-0024, NBHDL provides electricity distribution services in the City of North Bay ("the City"), serving over 24,197 customers.

NBHDL is incorporated under the Ontario Business Corporations Act. NBHDL is a subsidiary of the City of North Bay Holdings Limited solely owned by the City of North Bay.

NBHDL receives power from Hydro One Networks Inc. ("HONI") and delivers electricity to its customers. NBHDL is responsible for maintaining distribution and infrastructure assets deployed over 270 square kilometres of rural area and 49 square kilometres of urban area within the North Bay service areas, as shown in Figure 1-1.

Figure 1-1: Map of Distribution Service Territory



1.3.1 Corporate Mission, Vision, and Core Values Statement

Mission

NBHDL is committed to distributing electricity to its customers in a safe, reliable and efficient manner that provides good value for money while being responsive to customer and community needs and contributing to provincial and local public policy objectives.

Vision

To be recognized as a community leader creating exceptional value for customers and stakeholders, and committed to innovation, efficiency, and prosperity.

Core Values

- ***CV1 - Providing Exceptional Value to Customers*** – First and foremost, we ensure the safe, reliable, and cost-effective distribution and delivery of electricity to the end user. Second, we strive to provide an environment rich in timely, up-to-date information to aid the customer in the management of their electrical needs, through our website, social media platforms, over the telephone, and/or in person. Third, we engage with the customer to learn and identify their needs, preferences, and expectations and then use that information to help shape the customer service experience, in a process founded in continuous improvement, responsiveness and transparency.

- ***CV2 - Ensuring Safety of the Worker and Members of the Community*** - Safety is of utmost importance at NBHDL, of both the worker and the community. NBHDL continues to achieve an excellent workplace safety record, but safety is much more than a record. Safety is a culture, an aspect of business that must be worked on every day in order for it to be effective. Our commitment lies in ensuring every worker is able to return home at the end of each work day, and every member of the community is able to enjoy the beauty of North Bay without risk from the operation of our distribution system. This is achieved by a strong commitment to inspection, accountability, transparency, compliance, reporting, continuous improvement and most importantly the philosophy that safety comes before everything else.

- ***CV3 - Maintaining Distribution System Reliability and Quality*** – Through sound asset management principles and the execution of preventative and planned maintenance programs NBHDL is committed to maintaining distribution system reliability and quality to meet or outperform established targets. The pride of the organization is rooted in this value, and therefore it is second nature in everything we do. It is extremely important that we deliver a positive experience to the customer and the community, and system reliability and quality is the backbone in doing so.

- ***CV4 - Continuously Improving Efficiency and Productivity Performance to Provide Better Value-for-Money*** – Progress is created from the desire and commitment to continuously improve while pursuing the most effective and productive methods to achieve goals. NBHDL strives for this in every aspect of the business, and as a community steward and leader owes it to our customers and shareholder to do so in turn providing rate stability, affordability and business prosperity.

- ***CV5 - Actively Supporting Provincial and Local Public Policies and Objectives*** – The best path forward involves interaction, involvement and participation with the regulator and respective governing bodies, provincial and municipal. When the goals of all parties are aligned the greatest outcomes are achieved for the end user and therefore NBHDL takes great pride in implementing, supporting and offering provincial and local public policies. To complement this NBHDL seeks out participation on local committees and OEB working groups, and liaises with provincial agencies to help shape policies and objective as they are being created to maximize the benefits and aid in the delivery to the end user.

- ***CV6 – Instilling Adaptability, Flexibility, and Responsiveness to Ensure Longstanding Prosperity*** – NBHDL has officially served the City of North Bay for over 80 years, and in

order to continue for another 80 years the business must be flexible, nimble, open to new ways, and enable technology and innovation while adapting to the evolving needs and preferences of the customer, community and broader sector. Important to this value is the continued investment in a talented and engaged workforce, as the people make, move and steer the ship.

1.3.2 Customers Served

In 2019, NBHDL served 24,199 electricity distribution customers across its service area. North Bay is a vibrant city comprising of approximately 51,553 residents. The City has both urban and rural settings situated between Lake Nipissing and Trout Lake.

The table below illustrates the minor changes in NBHDL's customer base over the historical period, which includes residential, general service less than 50 kW, and general service greater or equal to 50 kW. Distribution system investments to date have focused on sustaining the existing distribution system infrastructure with a minimal cost impact to customers and servicing the distribution system to meet customer needs.

Table 1-1: NBHDL's 2015-2019 actual customer base

Annual Year	Residential	General Service <50 kW	General Service ≥50kW	Large Use > 5MW	Total
2015 Actual	21,122	2,646	255	0	24,023
2016 Actual	21,173	2,659	254	0	24,086
2017 Actual	21,192	2,653	262	0	24,107
2018 Actual	21,229	2,654	259	0	24,142
2019 Actual	21,280	2,653	264	0	24,197

1.3.3 System Demand and Efficiency

Table 1-2 shows the annual peak demand in kilowatt for NBHDL's distribution system.

Table 1-2: Peak system demand statistics

Annual Year	*Winter Peak (kW)*	*Summer Peak (kW)*	*Average Peak (kW)*
2015 Actual	106,743	82,078	80,901
2016 Actual	93,764	81,789	79,288
2017 Actual	93,113	76,815	76,442
2018 Actual	97,822	84,551	79,423
2019 Actual	99,886	80,442	78,314

NBHDL experiences its peak demand mostly during winter months. Peak data shown includes the net effect of embedded loads and generators. Variances in seasonal peaks are attributable to annual changes in winter weather conditions and loading impacts associated with the number of heating degree days. Table 1-3 indicates the efficiency of the kilowatt-hour purchased by NBHDL.

Table 1-3: Efficiency of kWh purchased by NBHDL

Annual kWh Purchased	Total kWh Delivered (excluding losses)	Total Distribution Losses (kWh)	Total kWh Purchased	Losses as % of Purchased
2015 Actual	516,728,999	21,594,197	538,323,196	4.0%
2016 Actual	488,765,497	20,222,127	508,987,624	4.0%
2017 Actual	482,398,546	18,299,793	500,698,339	3.7%
2018 Actual	496,980,971	17,908,594	514,889,565	3.5%
2019 Actual	495,761,810	18,386,013	514,147,824	3.6%

1.4 Capital Categories & Drivers

The Filing Requirements outline four categories of investments into which projects and programs must be grouped. The drivers for each investment category align with those listed in the Filing Requirements. For reporting purposes, a project or program involving two or more drivers associated with different categories is included in the category corresponding to the trigger driver. However, all drivers of a given project or activity were considered in the analysis of capital investment options and are further described in Section 4 of the DSP.

System Access

These investments are modifications to the distribution system NBHDL is obligated to perform to provide a customer (including generator customers) or group of customers with access to electricity services via NBHDL's distribution system. This investment group includes asset relocations requested from the City.

System Renewal

These investments involve replacing and/or refurbishing system assets to extend the original service life of the assets and thereby maintain the ability of NBHDL's distribution system to provide customers with electricity services.

System Service

These investments are modifications to NBHDL's distribution system to ensure the distribution system continues to meet NBHDL's operational objectives while addressing anticipated future customer electricity service requirements.

General Plant

These investments are modifications, replacements or additions to NBHDL's assets that are not part of the distribution system; including land and buildings; tools and equipment; rolling stock; and electronic devices and software used to support day to day business and operations activities.

2 DISTRIBUTION SYSTEM PLAN (5.2)

Section 2.1 provides an overview of the DSP. Section 2.2 summarizes coordinated planning activities with third parties. Section 2.3 covers the performance measurement approach to continuously improve AM and capital expenditure planning processes. Finally, Section 2.4 summarizes the realized efficiencies from smart meters.

2.1 DISTRIBUTION SYSTEM PLAN OVERVIEW (5.2.1)

This section provides the OEB and stakeholders with a high-level overview of the information filed in the DSP, including key elements of the DSP, an overview of customer preferences and expectations, sources of expected cost efficiencies, the period covered by the DSP, the vintage of the information, an indication of important changes to NBHDL's AM processes, aspects of the DSP that are contingent on the outcome of ongoing activities or future events, and minor changes to support grid modernization and climate change adaptation with the continuous mindset of providing a customer benefit.

2.1.1 Key Elements of the DSP (5.2.1a)

The electric distribution system is capital-intensive, and prudent capital investments and maintenance plans are essential to ensure the sustainability of the distribution network. NBHDL's DSP outlines the practices, policies and processes that are in place to ensure that decisions on capital investments and maintenance plans support NBHDL's desired outcomes in a cost-effective manner and provide value to the customer. Table 2-1 presents the capital expenditures by investment category for both the historical and forecast period.

Table 2-1: Historical and forecast capital expenditures

Category	Historical ($ '000)						Forecast ($ '000)				
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
System Access	966	725	778	1,306	1,757	966	951	969	987	1,006	1,025
System Renewal	4,448	4,412	5,109	3,141	3,788	3,986	4,544	4,008	4,057	4,154	4,221
System Service	554	342	681	1,839	273	407	288	294	299	305	311
General Plant	714	824	607	330	771	1,030	909	587	666	1,041	649
Gross Capital Expenses	**6,682**	**6,302**	**7,175**	**6,615**	**6,589**	**6,388**	**6,692**	**5,858**	**6,010**	**6,505**	**6,206**

NBHDL expects that the operational and service requirements driving its capital expenditures that comprise this DSP will generally remain consistent through the planning horizon. The projected expenditures for the forecast years reflect the following planning considerations:

- Typical spending needs of a distribution electric utility serving a low growth customer base.
- Focusing on planned capital sustainment investments required to replace the ageing assets found in NBHDL's distribution system.
- Minimal incremental investments in grid modernization to make the distribution system more adept in monitoring, locating, and responding appropriately to power outages and providing customers with timely information to enable consumption-related decision making. NBHDL will strategically invest in projects or initiatives that provide a positive cost-benefit for customers in order to modernize and improve the overall network while maintaining low electric bills. Our

customer survey identified a relative customer satisfaction to outage restoration times. See Section 2.1.8 for details.

Specific investment category spending requirements include:

- System Access spending driven by customer connection needs and third-party infrastructure needs requiring mandatory plant relocation.
- System Renewal investments required to replace the end of life assets and/or assets in deteriorating condition, including poles, wires, underground infrastructure and transformers.
- System Service spending is driven by both customer demand needs and overall system capacity, efficiency and operational improvements
- General Plant investments to meet the building, fleet, and information technology ("IT") needs.

NBHDL forecast period expenditures represent a consistent total budget envelope across all years balancing annual variations in anticipated non-discretionary System Access projects with changes in the other three investment categories, which the utility can usually pace and prioritize with a greater degree of control – thus facilitating the overall smoothness and predictability of rate changes over the planned timeline.

NBHDL's DSP is a product of multiple deliverables from initiatives, processes and studies involving several stakeholders, but not limited to the following:

- Customer engagements
- Asset Condition Assessment
- Regulatory obligations
- NBHDL's AM program – includes maintenance and end-of-life replacements
- City and region road projects requiring plant relocation and/or removal
- City, Regional and Provincial growth plans

The current DSP was developed with the objective of not only addressing the short-term and medium-term needs but also to ensure that the system has sufficient resilience and flexibility to achieve safe and reliable distribution in the long term based on effective financial planning.

2.1.1.1 *Key Challenge: Customer Connections and Service Requests*

Through the historical period, NBHDL experienced highly variable levels of customer connections and service requests. The proposed budget attempted to best allocate resources and funds with the available information, however, the nature of the available information is highly volatile and significant changes can occur between each month and year. This is apparent within the historical variance between NBHDL's proposed and actual expenditures. To accommodate the increasing count of connection requests, NBHDL had to reallocate resources and budget from its System Renewal budget as well as reprioritize the renewal projects for each year.

DSP IMPACT

As a result of the historical performance, the currently proposed System Access expenditures reflect an increase in expenditures to manage and secure resources required to deliver the expected performance. Although these service requests cannot be guaranteed, NBHDL prefers to be prepared to serve its customers promptly without needing to revise the budget and resources from other project categories. Should future decreases occur in any given year, NBHDL intends to reposition its resources into addressing other System Access projects and/or ageing infrastructure.

2.1.1.2 *Key Challenge: Infrastructure Development*

City of North Bay Road Projects

The City of North Bay has ongoing road rehabilitation and widening projects some of which may require the relocation of NBHDL plant.

DSP IMPACT

The current road project schedule has a limited impact on System Access spending in the DSP. Future changes to the road schedule, within the period of the DSP, may require reallocation of resources to System Access spending from other capital investments.

2.1.1.3 *Key Challenge: Aging Infrastructure*

NBHDL continues to identify a need to proactively manage the replacement of assets that are at or near the end of life. Assets severely deteriorated can begin to affect system service levels through an increase of outages on account of defective equipment. Replacement plans covering a multiyear period have been developed to begin managing and prioritizing assets found to be the end of life. Replacement plans ensure that planning objectives related to service levels, customer satisfaction and operating cost control are achieved.

DSP IMPACT

It is recognized that System Renewal investments are a greater degree of discretion. The timing for execution and annual program spending is a trade-off between the risk of outages due to equipment failure and maintaining current system service levels. NBHDL's objectives are to ensure that the future distribution system is managed appropriately to deliver power at the quality and service levels expected by its customers and to minimize the lifetime cost by balancing preventative maintenance, life-extending refurbishment, and end of life replacement. In this DSP, System Renewal spending is paced throughout the forecast period of the DSP to accommodate annual spending variances in the other investment categories to maintain overall budget envelope spending, while continuing the progress of replacing the end of life assets in a timely and cost-effective manner that NBHDL believes it can maintain current levels of reliability. In short, the system is projected to meet the customers' needs for quality and reliability of power at a reasonable and affordable cost to customers.

2.1.2 Overview Customer Preferences and Expectations (5.2.1b)

NBHDL performed a survey, in 2019, in 2 phases where it consulted customers to obtain information on their satisfaction of the service it receives from NBHDL and for suggestions for the future so that NBHDL can align its future planning with customer needs and expectations where feasible.

Overall, customers are satisfied with NBHDL and aside from issues with the cost of services, there are little to no additional concerns, with many of the respondents to the online survey citing no changes needed whatsoever. When a response is given outside of the cost of services, or no changes needed, the concerns are around hours of customer service availability, communication preferences, climate change concerns and hopes for more information regarding decreasing consumption. Additionally, respondents agree that the utility's standard of reliability is consistent with their expectations. In addition, respondents felt that NBHDL reacts well to power outages and are satisfied with the restoration efforts.

In summary, customer preferences are summarized in the following points:

- NBHDL could improve service by having '*better prices/lower rates'*. When presented with the opportunity to reduce costs through NBHDL's offering of incentives to encourage customers to go paperless, saving on supplies and postage, most customers agree with the notion. This has no impact on the DSP.
- Customers support priority planning for the next five years centred mainly on maintenance and upgrades of equipment, both in proactive measures and to outages and response times, as well as educating customers, and developing better technological systems and supports. NBHDL has considered this into their DSP.
- Customers support the priority of '*modernizing the electrical system – especially concerning net-metering and electric vehicles – to support the reduction of greenhouse gases*'. NBHDL has considered this into their DSP.
- Customers felt that reducing response time and the number of outages were important priorities for NBHDL to consider. When asked about the automation of the electrical grid, a measure that would improve reliability, customers responded positively. However, when understanding the payback period the customer preferences varied. NBHDL has considered this into their DSP.
- Respondents rated '*investing more in tree trimming to help reduce the number of outages*' as '*high*' or '*very high*' priority. NBHDL has considered this into their DSP.
- Customers would prefer to move overhead wires to underground over a long-term period but feel overhead infrastructure should be used if it is the most cost-effective option. NBHDL has considered this into their DSP.

Through NBHDL's customer engagement, certain factors such as safety, reliability and cost have all been identified as concerns at a residential and business level. Customers have indicated that they would like reliability maintained and have an obvious and demonstrated preference for maintaining safety. NBHDL's infrastructure System Renewal projects address these at a broad level. Through the DSP however, there are no specific projects that address specific customer preferences in relation to capital spending and the costs included in the DSP. NBHDL uses the information derived from customer engagement pieces to ensure its decisions are aligned with customer preferences and that its decisions are valid based on the customer feedback generally.

2.1.3 Anticipated Sources of Cost Savings (5.2.1c)

NBHDL's planning and investment processes follow Good Utility Practices ("GUP") that are communicated through the DSP. GUP has inherent cost savings through sound decision making, thoughtful compromises, right timing, and optimum expenditure levels. This includes adhering to the OEB's Distribution System Code that sets out both GUP, minimum performance standards for electricity distribution systems in Ontario, and minimum inspection requirements for distribution equipment. Consistent with good practices, over the years NBHDL maintains its equipment in a safe and reliable working order and, only when economically justified or AM objectives are met, upgrades, or replaces its equipment. Consistent maintenance of its equipment has permitted NBHDL to, in some circumstances extract an extended useful working life from certain assets.

Additional costs savings expected to be achieved over the forecast period by NBHDL through good planning and DSP execution include the following:

- Prioritizing projects with significant benefits through a formalized AM prioritization protocol.
- Evaluating asset health to coordinate repair and replacement efforts.
- The focus on the renewal of the system, specifically the replacement of assets past their useful life, is anticipated to result in less reactive based maintenance (trouble calls). The benefit is difficult to quantify, however, it is anticipated to help mitigate the effect of other O&M cost

increases in the longer term. Fewer trouble calls also have the potential to result in high reliability.

- The use of supervisory control and data acquisition ("SCADA") is anticipated to reduce man-hours and truck rolls required to deal with breaker operations and reduce restoration times in outages specific to that system due to the ease of operation from the control room.
- The proactive replacement of underground cabling is anticipated to help reduce expensive reactionary O&M costs and reduce outages relating to underground cable failure, in turn, improving reliability. This focus allows NBHDL to rebuild the area with current underground construction designs that have evolved significantly since the 1970s.
- Following GUP that have inherent cost savings through sound decision making, thoughtful compromises, right timing, and optimum expenditure levels.
- Incorporating an annual review cycle of the actual expenditures to the proposed planned expenditure to manage large variances and to further improve the planning and execution processes.

2.1.4 Period Covered by DSP (5.2.1d)

The planning horizon for this DSP covers eleven years with a six-year historical period of 2015 to 2020, and a five-year forecast period of 2021 to 2025, where 2021 is the Test Year.

2.1.5 Vintage of the Information (5.2.1e)

Unless otherwise noted, all information contained in the DSP is current as of September 30, 2020.

2.1.6 Important Changes to Asset Management Processes (5.2.1f)

This is NBHDL's second DSP under the current Filing Requirements with the recent revisions included. The continuation of programs such as pole testing, infrared scanning, and dissolved gas analysis ("DGA") analysis have improved NBHDL's ability to assess the condition of in-service assets more accurately. Recent investments made into SCADA assists NBHDL by providing real-time system information that facilitates the rapid identification of system issues and remote switching to improve the efficiency of outage response.

Additionally, major revisions were made to NBHDL's pole inspections developed internally. The major revisions allow for NBHDL to prioritize data collection that feeds into NBHDL's asset condition framework and prioritization framework to select poles that have the highest risk of failure.

2.1.7 DSP Contingencies (5.2.1g)

Few investments described in the DSP are contingent upon the outcome of ongoing activities or future events. Specifically, the level of actual investments for System Access may slightly deviate year-to-year from the proposed investment levels, depending upon the number of customer requests for new services and line relocates. Customer connection forecasts are based on timing information received from the City of North Bay, planning reports, develop submissions and inquiries and historical connection rates. NBHDL expects such deviations can vary from minor to major and the total expenditure level during the next five years is reflective of the historical period when adjusted for inflation. These coordinated efforts are ongoing, and the DSP is contingent on them with respect to allocating part of the budget envelope only.

Additionally, the City of North Bay is in very early stages with identifying plans for the City's south-side development. NBHDL is in constant communication with local developers and the City's development team to accordingly plan and accommodate resources to meet its obligations of connecting customers. Currently, there are no immediate impacts to the DSP that NBHDL can forecast and account for, however, should the City quickly advance to planning and development, NBHDL intends to reprioritize its projects in the given year. NBHDL does not foresee any issues to accommodate future growth in

that area. Depending on development requirements, additional spending in System Service might be required to manage the demand, but it is not anticipated at this time.

2.1.8 Grid Modernization, Energy Resources & Climate Change Adaptation (5.2.1h)

As the main priority for NBHDL is to maintain the current performance of its system while minimizing bill impacts to its customers, NBHDL is not proposing major, unique projects related to grid modernization, distributed energy resources and climate change adaptation. However, NBHDL has ongoing activities that would be in alignment with grid modernization and climate change adaptation. Additionally, NBHDL is reviewing new activities to determine applicability to NBHDL's system that may assist with system modernization. These activities include:

Installation of automated switches (reclosers) – proactive feeder sectionalizing to address high priority areas with reliability and or access issues. Expected to improve the efficiency of outage restoration work on the parts of the system enabled with this equipment. The activity supports a flexible energy system and improves value and performance for consumers.

Installation of Line Sensors – NBHDL continues to monitor the performance of recently installed line sensors to determine the feasibility of a larger-scale implementation. Line sensors are used to provide instantaneous situational awareness of the distribution system (current, voltage, vars, harmonics, etc.) and provide location data to help identify faults. The activity supports improving the value and performance for consumers.

Storm Hardening – NBHDL employs proven storm hardening techniques such as installing stainless steel equipment for below-grade applications, moving below grade equipment to above grade (where possible) where flooding is a possibility, design to CSA Heavy Loading conditions, and utilize stronger poles in construction. The activity is in response to challenges of climate change.

Replacement of obsolete assets – grid modernization effort to remove assets that no longer meet NBHDL's design standards. Removing these assets can support reliability performance, resiliency, and operational efficiency, while reducing NBHDL's procurement and spare inventory costs through standardization of equipment. The activity supports affordable energy is provided to all consumers within NBHDL's service area.

2.2 Coordinated Planning with Third Parties (5.2.2)

2.2.1 Summary of Consultations (5.2.2a, 5.2.2b, 5.2.2c)

This DSP has been prepared through a coordinated planning process with all major stakeholders. Input from the following stakeholders has been considered by NBHDL during the preparation of the DSP:

- customers
- the municipal government
- the transmission company – HONI
- the Embedded distributor – HONI

The following sections address the Filing Requirements for each of the stakeholders identified above.

2.2.1.1 *Customer Consultations*

Customer engagement is important to the success of NBHDL. The purpose of these engagement processes is to focus on addressing issues of concern raised directly by customers. The issues are addressed according to NBHDL customer preference on how they wish to be served and engaged.

Examples of customer engagements include:

- Customer service phone calls answered on different topics of concern to customers.
- Locates completed to allow customers to safely build on their property without danger of electrical contact.
- Consultation on the NBHDL vegetation management program and how the program may impact trees on a customer's property (which may include tree planting).
- Consultations with customers on scheduled outages to minimize impact to business and residents where possible.
- Sign-ups for eBilling and using the web portal to look at time-of-use ("TOU") data for customers.
- Small and large business consultations in energy conservation projects.
- Monthly bill inserts and on-bill messaging are included on topics of interest and relevance to customers.

NBHDL is both proactive and reactive in its customer engagement consultations. The majority of the exercises and discussions provide helpful insight into the day to day operations of NBHDL. The examples demonstrate that customer engagement and communication is a continuous priority for NBHDL and ties directly to NBHDL's core objectives of community and customer focus and safety.

NBHDL also makes significant efforts to engage the largest energy consumers in the City to work on their important issues. The important issues include electricity rates and pricing, billing inquiries, electrical supply concerns, demand response, energy conservation, metering and sub-metering, monitoring and changing electricity demands. NBHDL's experience with this approach is that larger electricity consumers are very busy with their core responsibilities and they have a tolerance for the right amount of engagement that benefits their business.

In 2018 and 2020, NBHDL proceeded to complete its formalized customer engagement for both residential and small business customers through a series of telephone surveys. The purpose of these activities was to gauge the level of customer satisfaction throughout all aspects of the organization, to determine a benchmark for customer service and reliability for which NBHDL could strive for continuous improvement and to assist in determining customer preferences. These consultations were used as a way of determining what NBHDL was doing well, how it could improve and what customers wanted to see from the organization. NBHDL sought direct input from customers to determine if NBHDL's operational and capital plans aligned with customer preferences and whether customers would ultimately support the decisions that NBHDL is making to run an efficient and effective distribution company. The recent customer engagement process and results are detailed in Section 4.1.3 with the detailed customer engagement information provided in Exhibit 1.

In general, customer consultations support the DSP's focus on maintaining existing reliability and service levels through prioritized and paced investment plans that smooth and mitigate impact to rates.

2.2.1.2 *Municipal Government Consultations*

NBHDL interacts with the City in several ways and each interaction helps in the coordination of infrastructure planning and the connection of customers in a timely fashion. For each municipal government consultation, NBHDL may provide relevant material that pertains to the discussion topic of the meeting, however, each meeting differs with variable information being prepared. Hence, there are no relevant material documents to be presented at this time.

City Engineering Departments

The first form of consultation is the annual utility meeting held by the City's Engineering Departments which was recently held in April 2020. All service utilities are invited to the meeting where the City reviews each service utilities high-level 10-year capital plan with a stronger emphasis on what projects are scheduled for the current and upcoming planning year. The utilities that participate also share their plans with NBHDL to identify any operational efficiencies, to assess potential new developments or electrical needs and to account for areas of potential load growth.

Although specific details about the City projects are rarely available at the time of the annual meeting and therefore scheduling and/or budgeting the projects is not a feasible deliverable from the meeting, the awareness of what projects are on the horizon provides the opportunity to familiarize with and prepare for the projects. It also provides the NBHDL engineering department with a list of projects to monitor and allows for coordination of any infrastructure plans NBHDL must integrate into the City plans. The meeting does not have a direct effect on the DSP investment level as a historical average is used to estimate the expenditure levels. Expenditures include road relocations and City required infrastructure investments which aids in the coordination of NBHDL's infrastructure planning.

Development and Review Team

The second consultation process is participating in the City Development and Review Team ("DART") where representatives from all utilities, City departments and local agencies (MTO, North Bay and Mattawa Conservation Authority, etc.) review applications on a biweekly basis put forth to the City that involve new development/servicing, zoning changes and site plan/control. The main goal of the team is to identify and communicate to potential developers, property owners, local design firms, any showstoppers that may be present with what is being proposed before substantial time and money are invested. This is an extremely helpful process as it provides the end-user with issues that must be addressed upfront and at the same time provides NBHDL with notice of upcoming developments and proposals allowing for the better planning of work and the timely connection of new customers. This interaction does not affect the DSP investment level but contributes to successfully meeting the required Distribution System Code ("DSC") connection timelines and enhances customer communications and interactions.

City Economic Development Office

The last form of consultation is with the City Economic Development Office ("EDO"). This interaction is not formal but is very important. A strong relationship exists between NBHDL and the EDO which provides the City with the ability to easily obtain information that helps in attracting new development into the NBHDL's service territory. The communication is typically initiated by the City and does not have an impact on the DSP investment levels. However, it represents a communication path that promotes the connection of customers and provides insight into projects that may be on the horizon. Furthermore, it supports better planning and execution of system access related projects managed by NBHDL as the plans from the City are proactively communicated.

2.2.1.3 *Transmitter Consultations – Hydro One Networks Inc.*

NBHDL belongs to the "North/East of Sudbury Region", for which HONI is the lead transmitter. HONI is primarily responsible for steering the regional planning in this region. The consultations started in October 2015 with the Information Gathering followed by completing a Needs Assessment in April 2016. The first Regional Planning Cycle was completed in 2017. The Needs Assessment reports no additional regional coordination is required for NBHDL and therefore has no impact on NBHDL's current DSP leading up to 2021. No capital contribution is expected from NBHDL at this time.

The next planning cycle is intended to start in Q1/Q2 2021. At the time of filing this DSP, NBHDL has not yet been engaged by HONI for the next planning cycle. Hydro One's Regional Planning Status letter is in Appendix H. There are no other relevant material documents to be presented at this time.

2.2.1.4 *Embedded Distributor Consultations – Hydro One Networks Inc.*

HONI has embedded assets within the NBHDL system, however, at this time NBHDL has not identified a need to plan for any consultation with HONI to determine if any investments would be required on the NBHDL system over the DSP forecast period. There are no relevant material documents to be presented at this time.

2.2.2 Regional Planning Process

NBHDL belongs to the North/East of Sudbury planning region which is the area roughly bordered by Moosonee to the north, Hearst to the northwest, Ferris to the south and Kirkland Lake to the east. The Regional Planning Process started in October 2015 with the Information Gathering followed by completing a Needs Assessment in April 2016. The Local Plan for Timmins-Kirkland Lake Voltage Regulation was published in November 2016. NBHDL does not service this area and as a result, is not involved in the planning process.

The outcome of the Regional Planning Process is the Regional Infrastructure Plan ("RIP") which is comprised of both the Needs Assessment and the Local Plan. The RIP can be found online on HONI's page. No further regional coordination is identified for the remaining regions as communicated by HONI.

The next planning cycle is intended to start in Q1/Q2 2021 or earlier if a new need is identified for the region. Hydro One's Regional Planning Status letter is in Appendix H. There are no other relevant material documents to be presented at this time.

2.2.3 IESO Comment Letter (5.2.2d)

NBHDL submitted a request for a letter of comment to the Independent Electricity System Operator ("IESO") in September 2020. The IESO reviewed the letter containing NBHDL's information on REG applications, planning and investments, and provided a response concluding that no comment letter from the IESO is required as there are no REG investments over the DSP period 2021-2025. (attached as Appendix A).

2.3 Performance Measurement for Continuous Improvement (5.2.3)

NBHDL's corporate emphasis on continuous improvement is reflected in all areas of its operations. Like most utilities in Ontario, NBHDL must replace ageing, at risk of failure distribution infrastructure to ensure the safe and reliable supply of electricity. In addition to the strategic replacement of ageing assets, NBHDL continues to focus on core maintenance activities to reduce the disruption of electricity distribution to customers. NBHDL focuses on short and long-term planning to ensure sufficient system capacity is available, and contingencies are in place should there be a loss of critical distribution infrastructure.

NBHDL monitors several performance measures, including those mandated by the OEB, that may assist in the utility's continuous improvement activities and satisfying customer requests. These measures can be divided into three groups:

1. Customer-oriented performance.
2. Cost efficiency and effectiveness.
3. Asset/system operations performance.

Where applicable, the performance measures included on the scorecard have an established minimum level of performance expected to be achieved. The scorecard is also used to continuously improve NBHDL's AM and capital planning process. NBHDL's current performance state is represented by NBHDL's official scorecard results for the recent historical year as published by OEB. The scorecard is designed to track and show NBHDL's performance results over time and helps to benchmark its performance and improvement. Furthermore, the scorecard includes traditional metrics for assessing services, such as frequency of power outages and costs per customer.

Each metric provided in the table and subsections below influences NBHDL's DSP to achieve the best performance for its customers. The following sections address performance metrics as published by the OEB in the performance scorecard and with additional performance metrics identified in OEB's Rate Filing Requirements. NBHDL's recent year scorecard is shown in Appendix B.

Table 2-2: DSP Performance measures for NBHDL

Performance Outcome	Measure	Motivation	Metric	Target
Customer-oriented performance	Service Quality	Regulatory/ Consumer	New Residential/Small Business Services Connected on Time	90%
			Scheduled Appointments Met on Time	90%
			Telephone Calls Answered on Time	65%
			Renewable Generation Connection Impact Assessments Completed on Time	100%
	Customer Satisfaction	Customer	Customer Satisfaction Survey	80%
	System Reliability	Regulatory/ Customer	SAIDI	2.10
			SAIFI	1.99
Cost efficiency and effectiveness	Cost Control	Regulatory/ Customer/ Corporate	Total Cost per Customer	Maintain Group 3
			Total Cost per km of Line	Maintain Group 3
	Distribution System Plan Implementation Progress	Corporate/ Regulatory	DSP Implementation	100%
Asset/system operations performance	Safety	Regulatory/ Corporate	Level of Public Awareness	80%
			Level of Compliance with Ontario Regulation 22/04	C
			Serious Electrical Incident Index	0
	Distribution Losses	Corporate	Line Losses	<4%

Targets for *First Contact Resolution* and *Billing Accuracy* do not pertain to the DSP and were excluded for this reason. These metrics are discussed in Section 2.1.8.1.1 of Exhibit 1.

Annual performance variances that are not within target ranges or meet minimal performance thresholds would result in senior management review of performance cause that may result in changes to immediate or plans to direct performance back to target levels. NBHDL has been and continues to be, focused on maintaining the adequacy, reliability, and quality of service to its distribution customers.

2.3.1 Customer-Oriented Performance

2.3.1.1 *Service Quality*

2.3.1.1.1 Methods and Measures (5.2.3a)

NBHDL measures and reports on an annual basis on each of the service quality requirements set out in the DSC. Failure to meet minimum service quality targets would result in measures being taken to realign performance with DSC service quality standards. Service Quality measures include the following major measures: New Residential/Small Business Services Connected on Time, Scheduled Appointments Met on Time and Telephone Calls Answered on Time. Additional sub-measures are tracked as part of the DSC requirements. All these measures are self-explanatory, and all relate to NBHDL providing connection services as well as quality customer service. NBHDL is committed to meeting and exceeding all targets found in the Service Quality performance measure group.

2.3.1.1.2 Historical Performance (5.2.3c)

Year over year, NBHDL has consistently exceeded the OEB targets for its service quality as part of the customer focus efforts. NBHDL's customer service representatives answer a varying number of phone calls per year within the 30-second window prescribed by the OEB. The overall answer rate is well above the industry targets and is indicative of NBHDL's dedication to being an organization focused on customer service. Table 2-3 presents the measure and sub-measures for tracking NBHDL's performance in the service quality category.

Table 2-3: Performance Measures - Service Quality

Measure	Sub-Measure	2015	2016	2017	2018	2019	Minimum Standard	NBH Target
New Residential / Small Business Services Connected on Time	Low Voltage Connections	100%	100%	100%	100%	100%	90%	90%
	High Voltage Connections	100%	100%	N/A	100%	N/A	90%	
	Reconnection Performance Standards	100%	100%	100%	100%	100%	85%	
Telephone Calls Answered on Time	Telephone Accessibility	82.10%	83.60%	86.56%	91.13%	95.65%	65%	65%
	Telephone Call Abandon Rate	6.60%	6.10%	4.87%	5.62%	1.58%	<10%	
Scheduled Appointments Met on Time	Appointments Met	100%	99.90%	100%	100%	100%	90%	90%
	Appointment Scheduling	100%	100%	100%	100%	100%	90%	

2.3.1.1.3 Performance Trend into the DSP (5.2.3d)

NBHDL has exceeded the industry targets for each service quality measure. NBHDL's outstanding performance on these measures indicates no substantial additional material projects are required for investments in this area. NBHDL continues to strive to better serve the customer with the highest excellence. NBHDL's intended action for these measures is to maintain the performance.

2.3.1.2 *Customer Satisfaction*

2.3.1.2.1 Methods and Measures (5.2.3a)

Customer satisfaction survey results and customer engagements are important to the success of NBHDL. The purpose of the survey is to focus on addressing issues of concern raised directly by customers. NBHDL is proactive and reactive in its customer engagement consultations, the majority of which provide helpful insight into the day to day operations of NBHDL. NBHDL relies on direct, day-

to-day, real-time interactions with customers to inform NBHDL's decision-making process, to advise of issues important to customers and to address communication and customer service needs.

2.3.1.2.2 Historical Performance (5.2.3c)

Table 2-4: Performance Measures - Customer Satisfaction

Measure	2015	2016	2017	2018	2019	NBH Target
Customer Satisfaction Survey	A	85%	85%	89%	89%	80%

NBHDL sets a high standard for performance when it comes to customer care and is especially proud of the results considering the increase in customer concerns over proving and value across Ontario. NBHDL strives to deliver customer excellence and value and believes this is shown in the various results of the survey including the category of demonstrating credibility and trust, where NBHDL once again exceeded 80%.

2.3.1.2.3 Performance Trend into the DSP (5.2.3d)

NBHDL's outstanding performance on the measure indicates no substantial additional material projects are required. NBHDL continues to strive to better serve the customer with the highest excellence. NBHDL's intended action for the measure is to maintain the performance.

NBHDL feels that once customers see the big picture of what happens on the local level, within the communication, the value of the work NBHDL does to provide safe and reliable power and excellent customer service becomes more apparent. NBHDL will continue to use the bi-annual survey results to benchmark improvement and to identify additional opportunities to enhance customer satisfaction. On-going, daily interactions that leave the customer with the information they need will remain NBHDL's highest priority.

2.3.1.3 ***System Reliability***

2.3.1.3.1 Methods and Measures (5.2.3a)

System reliability is an indicator of the quality of electricity supply received by the customer. System reliability and performance are monitored via a variety of weekly, monthly, annual, and on-demand reports generated by the SCADA system and the Outage Management System ("OMS").

The reliability of supply is primarily measured by internationally accepted indices SAIDI and SAIFI as defined in the OEB's *Electricity Reporting & Record Keeping Requirements* dated May 3, 2016. SAIDI, or the System Average Interruption Duration Index, is the length of outage customers experience in the year on average, expressed as hours per customer per year. It is calculated by dividing the total customer hours of sustained interruptions over a given year by the average number of customers served. SAIFI, or the System Average Interruption Frequency Index, is the number of interruptions each customer experiences in the year on average, expressed as the number of interruptions per year per customer. It is calculated by dividing the total number of sustained customer interruptions over a given year by the average number of customers. An interruption is considered sustained if it lasts for at least one minute.

$$SAIDI = \frac{Total\ customer\ hours\ of\ sustained\ interruptions}{Average\ number\ of\ customers\ served}$$

$$SAIFI = \frac{Total\ customer\ interruptions}{Average\ number\ of\ customers\ served}$$

Loss of Supply ("LOS") outages occur due to problems associated with assets owned by another party than NBHDL or the bulk electricity supply system. NBHDL tracks SAIDI and SAIFI including and excluding LOS. Major Event Days ("MED") are calculated using the IEEE Std 1366-2012 methodology. MEDs are confirmed by assessing whether the interruptions were beyond the control of NBHDL (i.e. force majeure or LOS) and whether the interruptions were unforeseeable, unpredictable, unpreventable, or unavoidable.

Furthermore, NBHDL tracks its Worst Performing Feeders. There are no pre-defined regulatory metrics used to determine Worst Performing Feeders. In assessing feeders that contribute negatively to the reliability, NBHDL uses the following metrics: Customer Hours Interrupted ("CHI") and the number of Customers Interrupted ("CI"). These two metrics are directly related to SAIDI and SAIFI respectively. Planned outages, LOS and MEDs are excluded from the outage data. Abnormal feeder configurations were not excluded. Abnormal feeder configuration occurs when additional customers are temporarily added to a feeder to support construction or maintenance work performed on an adjacent circuit.

2.3.1.3.2 Historical Performance (5.2.3c)

NBHDL's reliability indices for 2015-2019 are shown in the figures below. In 2019, NBHDL's average number of hours in which power to a customer was interrupted (excluding LOS) was 1.16 and below the target range of 2.10. Additionally, NBHDL's average number of customer interruptions (i.e. frequency) was 1.35 and well below the target range of 1.99. NBHDL's goal is to have its system reliability trend in an improved manner over five years; however, it is important to note that in any given year, outage hours will correlate with storm occurrences and severity.

Figure 2-1: Performance Measure - SAIDI

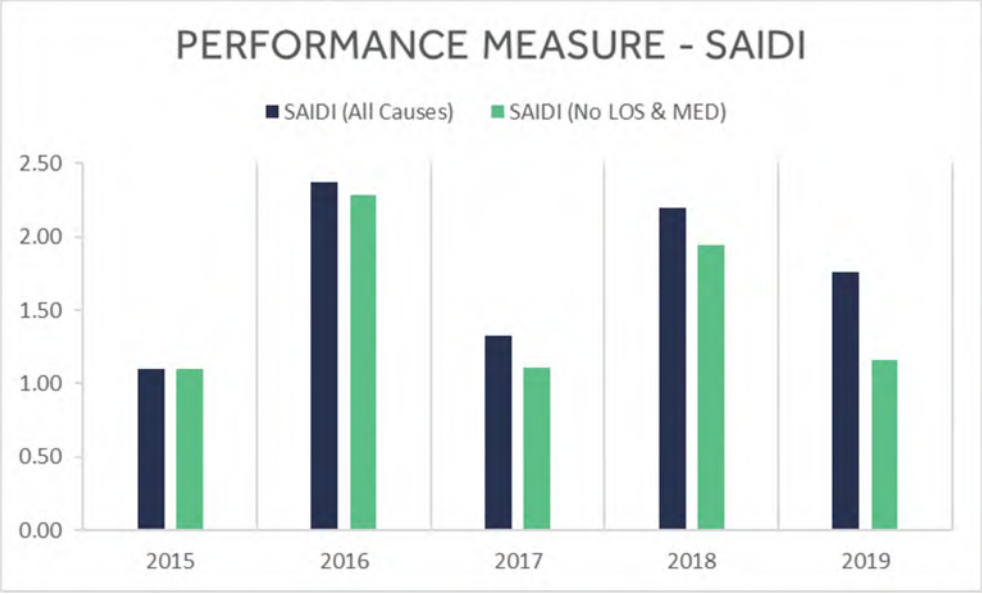
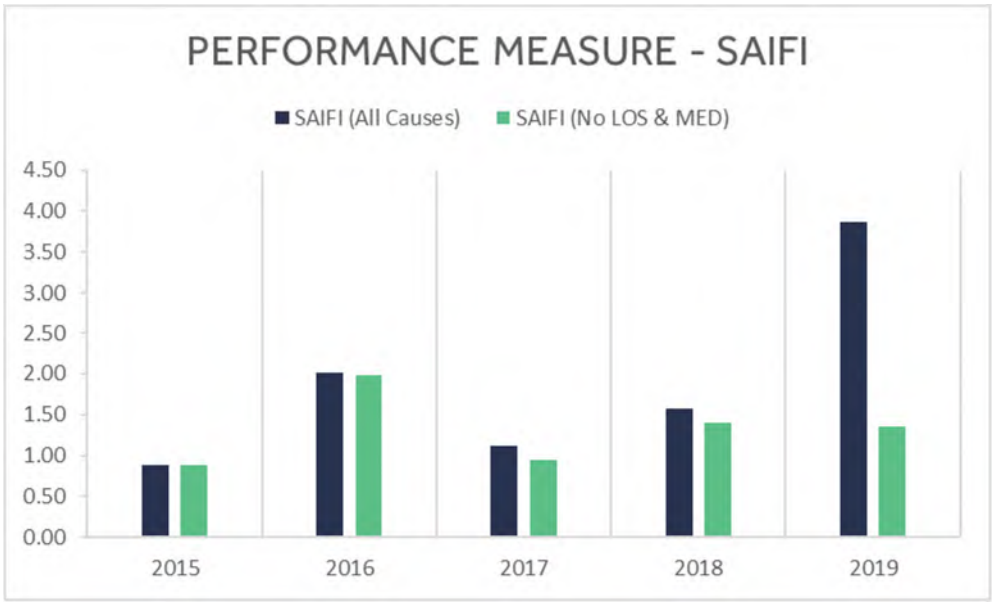


Figure 2-2: Performance Measure - SAIFI



Overall, NBHDL has exceeded its targets for its reliability measures while demonstrating a slightly improving trend, adjusted for LOS and MED. NBHDL's reliability metric values for the historical period, adjusting for LOS and MEDs, are shown below in addition to NBHDL's current target for each metric.

Table 2-5: 2015-2019 Reliability Metrics (LOS and MED adjusted)

Metric	2015	2016	2017	2018	2019	Average	NBH Target
SAIDI	1.10	2.29	1.11	1.95	1.16	1.52	2.10
SAIFI	0.88	1.98	0.94	1.40	1.35	1.31	1.99

Table 2-6 presents a summary of outages that have occurred within NBHDL's service territory. The summary provides three different categorizations for the accounting of outages. The table highlights a slightly decreasing trend of outages with NBHDL's service territory, excluding MED and LOS outages. Further breakdown by cause codes is provided in the subsequent subsections.

Table 2-6: Outage summation (2015-2019)

Categorization	2015	2016	2017	2018	2019
All interruptions	141	180	136	167	193
All interruptions excluding LOS	141	179	132	164	179
All interruption excluding MED and LOS	141	179	132	164	179

NBHDL did not experience any MEDs between 2015 to 2019.

Outage Details for Years 2015-2019

The following sections and figures provide the breakdown of historical outages for years 2015-2019 regarding the number of outages, the number of customers interrupted, and the number of customer hours experienced by the outages. Tracking outage performance by cause code provides valuable information on specific outage causes that need to be addressed to improve negative trending. As with the reliability indices, the five-year historical performance range is used as a target and results outside this range indicate positive or negative trending.

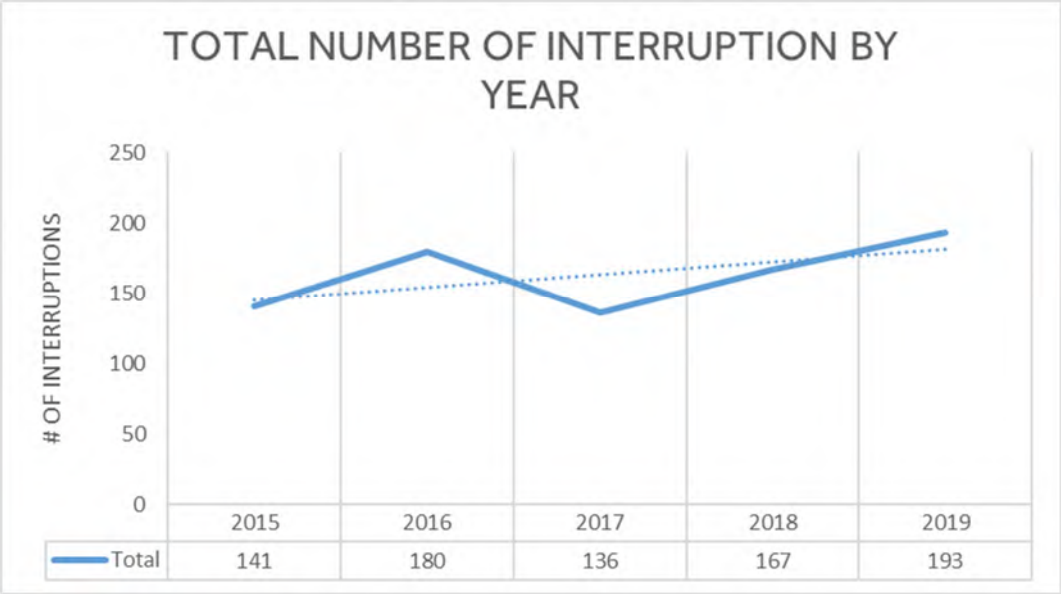
Outages Experienced

Table 2-7 presents the count of outages broken down by cause code. The number of outages is an indication of outage frequency and impact customers differently based on customer class. For example, residential customers may tolerate a larger number of outages with shorter duration while commercial and industrial customers may prefer fewer outages with longer duration thereby reducing the overall impact on production and business disruption. NBHDL continues to assess and execute capital and O&M projects to manage the number of outages experienced.

Table 2-7: Number of Outages by cause codes (2015-2019) - Excluding MEDS

Cause Code	2015	2016	2017	2018	2019	Total Outages	Percent Share	Percent Share Excluding LoS
0-Unknown/Other	7	13	13	18	10	61	7.47%	7.67%
1-Scheduled Outage	5	14	4	19	13	55	6.73%	6.92%
2-Loss of Supply	-	1	4	3	14	22	2.69%	---
3-Tree Contacts	30	17	24	25	43	139	17.01%	17.48%
4-Lightning	3	-	4	2	0	9	1.10%	1.13%
5-Defective Equipment	36	37	12	47	27	159	19.46%	20.00%
6-Adverse Weather	6	10	10	1	6	33	4.04%	4.15%
7-Adverse Environment	-	1	-	-	-	1	0.12%	0.13%
8-Human Element	2	8	5	4	15	34	4.16%	4.28%
9-Foreign Interference	52	79	60	48	65	304	37.21%	38.24%

Figure 2-3: Total number of outages by year (2015-2019) - Excluding MEDS



The total number of interruptions over the historical period varies from a low of 136 to a high of 193 in the recent year, with the overall trend increasing in the period. This represents an average of 0.37 to 0.52 interruptions per day. The average is small enough that NBHDL's customers have not raised major concerns that would spark NBHDL to aggressively plan capital projects to address the

deteriorating asset base. However, the observed increasing trend indicates continuous renewal throughout the system in the correct places is needed to allow NBHDL to manage the number of interruptions it has control of. The contributing cause codes that account for the increasing number of uncontrollable interruptions in recent years include *Loss of Supply, Tree Contacts,* and *Foreign Interference*.

The top three cause codes ranked by percentage share over the historical period are *Foreign Interference, Defective Equipment* and *Tree Contacts.* The top three cause codes remain the same for the analysis of customer hours interrupted, however, when observing the total customers interrupted *Loss of Supply* and *Human Element* are also major contributors, largely from the fact that the year 2019 was an anomaly year which contributed significantly.

Scheduled Outages have been increasing over the historical period due to the execution of NBHDL's plans. Over the last five years, it has contributed to 6.73% of the total number of outages that occurred. These outages are due to the disconnection of service for NBHDL to complete capital investments or to perform maintenance activities on assets that require them to be disconnected for employee safety. In the historical period, the majority of these plans were attributed to the voltage conversion efforts for NBHDL's system. The voltage conversion is still underway but should be completed at the end of 2020 or early 2021. NBHDL continues to plan capital work and maintenance appropriately in times that would affect minimal customers and with short durations.

The total number of *Loss of Supply* outages attributed to a small share of 2.69%. These outages are due to problems associated with assets owned outside of NBHDL in which NBHDL has no control over nor does it maintain. Although *Loss of Supply* outages have a minimal contribution in terms of outage counts, they have a significant impact on the total CI and CHI. One outage can affect a whole portion of NBHDL's system and may give NBHDL limited switching capability, resulting in customers' power not being restored quickly. Particularly in 2019, NBHDL experienced a significantly higher contribution to CI and CHI metrics due to *Loss of Supply* related outages.

Tree Contact outages continue to be a major top three contributing cause to the total outages, total customers interrupted, and customer hours interrupted. *Tree Contact* outages accounted for 17.01% of total outages experienced over the past five years. However, NBHDL has experienced a decrease (i.e. improvement) to the total customers interrupted and customer hours interrupted over the historical period. This is largely due to NBHDL's continued investment and efforts in managing the surrounding vegetation. NBHDL plans to continue investing its vegetation management program to manage Tree Contact related outages.

Defective Equipment outages continue to be a major top three contributing cause to the total outages, total customers interrupted and customer hours interrupted. *Defective Equipment* outages accounted for 19.46% of the total outages experienced at NBHDL. These failures result from equipment failures due to condition deterioration, ageing effects or imminent failures detected from reoccurring maintenance programs. NBHDL has planned investments to prioritize assets for replacement before experiencing a failure that may cause an outage. NBHDL utilizes evaluations such as the Asset Condition Assessment to assist in prioritizing investments in asset classes.

Adverse Weather outages contributed minimally to the total number of outages as well as the impact on customers interrupted and customer hours interrupted. Where possible, NBHDL completes storm hardening efforts and sectionalizes its feeders to minimize the impact of weather contributing outages. Additionally, investing in vegetation management may help curb the number of trees potentially falling onto NBHDL's assets and causing an outage.

Foreign Interference outages continue to be a major top three contributing cause to the total outages, total customers interrupted, and customer hours interrupted. The outages contributing to the cause include animal interference, dig-ins, vehicle collision and/or other foreign objects. Some of these contributing factors can be minimized such as educating the public about calling before digging or installing animal guards in areas observed to have a high activity of animals, both of which NBHDL continues to do. However, other factors such as vehicle collisions can happen at random and depending on the extent and where the collision happens may result in a large impact.

Customers Interrupted and Customers Hours Interrupted

The number of customers interrupted is a measure of the extent of outages. Customer Hours Interrupted is a measure of outage duration and the number of customers impacted. The tables and figures below provide the historical values and trends for both CI and CHI with percent share calculations with and without *Loss of Supply* contributions.

Table 2-8: Customers Interrupted by cause codes (2015-2019) - Excluding MEDS

Cause Code	2015	2016	2017	2018	2019	Total CI	Percent Share	Percent Share Excluding LoS
0-Unknown/Other	431	4,020	4,856	2,140	1,172	12,619	5.52%	7.94%
1-Scheduled Outage	155	661	279	154	925	2,174	0.95%	1.37%
2-Loss of Supply	-	651	4,368	3,966	60,864	69,849	30.54%	--
3-Tree Contacts	5,874	13,010	5,485	6,704	4,772	35,845	15.67%	22.56%
4-Lightning	360	-	692	341	-	1,393	0.61%	0.88%
5-Defective Equipment	6,043	10,007	3,026	15,209	3,847	38,132	16.67%	24.00%
6-Adverse Weather	4,410	4,268	1,855	15	609	11,157	4.88%	7.02%
7-Adverse Environment	-	6	-	-	-	6	>0.01%	>0.01%
8-Human Element	1,121	6,566	2,437	8,108	14,621	32,853	14.36%	20.68%
9-Foreign Interference	2,957	9,434	4,126	1,393	6,810	24,720	10.81%	15.56%

Figure 2-4: Total number of customers interrupted by year (2015-2019) - Excluding MEDS

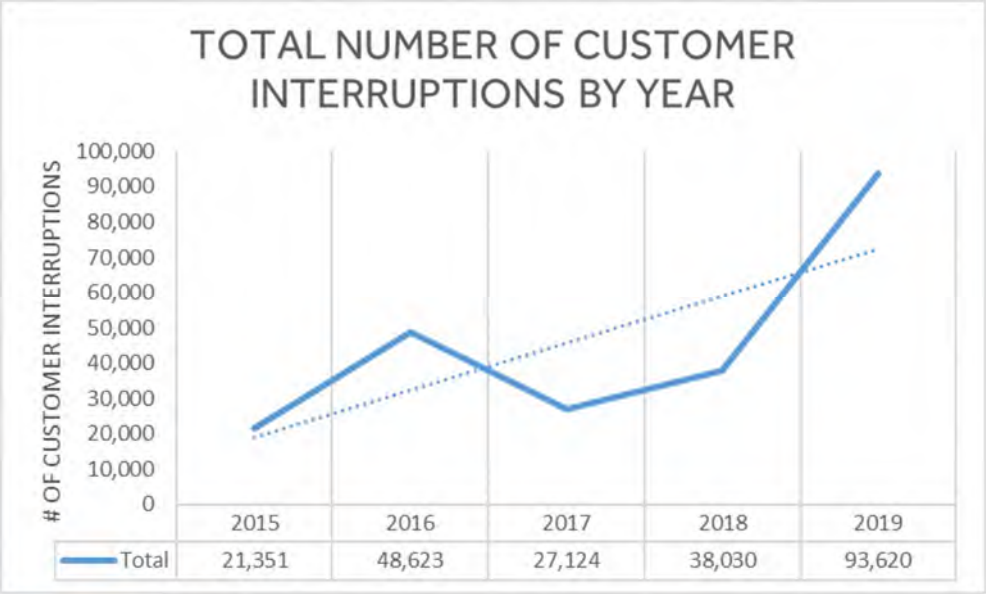
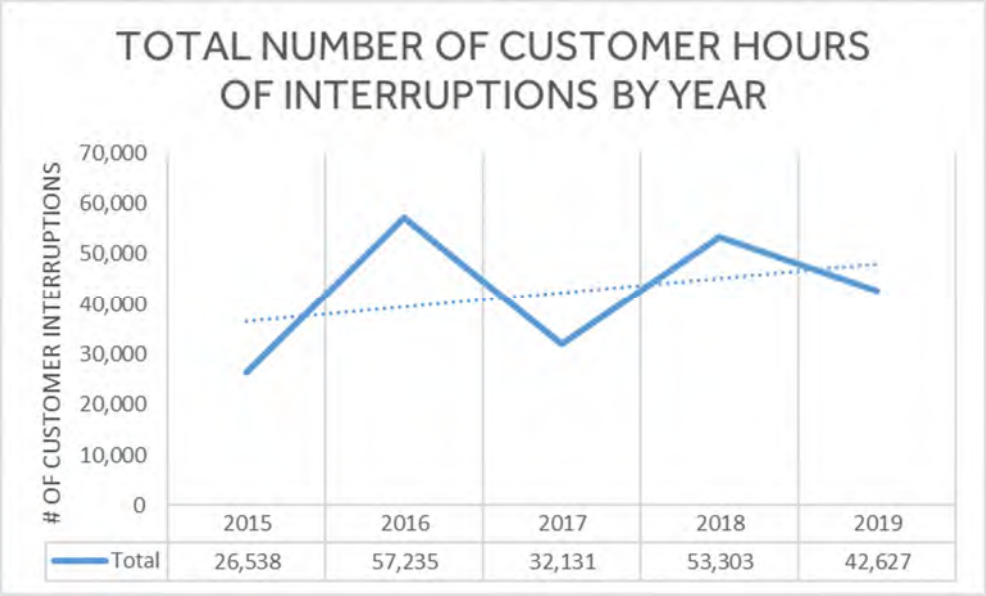


Table 2-9: Customer Hours Interrupted by cause codes (2015-2019) - Excluding MEDs

Cause Code	2015	2016	2017	2018	2019	Total CHI	Percent Share	Percent Share Excluding LoS
0-Unknown/Other	183	1,127	1,399	1,671	726	5,106	2.41%	2.77%
1-Scheduled Outage	377	687	283	232	3,126	4,705	2.22%	2.55%
2-Loss of Supply	-	1,703	5,355	5,914	14,489	27,461	12.96%	---
3-Tree Contacts	11,660	18,710	12,043	13,349	7,991	63,753	30.10%	34.58%
4-Lightning	108	-	1,063	506	0	1,677	0.79%	0.91%
5-Defective Equipment	6,899	20,054	5,438	27,660	5,747	65,798	31.06%	35.69%
6-Adverse Weather	3,314	3,171	1,493	10	878	8,866	4.19%	4.81%
7-Adverse Environment	-	3	-	0	0	3	>0.01%	>0.01%
8-Human Element	47	1,225	321	1,777	870	4,240	2.00%	2.30%
9-Foreign Interference	3,950	10,554	4,736	2,184	8,800	30,224	14.27%	16.39%

Figure 2-5: Total number of customer hours of interruption by year (2015-2019) - Excluding MEDs



An increasing trend can be seen for both the total customers interrupted and customer hours interrupted over the historical period. As seen in the tables, the top three common cause codes are *Foreign Interference, Defective Equipment* and *Tree Contacts.* NBHDL proposes continued investments into its AM strategy to manage the impact of outages on the total CI and CHI. NBHDL has recently increased its vegetation clearances with intentions to reduce outages from vegetation. However, while executing the vegetation management program, NBHDL follows regulations when managing unique tree species.

In addition to the vegetation management program, NBHDL replaces defective assets to maintain reliable service to its customers. In the past, NBHDL has been focusing on completing its voltage conversion by prioritizing the line segments with significant deterioration. With the completion of the voltage conversion program, moving forward NBHDL will have an increased preference to replace deteriorated assets that may cause an outage. This is in alignment with customer preferences to maintain the system's performance and safety. Tools such as the Asset Condition Assessment help to select and prioritize investments to manage the asset system health. Supporting studies assist NBHDL with capital planning that can mitigate the effects of outages due to defective equipment or other outage causes.

Furthermore, NBHDL has planned investments to manage the number of outages related to animal contact as well as continued education to the public regarding digging in areas with underground asset present. Lastly, NBHDL continues to plan capital and O&M activities at times that have a minimal impact on customers by addressing multiple work orders in an area at once rather than multiple times over an extended period. This is further supported through the close relationship NBHDL maintains with the City to coordinate efforts to reduce impacts to residents.

Worst Performing Feeder

NBHDL uses two years of outage data to develop the Worst Performing Feeders ("WPF") list. Since it typically takes two years to design and implement measures to improve reliability on feeders that perform poorly in the prior years, the number of years for outage data should not be too long. That is

if there are too many years the list may contain feeders that have been previously addressed. Hence, the choice of two years of outage data.

NBHDL's focus on developing the Worst Performing Feeders is based on the feeder's contribution to the overall system reliability as opposed to the reliability experienced by an average customer on the feeder.

Table 2-10: Worst Performing Feeder analysis (2018-2019)

Ten Worst Performing Feeders Based on CI - 2018-2019			Ten Worst Performing Feeders Based on CHI - 2018-2019		
Feeder	CHI	CI	Feeder	CHI	CI
15M3	3,542	12,273	18M5	8,652	8,982
18M2	7,816	11,185	14F2	8,311	3,147
18M5	8,652	8,982	18M2	7,816	11,185
17F1	5,686	3,551	17F2	6,079	2,116
11F1	2,528	3,383	18M8	5,902	1,531
14F2	8,311	3,147	17F1	5,686	3,551
10F2	2,265	2,755	13F2	5,615	2,316
15M2	313	2,550	14F3	4,732	2,096
13F2	5,615	2,316	15M3	3,542	12,273
17F2	6,079	2,116	14F1	2,842	1,218

Between both lists, seven common feeders significantly impact reliability performance. Outages that occurred on worst performing feeders are analyzed to determine the nature and root causes of the outages, the condition of assets involved in the outages, and the capabilities for load transfer including outage restoration time. Based on the causes that are responsible for the poor performance of a feeder, the typical work performed to mitigate poor reliability performance includes; installing new automated line reclosers, replacing overhead and underground conductors, installing new fault indicators, reframing poles to increase phase separation, installing animal/bird guards, repairing or replacing deteriorated equipment, installing surge arresters on distribution lines, and proactive tree trimming. With a stronger emphasis on worst performing feeders, there is the potential to positively impact reliability performance for NBHDL's customers. NBHDL notes that not all outage causes are controllable, such as motor vehicle accidents and severe weather. However, select feasible measures may be implemented to reduce the impact of outages caused by these events.

2.3.1.3.3 Performance Trend into the DSP (5.2.3d)

Expressed as a percentage of the total sustained outages in the NBHDL system, the leading causes that continue to impact reliability performance are *Foreign Interference, Tree Contacts* and *Defective Equipment*. Since the NBHDL system is predominantly overhead with a substantial portion running through rural areas, trend data can often be correlated with the number and severity of storms that roll through the City each year.

Outages that are caused by tree contacts are mitigated with a cyclical Vegetation Management program. NBHDL's goal is to achieve a new standard of a 5-year cycle, by changing from primarily trimming/topping to performing full removals to address the high number of trees located near live conductors. The removal of trees in many cases is often the more responsible approach long-term since it can adversely affect the health of a tree. NBHDL follows good arboricultural practice within its tree-trimming operations. Once all areas within NBHDL's service territory are completed to the new standard, it is expected that the overall number of tree-related outages be reduced and in turn, since trees can be at a much greater separation from poles and high voltage lines, there could be a reduction

in the potential of animal contact situations (reducing foreign interference outages). In addition, the new standards can help reduce tree-related damage in storm situations and make the system safer for the general public and power line crews.

NBHDL has committed to doing its part in restoring the tree canopy in the urban part of the City. As such, NBHDL has continued to maintain efforts to re-green the City while addressing the need for safe tree clearance concerning power lines.

Outages involving defective equipment are mitigated through periodic inspections of the distribution system, regular maintenance activities, and system renewal and rejuvenation projects. NBHDL is committed to reducing outages caused by equipment failure and continues to invest in upgrading its system and rebuilding its ageing infrastructure.

NBHDL uses SAIDI and SAIFI reliability indices to gauge the system reliability performance and maintain tight control over capital and maintenance spending. Additionally, NBHDL intends to use the WPF analysis to plan additional targeted mitigation measures. DSP investment priorities are expected to result in outcomes that maintain existing reliability performance.

Furthermore, NBHDL has current programs in place to assist in managing the number of controllable outages. These programs include:

- Planned renewal of end-of-life assets such as poles and transformers;
- Proactive vegetation management;
- Inspection of the plant to identify potential problems;
- Testing of wood poles; and
- Design and construction of distribution circuits to meet standards.

2.3.2 Cost Efficiency and Effectiveness

2.3.2.1 *Cost Control (5.2.3b)*

2.3.2.1.1 Methods and Measures (5.2.3a)

Managing costs is a responsibility taken seriously at NBHDL. The levels of spending are measured and prudently controlled so that customer rates are minimally affected. Total cost per customer is calculated as the sum of NBHDL's capital and operating costs and dividing this cost figure by the total number of customers the utility serves:

$$Total\ Cost\ per\ Customer\ = \frac{\sum Capital\ \&\ O\&M\ costs}{Number\ of\ customer\ served}$$

NBHDL as well collects the trend data on the total cost per kilometre of line. The total cost is calculated as the sum of NBHDL's capital and operating costs divided by the total kilometres of the line in service at NBHDL:

$$Total\ Cost\ per\ Kilometer\ of\ Line\ = \frac{\sum Capital\ \&\ O\&M\ costs}{Kilometers\ of\ line}$$

Additionally, NBHDL tracks the additional metrics introduced in OEB's newest Chapter 5 update: the O&M Cost per customer, O&M Cost per kilometre of line and O&M Cost per MW of Peak Capacity. The metrics are calculated with the total O&M costs divided by the respective number for each metric, defined as follows:

$$O\&M\ \ per\ Customer\ = \frac{\sum O\&M\ Cost}{Number\ of\ customer\ served}$$

$$O\&M\ Cost\ per\ Kilometer\ of\ Line\ = \frac{\sum O\&M\ Cost}{Kilometers\ of\ line}$$

$$O\&M\ Cost\ per\ Average\ Peak\ Capacity\ = \frac{\sum O\&M\ Cost}{Average\ Peak\ Capacity}$$

2.3.2.1.2 Historical Performance (5.2.3c)

NBHDL experienced slight increases in its total expenditures required to deliver quality and reliable services to customers. Province-wide programs such as Smart Meters and Time of Use pricing, growth in wage and benefits costs for employees, increased customer engagement, an extensive overhaul to the vegetation management program, increased information technology costs supporting new regulated and internal business processes, as well as investments in the renewal of the distribution system, have all contributed to increased operating and capital costs at NBHDL. NBHDL's capital cost metrics have been generally consistent in the past, experiencing very slight increases each year. Specifically, the total cost per customer experienced an average 1% increase per year and the total cost per kilometre of the line experienced an average 3.06% increase per year over the last five years. NBHDL's capital focus is asset renewal which is simply replacing (and in some cases reducing) the same kilometres of line, not increasing the total kilometres. This results in increasing renewal costs each year, but with the same (or lower) total kilometres of line. NBHDL also experiences a low level of growth in its total kilometres of lines due to a low annual customer growth rate. The capital cost metrics are visualized below in their respective figures.

Operating costs are those associated with the maintenance, inspection, and operation of the system and those associated with metering, billing, and collections. NBHDL has experienced increases in the operating, maintenance, and administration ("OM&A") workload as a result of increased demand by customers for services and has managed the substantially increased workload without a major change to staffing levels. NBHDL is proposing to increase its vegetation management budget to manage the number of tree-related outages, invest in an upgrade to its GIS to stay current with the technology and continue to digitize its information, perform some underground cable testing for better asset management, arc-flash studies to improve overall system safety and a wood pole testing program to better manage the pole assets. These new initiatives for NBHDL are standard operating procedures in many utilities in Ontario and will allow NBHDL to manage its assets in a more efficient manner with a focused investment strategy that will benefit its customers. The O&M cost metrics are visualized below in their respective figures.

Figure 2-6: Performance Measure - Total cost per customer

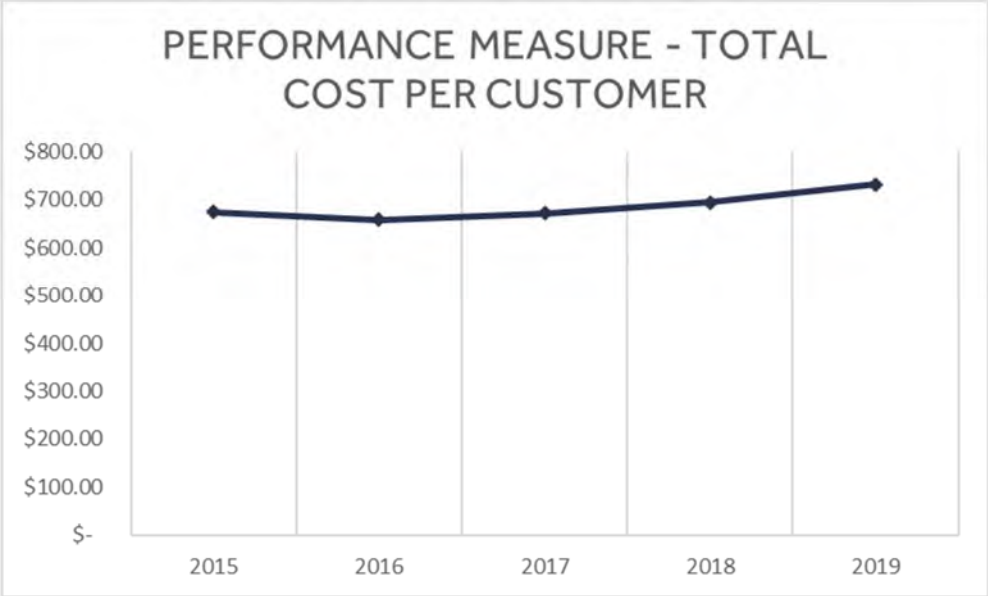


Figure 2-7: Performance Measure - Total cost per kilometre of line

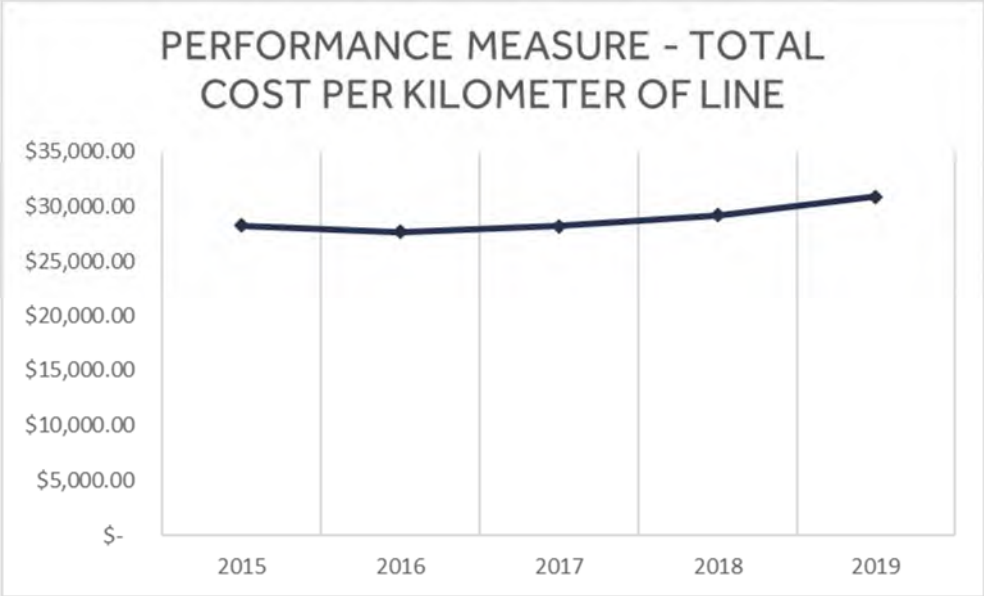


Figure 2-8: Performance Measure - O&M cost per customer

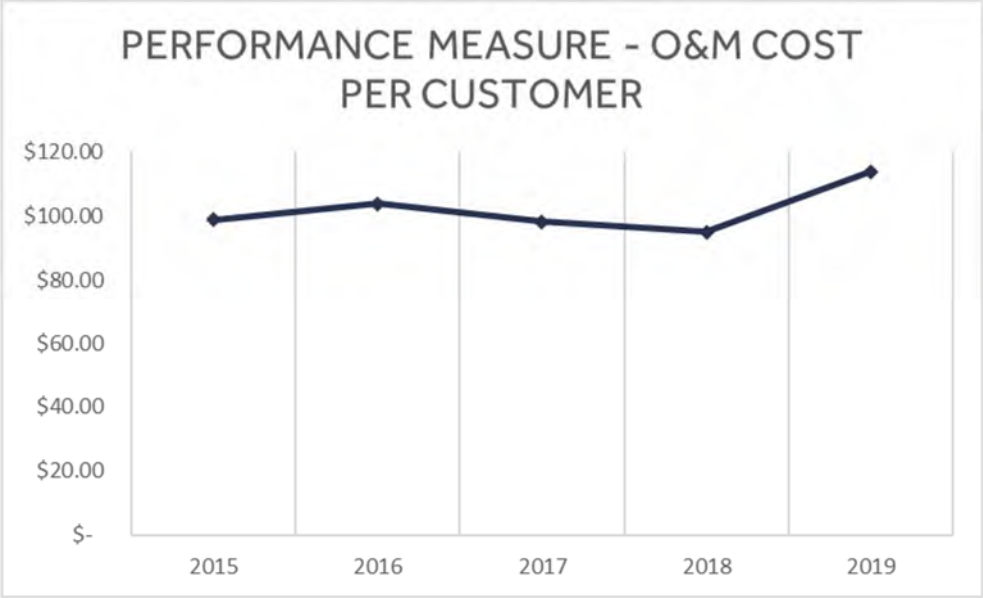


Figure 2-9: Performance Measure - O&M cost per kilometre of line

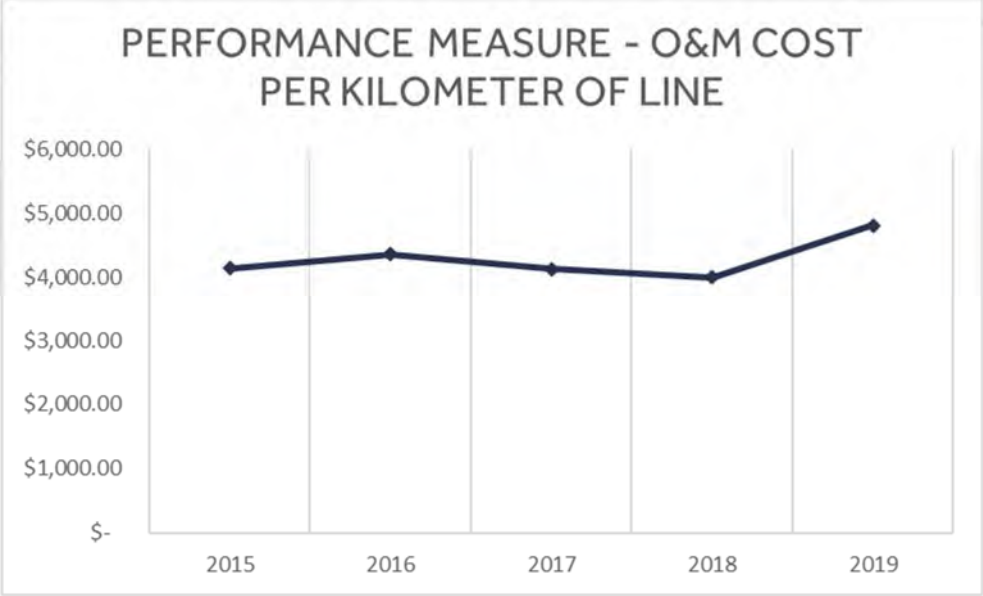
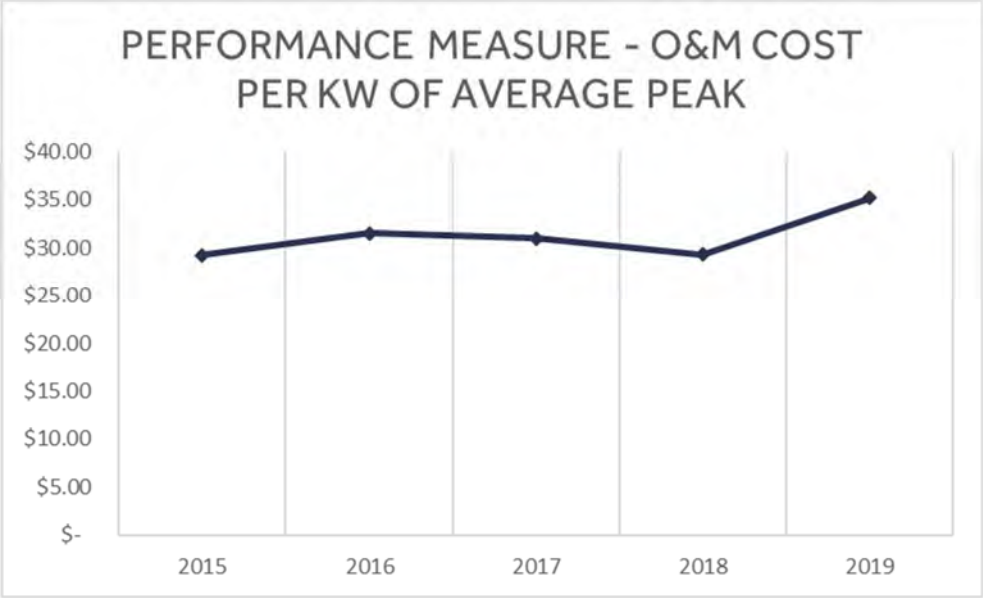


Figure 2-10: Performance Measure - O&M cost per kW of average peak



2.3.2.1.3 Performance Trend into the DSP (5.2.3d)

NBHDL continually strives to manage costs without unduly affecting service to customers or creating significant rate increases while addressing increasing customer expectations of an interactive, value-added service provided. NBHDL understands that the service it provides is an essential part of daily life for customers and increasing bills are a concern for all. NBHDL's costs account for approximately 28.6% of a typical residential customer's bill and the company actively monitors costs against prudent budgets set for both capital and operating costs which are aligned with NBHDL's rate application.

NBHDL continues to seek cost savings and improve efficiency while maintaining quality customer service and effective AM as detailed in the current rate application that sets out the capital and operating investment needs of the business for the next five years. With limited growth in the NBHDL service area, the cost metrics are expected to be in alignment with historical values over the DSP period. NBHDL considers the projects that would have a minimal cost impact on customers but return a benefit to the quality of the service. These trade-offs are considered and were communicated with customers to understand their preferences as part of the online survey mentioned previously. The projects and programs considered within this DSP period take a proactive approach so that NBHDL would be able to maintain its distribution system while minimizing the cost per customer as much as possible. NBHDL's intended goal for these measures is to maintain costs such that the annual increase does not exceed NBHDL's target.

2.3.2.2 ***Distribution System Plan Implementation Progress***

2.3.2.2.1 Methods and Measures DSP (5.2.3a)

NBHDL has based the DSP implementation progress as a percentage of budgeted gross capital spending compared to actual spending. Where forecast to year-end is materially greater than the budget, NBHDL reviews projects and determines if they can be deferred to a later date or reduce their scope. Mandatory projects for a given year are typically not subjected to deferral. NBHDL's target for this measure is that the DSP's actual spending to reach 100% of the approved DSP capital budget annually.

2.3.2.2.2 Historical Performance (5.2.3c)

NBHDL continues to strive in maintaining and achieving its communicated plans. The table below highlights NBHDL's historical performance for the DSP Implementation Progress metric. In 2019, NBHDL achieved 119% of the DSP. NBHDL is aligned with total DSP spending to date as variances to budget in a given year are typically addressed in the overall picture of the five-year plan spending. Given the dynamic nature of the business, several issues emerge over the course of a year that requires the management team to postpone, re-prioritize or otherwise amend the capital work plan adopted at the start of the year. External factors such as extreme cold weather and a deep frost line are the type of elements that can have an impact on the ground when executing the work and cause delays that are outside NBHDL's control.

Table 2-11: Performance Measure – DSP Implementation Progress

Measure	2015	2016	2017	2018	2019	NBH Target
Distribution System Plan Implementation Progress	94%	106%	118%	112%	119%	100%

2.3.2.2.3 Performance Trend into the DSP (5.2.3d)

NBHDL makes every effort to maximize the utilization of assets without compromising reliability or safety and will continue to do so in the future while executing on the DSP. As an effort to manage costs and keep rates low, NBHDL anticipates the capital spending should remain reasonably stable and paced for the forecast planning horizon.

2.3.3 Asset/ System Operations Performance

2.3.3.1 *Safety*

2.3.3.1.1 Methods and Measures (5.2.3a)

NBHDL is committed to protecting its workforce, customers, the public and the environment. In addition to achieving compliance with applicable laws, NBHDL strives for excellence in our environmental, health and safety performance through adopting good management practices and setting clear objectives and targets for achieving continual improvement.

NBHDL has a Joint Health and Safety Committee that meets monthly or as determined by the Committee. Multiple safety training sessions are held for staff throughout the year. While formal meetings and training programs are important, safety is a daily focus and practice for all employees. NBHDL makes every effort to eliminate accidents/incidents in the workplace and should an accident/incident occur, it is investigated for cause(s) and recommend action(s) are put in place when necessary to prevent a reoccurrence.

Additionally, NBHDL engages the public on the importance of safety through several avenues. An annual school program for grade school students provides an overview of electrical safety, safety messages, dangers in the home, safety tips and what to do, how to stay aware, and hazards.

NBHDL has adopted the Electrical Safety Authority ("ESA") Serious Electrical Incident Index into its performance measure scorecard and is annually reported to the OEB. The safety measures provided by the ESA include:

- Component A – Public Awareness of Electrical Safety
- Component B – Compliance with Ontario Regulation 22/04
- Component C – Serious Electrical Incident Index

Reg. 22/04

As with every other Ontario distributor, NBHDL's design, construction, inspection, maintenance practices are audited yearly as required by Ontario Regulation 22/04. The utility can be deemed to be in one of three performance categories:

1. In compliance
2. Needs Improvement
3. Not in compliance

NBHDL's target is to remain in compliance with all categories being audited which reflects NBHDL's 5-year historical performance.

2.3.3.1.2 Historical Performance (5.2.3c)

NBHDL continues to strive in maintaining its employee safety, health & wellness, and public safety measures and in compliance with Ontario Regulation 22/04. The table below highlights NBHDL's historical performance for each of the three components.

Table 2-12: Performance Measure – Safety

Measure	2015	2016	2017	2018	2019	NBH Target
Level of Public Awareness	81%	81%	81%	81%	81%	80%
Level of Compliance with Ontario Regulation 22/04	C	C	C	C	C	C
Serious Electrical Incident Index	0	0	0	0	0	0

In 2018, NBHDL had a single lost-time incident. While the incident was due to electrical contact at a substation and did not result in a serious injury, NBHDL took the situation with the utmost seriousness. NBHDL undertook an extensive investigation and re-evaluated the current practices, made recommendations and implemented those recommendations by reviewing the incident with all staff and retraining qualified personnel on the safe use of all equipment. This reinforces NBHDL's new safety culture established in 2017 as it instills awareness, involvement, accountability, and continuous improvements to ensure that similar incidents are avoided, and every worker returns home safely every day.

2.3.3.1.3 Performance Trend into the DSP (5.2.3d)

NBHDL continues to promote continued education, awareness and application of safe work practices and as such safety continues to play a key role in project prioritization. Ensuring a safe environment for workers and the public has been taken into consideration in the development of the DSP and NBHDL's AM and capital expenditure planning process.

Reg. 22/04

NBHDL continues to demonstrate prudent compliance with Ontario Regulation 22/04 and as such ESA compliance continues to play a key role in project prioritization. Ensuring Reg. 22/04 compliance is maintained has been taken into consideration in the development of the DSP and NBHDL's AM and capital expenditure planning process.

2.3.3.2 ***System Losses***

2.3.3.2.1 Methods and Measures (5.2.3a)

NBHDL system losses are monitored annually. System design and operation are managed such that system losses are maintained within OEB thresholds, as defined in the *OEB Practices Relating to*

Management of System Losses. Losses are monitored to ensure that the OEB 5% threshold is not exceeded. This includes system upgrade projects such as converting the 4.16kV distribution system in the downtown area of the city to 12.47kV, reducing line losses while increasing capacity without the need to construct additional lines. In new construction of lines, NBHDL will utilize optimal conductor sizes to minimize the line losses so far as practical within the design limitations of the project. NBHDL's distribution system is operated in a manner that keeps distribution feeders balanced with phase loading and is geographically configured to maximize efficiency in the delivery of power.

2.3.3.2.2 Historical Performance (5.2.3c)

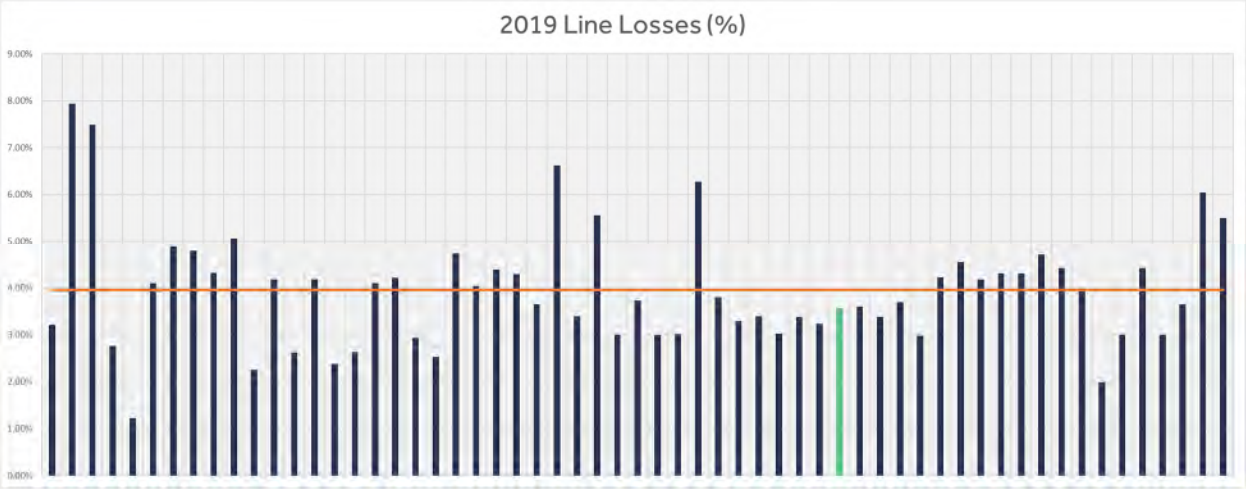
NBHDL system losses over the historical period are shown below.

Table 2-13: NBHDL System Losses

Year	2015	2016	2017	2018	2019	NBH Target
System Losses	4.0%	4.0%	3.7%	3.5%	3.6%	4.0%

Losses are trending in the 3.5 – 4.0% range over the historical DSP period and are trending well within the OEB 5% threshold. According to data from the *2019 OEB Yearbook of Ontario Electricity Distributors*[1], the average annual loss in Ontario was 3.91% in that year. NBHDL's system loss in 2019 was 3.6%, a system loss below the provincial average. The visible green bar in Figure 2-11 is NBHDL's line loss percentage in comparison to Ontario LDCs. It is evident NBHDL is performing well in this performance measure.

Figure 2-11: 2019 OEB Yearbook of Ontario Electricity Distributors Average Annual Line Loss



2.3.3.2.3 Performance Trend into the DSP (5.2.3d)

Historical performance is within the performance target set for line losses. Hence, there is no specific capital impact on the DSP. For the forecast period of the year, NBHDL continues to measure its line losses and manage investments to not exceed the maximum 5% system loss.

[1] http://www.ontarioenergyboard.ca/

2.4 REALIZED EFFICIENCIES DUE TO SMART METERS (5.2.4)

The installation of smart meters provides NBHDL and its customers an operational advantage in maintaining its service while simultaneously improving upon it. These operational advantages include:

- Advanced metering infrastructure ("AMI") data in ODS is used to monitor transformer loading. This allows for NBHDL to plan appropriately which areas require an upgrade before the transformer failing due to accelerated degradation or ageing. Effective planning reduces the overall cost impact experienced by customers. Transformer loading data is also used in designs to effectively size transformers for new and upgraded services.
- Smart meters provide more detailed energy use for customers throughout the day. This enables customers to proactively manage their energy consumption.
- Smart meter usage can be used to analyse and troubleshoot power quality issues.
- NBHDL will continue to investigate and look for economically beneficial considerations to implement an Outage Management System. NBHDL could utilize the functionality of meters to identify the extent of outages and devices that operated. This would permit NBHDL to have faster outage detection and restoration of service. NBHDL does not have quantitative data to currently support this initiative. Once it can be demonstrated that this initiative provides an end-user benefit to NBHDL customers, NBHDL will complete a thorough analysis supported by data.

3 ASSET MANAGEMENT PROCESS (5.3)

This section provides an overview of NBHDL's AM process, a description of assets managed by NBHDL, and a presentation of NBHDL's asset lifecycle optimization policies and practices.

3.1 ASSET MANAGEMENT PROCESS OVERVIEW (5.3.1)

3.1.1 Asset Management Objectives (5.3.1a)

In developing and implementing the Asset Management ("AM") plan, NBHDL's overarching corporate goal is to distribute electricity safely and reliably with the highest operating efficiency to provide good value service (in accordance with NBHDL's goals and objectives) and provide the shareholder with the full regulated return on equity. To achieve this corporate goal in AM planning, NBHDL adheres to the following key AM focus areas with associated corporate objectives.

Table 3-1: RRFE Outcomes – Core Values - Asset Management linkage

RRFE Outcomes	NBHDL Core Values	Asset Management Objective
Operational Effectiveness	Public & Employee Safety	i. Minimize lost time due to accidents involving NBHDL employees or contractors. ii. Minimize public safety incidents caused by factors within NBHDL's control. iii. Maintain compliance with all relevant ESA standards and guidelines.
	Reliability & Supply System Security	i. Managing, maintaining and operating the distribution system in a manner that is cost-effective, and minimizes the duration and frequency of interruptions. ii. Managing and maintaining the distribution system to meet power quality standards in accordance with good utility practise, all applicable standards and guidelines and NBHDL's Conditions of Service.
	Operating Efficiency	i. Continuously identifying and implementing measures that lead to sustainable long-term efficiencies that utilize resources more effectively.
	Getting Full Life out of Assets	i. Continuously improve efficiency and productivity performance to provide better value-for-money.
Customer Focus	Customer Service Quality	i. Maintaining service quality and customer satisfaction rates at or above industry targets. ii. Facilitating local economic development by providing timely responses to new customer connection or service expansion requests.
Financial Performance	Minimizing Asset Life Cycle Costs	i. Providing good value service for money while providing a fair rate of return to the City of North Bay.
Public Policy Responsiveness	Regulatory Compliance	i. Actively support provincial and local public policy objectives.

	Minimizing Environmental Risks	i. Environmental consideration in the design and management of the distribution system.

NBHDL acknowledges that these objectives must be weighted differently depending on various situations to provide the optimal prioritization of asset investments (weightings for the objectives are provided in section 4.2.2). As such, decisions involving investment into fixed assets play a major role in determining the optimal performance of distribution system fixed assets. Investments that are either oversized or made too far in advance of the actual system need may result in non-optimal operation. On the other hand, investment not made on time when warranted by the system needs to raise the risk of performance targets not being achieved and would also result in non-optimal operation. Optimal operation of the distribution system is achieved when "right-sized" investments into the replacement of assets and asset repair, rehabilitation and preventative maintenance are planned and implemented based on a "just-in-time" approach. In summary, the overarching objective of the Asset Management Strategy is to find the right balance between capital investments in new infrastructure, operating costs, and maintenance costs so that the combined total cost over the life of the asset is minimized.

3.1.2 Components of the Asset Management Process (5.3.1b)

The risk-based Asset Management Strategy in use by NBHDL in preparation of the AM plan determines the risk of asset failure based on the condition of the asset, which is commonly measured with the help of a yardstick of "Asset Health Indices". The risk-based framework computes the valuation of the risk-based on consequences of asset failure and identifies the optimal risk mitigation alternative through an evaluation of all available options. Asset management covers the full life cycle of a fixed asset, from preparation of the asset specification and installation standards – to the scope and frequency of preventative maintenance during the asset's service life – and finally to the determination of the assets end-of-life and retirement from service. At each stage of an asset's life cycle, decisions are made to achieve the right balance between achieving maximum life expectancy, highest operating performance, lowest initial investment (capital costs) and lowest operating costs.

In NBHDL's previous rate application, it employed techniques leveraged from PAS-55 to ensure optimal asset planning. PAS-55, a specification for asset management, has been developed and replaced with the latest specification recognized as ISO55000. NBHDL's AM plan is compliant with the PAS-55 AM standard and incorporates all the essential elements. The information found within PAS-55 is informative enough for NBHDL to develop and follow an appropriately sized strategy and plan. In preparing the consolidated DSP, NBHDL's overarching objective was to develop capital and preventative maintenance investment plans, which could be effectively implemented to achieve optimal system performance by focusing on stakeholder needs. Figure 3-1 illustrates the necessary decision framework inputs that were required to develop the optimal CAPEX and O&M investment plans.

Figure 3-1: Investment Plan Decision Framework

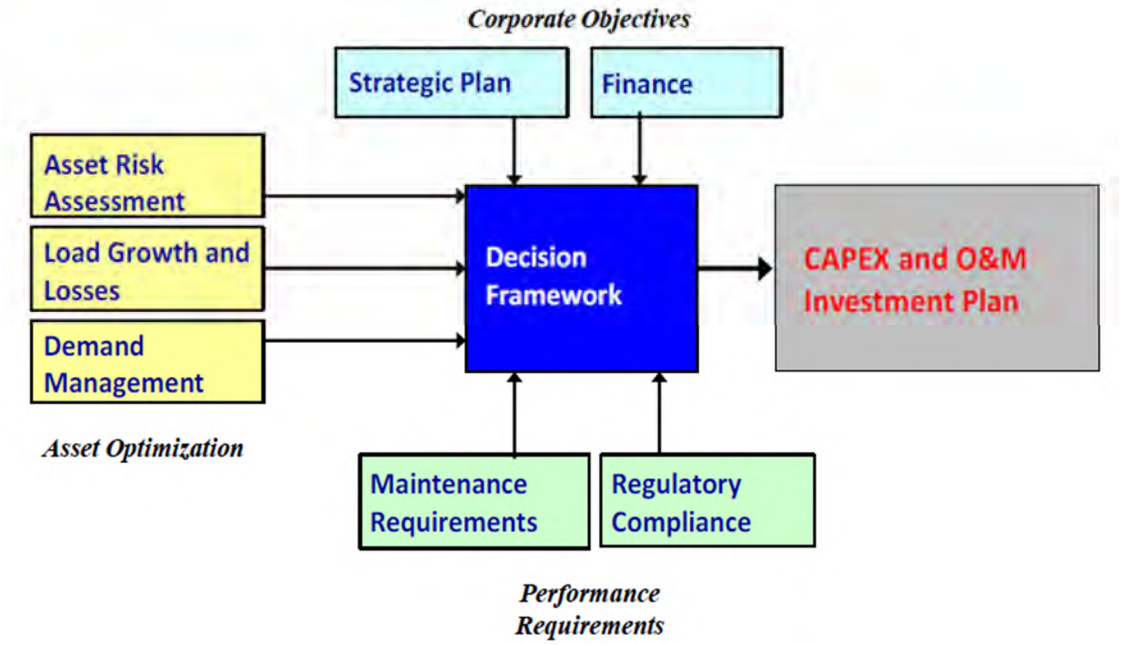


Figure 3-2 shows the basic decision support model employed by NBHDL in preparing the DSP, determining the scope and timing of the investments and prioritizing the investments into specific projects. The timing and size of investments are selected to minimize the "Total Cost" of risk and risk mitigation initiatives.

Figure 3-2: Risk-Based Decision Support System

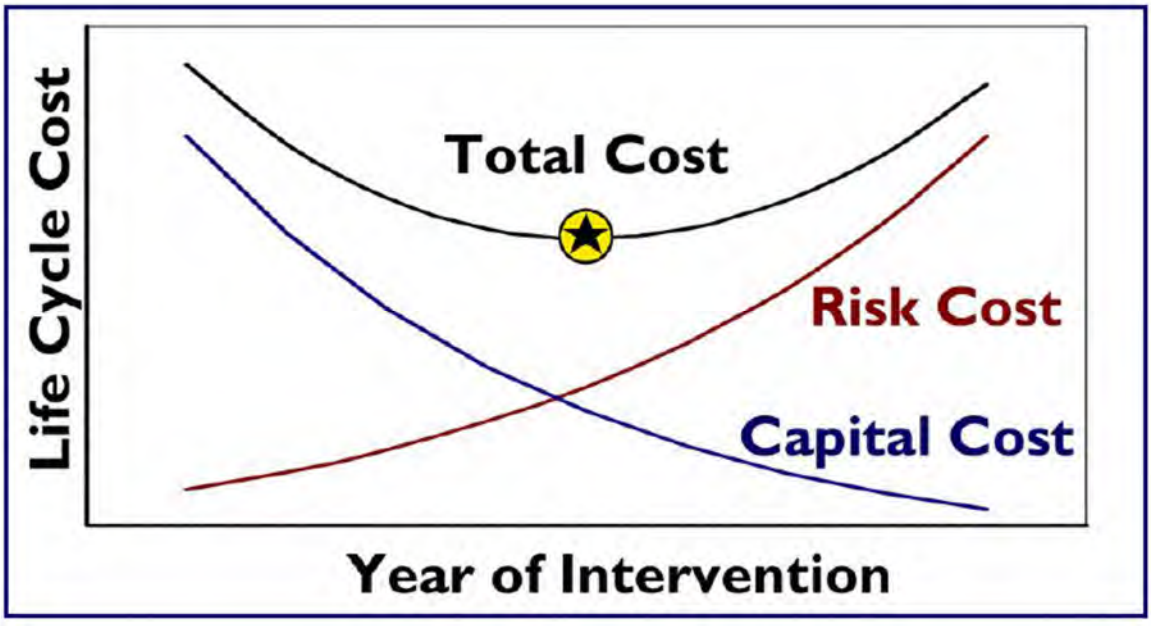
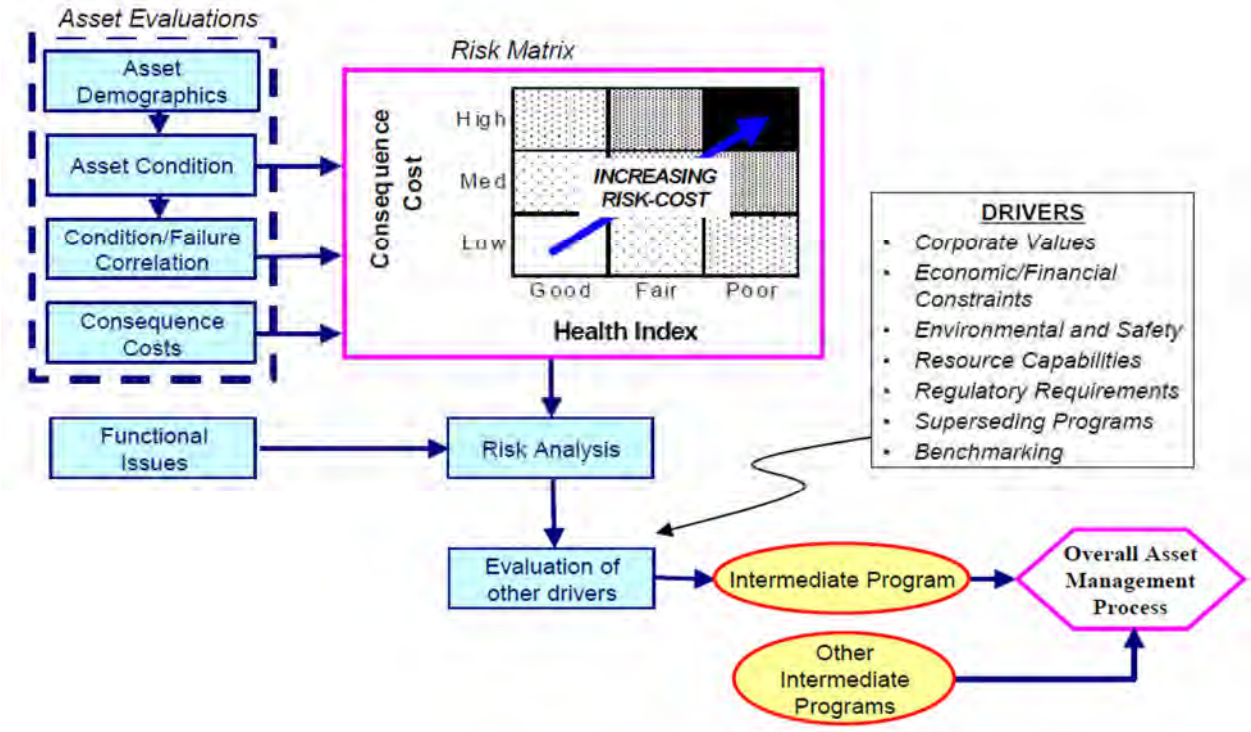


Figure 3-3 summarizes the risk matrix and decision process used to sift through a large number of assets and objectively identify the assets that present the highest risk of in-service failures so that the investments could be targeted into assets exhibiting the highest risk levels.

Figure 3-3: Asset Management Decision Process Flow



Numeric health indices, normalized to a scale of 100, have been used to express the health and condition of assets, further explained in section 3.2.3. This procedure allowed separation of the assets in “Very Good”, “Good” and “Fair” condition that requires minimal risk mitigation from those in “Poor” and “Very Poor” condition, requiring a higher level of investments. By following this process, the investment plan was prepared which is proposed to be implemented in this DSP for execution over the next five-year period.

Asset Register

To ensure efficiency in asset management, NBHDL maintains an asset register of all of its equipment and structures. This register system tracks assets using ArcGIS, NBHDL’s geographic information system (GIS) software.

Project Prioritization

First, NBHDL assesses the health and condition of all assets through an independent asset condition assessment. By considering the consequences of asset failure risk while still in service and the probability of failure, NBHDL determines the scope of investments needed to refurbish or replace assets in a prioritized list to mitigate the significant risks sooner. Prioritization of the System Renewal projects has been established using the Asset Investment Planning (“AIP”) tool, with appropriate weights assigned to various risk consequences (i.e. public and worker safety, power supply reliability, environmental impacts, economic efficiency of investments and regulatory compliance).

Capacity Constraints

Due to the excess capacity available in the NBHDL system, NBHDL has not previously had cause to employ any asst capacity utilization or constraint assessments. As such, these metrics are not informed of this DSP.

Asset Components and Prioritization

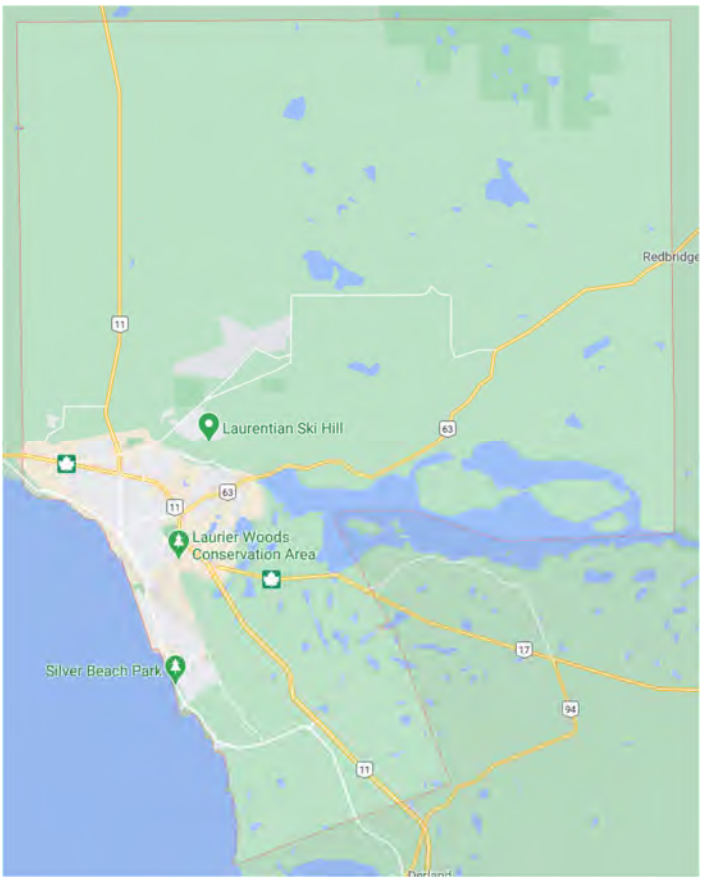
Using the information NBHDL has on the condition of its assets, NBHDL has created an in-depth prioritization matrix for capital expenditure prioritization for each capital year forward. As part of this DSP application, NBHDL has used the matrix to prioritize capital expenditure for 2021 investments. This matrix uses weighted scoring based on a variety of factors (including *inter alia*, reliability, safety, condition and aesthetics) to determine which project to complete at what time during any capital planning year. The weighted scores determine the prioritized order of projects.

3.2 Overview of Assets Managed (5.3.2)

3.2.1 Description of the Service Area (5.3.2a)

NBHDL is a medium-sized LDC in the Province of Ontario, serving the city of North Bay. As of December 31, 2019, NBHDL served approximately 24,197 customers covering an urban land area of 51 square kilometres and a rural land area of 279 square kilometres.

Figure 3-4: Geographical map visualizing the land area of North Bay and surrounding area



North Bay is in Northeastern Ontario, in the Nipissing District, which takes its name from its position on the shore of Lake Nipissing. The city straddles both the Ottawa River watershed to the east and the Great Lakes Basin to the west. Additionally, North Bay is situated on the Canadian Shield which gives rise to a different and more rugged landscape in comparison to Southern Ontario. The presence of several different soil types, the Canadian Shield, numerous clays, and muskeg make all excavation activities a challenge.

The climate in North Bay is typical of most towns in Northern Ontario and tends to be a less humid climate than that found in Southern Ontario. There are large seasonal differences, usually warm summer and cold to occasionally very cold winters. Winter-like conditions generally begin late November and end early April, while summer-like conditions generally begin early June to late August. Temperatures during the winter average to be near -20°C with extremes reaching -40°C, while summer averages near 20°C with extremes of 40°C. The frost-free period for North Bay averages 150 frost-free days a year, though external climate models may indicate a growing trend across the province of Ontario. Snowfall averages 50 centimetres per winter month.

The region is vulnerable to tornados and strong windstorms are a common occurrence. While potentially vulnerable, NBHDL's service area has not experienced any major storm event over the historical period.

NBHDL's distribution system area can be considered predominately suburban and largely overhead. The economic growth in the region is slow thus limited growth and expansion can be observed and anticipated on the infrastructure over 10 years.

3.2.2 Summary of System Configuration (5.3.2b)

NBHDL owns and operates 17 municipal stations. One substation, MS7, steps down from 44kV to 4.16kV. One substation, MS18, has dual winding transformers capable of supplying both 4.16kV and 12.47kV. The station consists of two transformers with each one supplying 4.16kV and 12.47kV. The remaining NBHDL substations step down from 44kV to 12.47kV.

Table 3-2 shows the length of overhead lines and underground cable phases employed on each distribution voltage system. There are 57 distribution feeders, of which seven are operating at 4.16kV and the remaining 50 operating at 12.47kV. There are eight sub-transmission feeders all operating at 44kV.

Table 3-2: System length configuration

	Overhead Line Lengths (km)		Underground Cable Lengths (km)
Voltage	*Distribution 4.16kV / 12.47kV*	*Sub-Transmission 44kV*	*Distribution 4.16kV / 12.47kV*
1 Phase	154	0	34
2 Phase	0	0	5
3 Phase	247	93	40
Total	401	93	80

NBHDL is bounded by HONI on all service territory boundaries. NBHDL is embedded in HONI's 44kV sub-transmission system at the City's water treatment plant located at 248 Lakeside Dr. and at substation #17, which is in North Bay's rural area at 20 Peninsula Road. HONI (distribution) is embedded in NBHDL's 44kV sub-transmission system at Bond St., also known as Wood's Junction. HONI (distribution) is also embedded in NBHDL's 12.47kV distribution system at the northern city limits of North Bay on Highway 11 North.

The substation ratings and maximum peak load reached at each of the substations during the past five years are indicated in Table 3-3 below.

Table 3-3: Station ratings and five-year historical peak load level

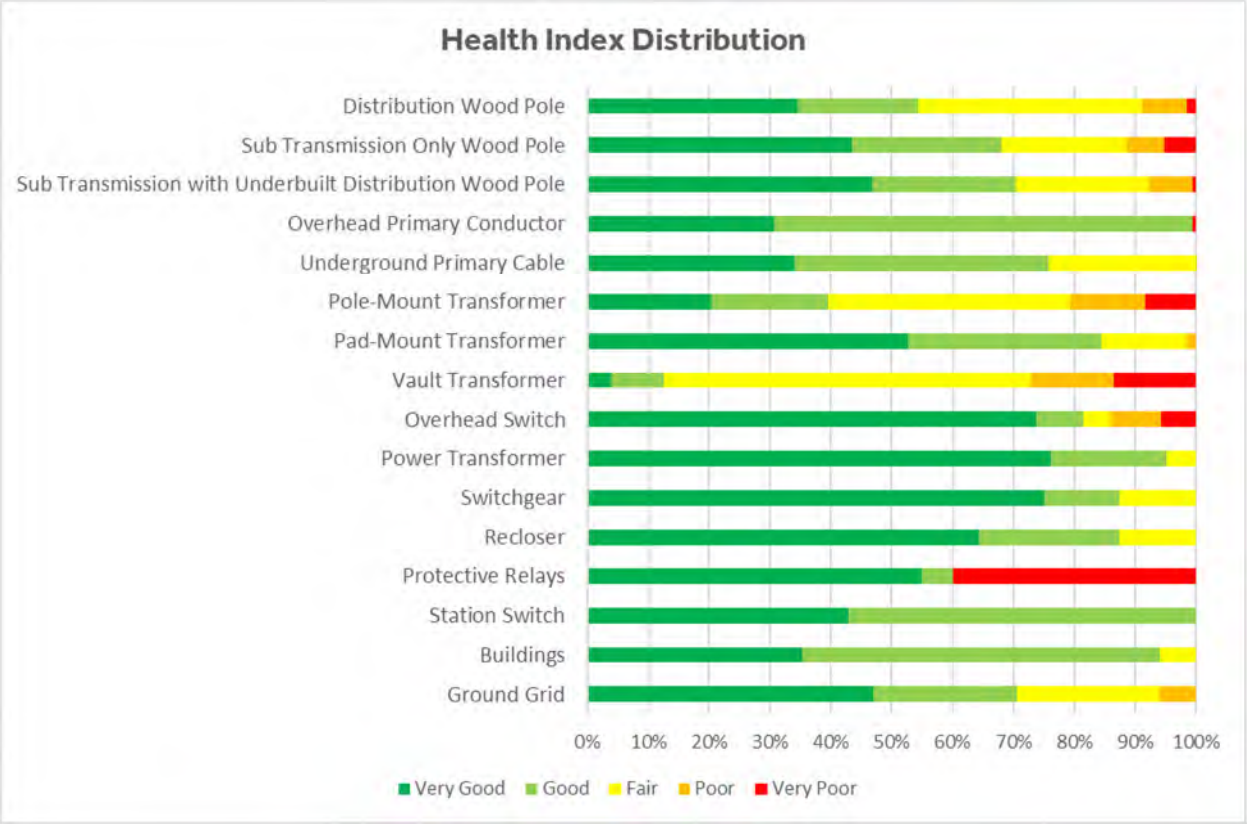
Distribution Station	MVA Rating		Peak Load During Last Five Years	Percent Peak Load of Max MVA Rating
	ONAN	ONAF		
12.47kV Supply Distribution Stations				
MS1	7.5	10	2.28	23%
MS4	7.5	10	7.24	72%
MS8	7.5	10	5.32	53%
MS10 (T1)	7.5	10	5.36	54%
MS10 (T2)	7.5	10	4.59	46%
MS11	7.5	10	7.76	78%
MS13 (T1)	7.5	10	4.41	44%
MS13 (T2)	7.5	10	5.30	53%
MS14	7.5	10	8.63	84%
MS15	7.5	10	7.86	79%
MS16	7.5	10	6.10	61%
MS17	7.5	10	5.75	58%
MS18 (T1)	7.5	10	7.95	80%
MS19	7.5	10	7.88	79%
MS20	7.5	10	8.59	86%
MS21	7.5	10	7.93	79%
MS22 (T1)	7.5	10	3.12	31%
MS22 (T2)	7.5	10	5.51	55%
MS23	2.5	N/A	0.74	30%
4.16kV Supply Distribution Stations				
MS7	5	6	5.01	84%
MS18 (T2)	7.5	10	4.72	47%

Few transformers have peaked above or near 80% capacity. NBHDL intends to monitor these transformers and their capacities periodically to maintain system performance and optimization. NBHDL may need to explore alternatives such as reconfiguration and complete feeder analysis for these specific units to manage the risk of overloading power transformers over an extended period. However, on a system level, there are no capacity constraints throughout NBHDL's system, with available capacity for future growth.

3.2.3 Results of Asset Condition Assessment (5.3.2c)

The Asset Condition Assessment ("ACA") study was carried out by METSCO for NBHDL to establish the health and condition of station and distribution assets in-service. The study was completed in September 2020. The study is supported by NBHDL's data collection processes through current maintenance practices, such as visual inspections, pole testing, and power equipment oil sampling. Figure 3-5 presents the summary results of the ACA.

Figure 3-5: NBHDL Health Index Distribution for Major Assets



As the figure above indicates, the majority of NBHDL's distribution system is in Good or better condition, with specific asset classes containing units found to be in Poor and Very Poor condition – most notably pole-mount transformers, vault transformers, overhead switches and station protective relays. The remaining assets exhibit a condition degradation pattern that can be expected of a mature utility and require periodic system renewal to mitigate additional failure risks of assets. Although some of the assets' condition may not report as "poor" or "very poor" in the ACA, the asset might be at an age that is typically considered the end of its useful life and would be prioritized for replacement. In order to perform proper resource planning and distribute investments evenly during the 5-year period of this DSP, NBHDL might choose to replace an asset based on its age to decrease the risk of failure. It is important for NBHDL to spread out its assets expenditures to avoid NBHDL having too many assets to replace in the same year. NBHDL does not have the capacity and resources to replace numerous assets at the same time. Leaving old assets in place would increase the risk of impacts to customers due to component failures and leave the system vulnerable to outages. Feeder information as explained in Section 2.3.1.3.2 does not drive NBHDL's capital investments in any significant way. NBHDL's experience with its worst performing feeders are primarily a result of tree contact, which is addressed through the vegetation management program within OM&A. For the 2021 test year, there are no specific capital projects related to feeder improvement.

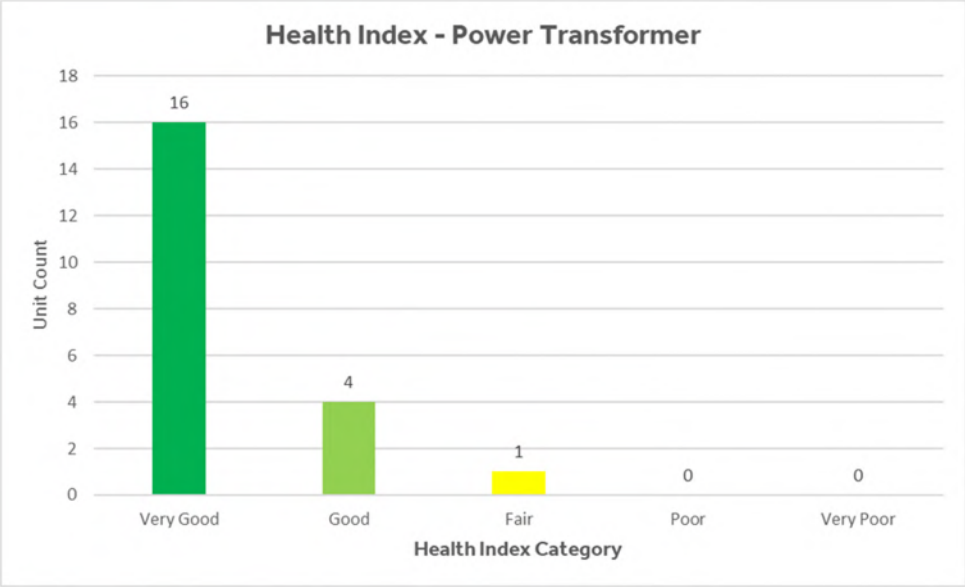
The complete ACA report is filed in Appendix C.

Station Transformers

The key role of station transformers is to step down transmission or sub-transmission voltage to distribution voltage. NBHDL has 21 in-service power transformers. A single power transformer is in-

service for more than 50 years and presents a risk of failing based on a typical useful life of 45 years. Figure 3-6 presents a detailed breakdown, with 95% of assets being in Good or better condition.

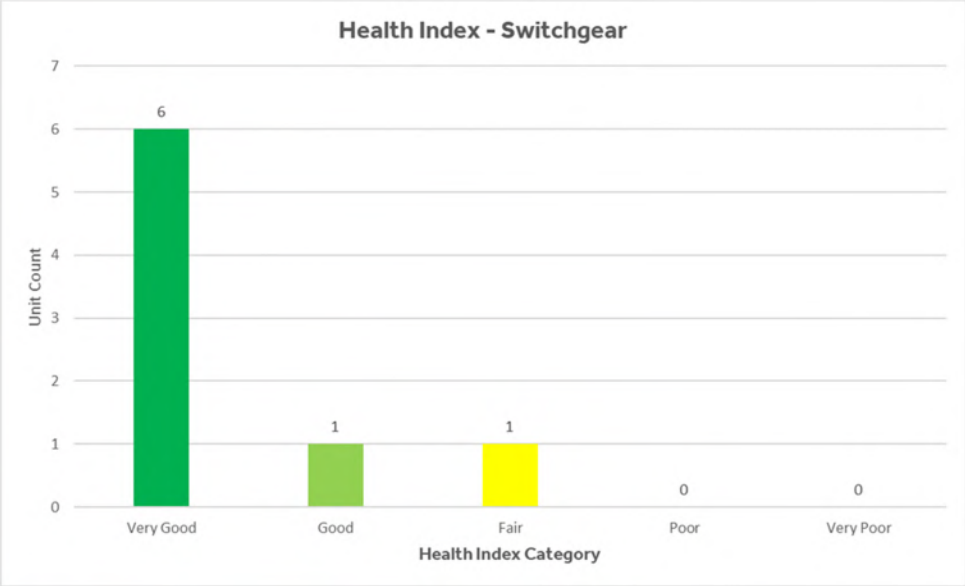
Figure 3-6: Power Transformer Health Index Demographic



Station Switchgear

NBHDL distribution system employs a total of 8 switchgears. All the switchgears at the NBHDL system are in-service for less than 30 years. No risks associated with asset conditions are identified, with 87% of the asset class being Good or better condition, shown in Figure 3-7.

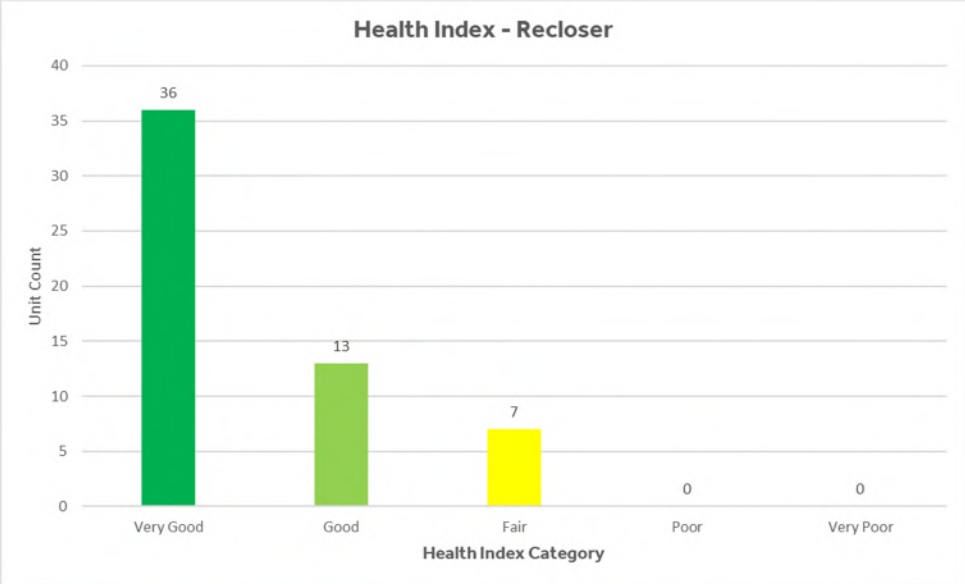
Figure 3-7: Switchgear Health Index Demographic



Recloser

Reclosers are installed on the distribution system to interrupt the circuit during a fault and are designed to automatically reclose to restore the normal operating conditions. NBHDL owns 31 oil type and 25 vacuum type reclosers within its service territory. All the reclosers are in-service for less than 30 years in service. No risks associated with asset conditions are identified, with 87% of the asset class being Good or better condition, shown in Figure 3-8.

Figure 3-8: Recloser Health Index Demographic

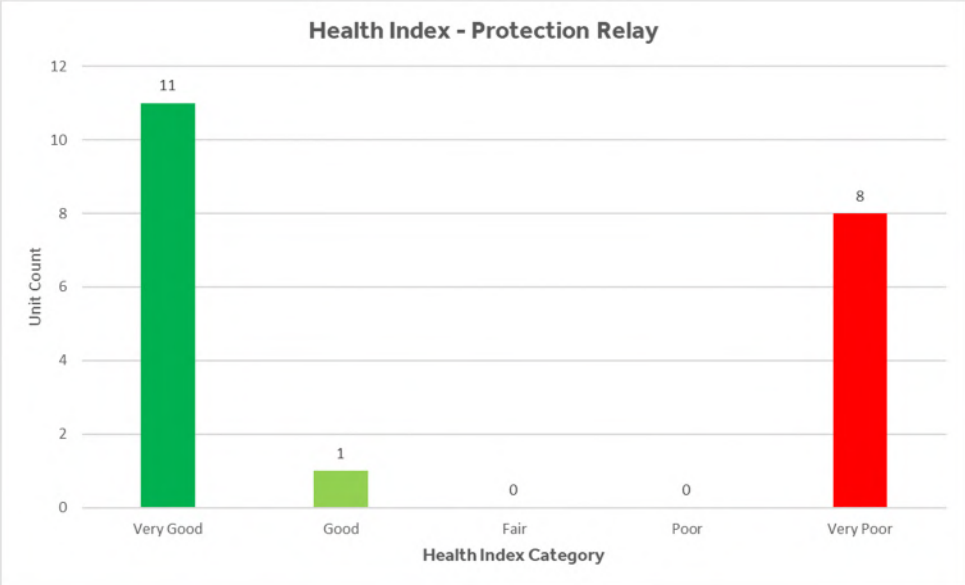


Station Protection Relays

The function of protection relays on distribution systems is to detect and annunciate abnormal operating conditions and initiate circuit breaker or recloser trip to isolate faulty circuits from healthy circuits. Protection relays obtain their input from instrument transformers, process the information, and automatically take corrective action with adequate speed and selectivity.

NBHDL employs a total of 20 protection relays in its stations. All protection relays are in-service for less than 30 years. 40% of the relays are in Very Poor condition shown in Figure 3-9. The main factors driving these relays into Very Poor condition are discretionary and non-discretionary obsolescence considerations. NBHDL has identified several of the oldest relays to be obsolete and has planned investments to address the Very Poor assets.

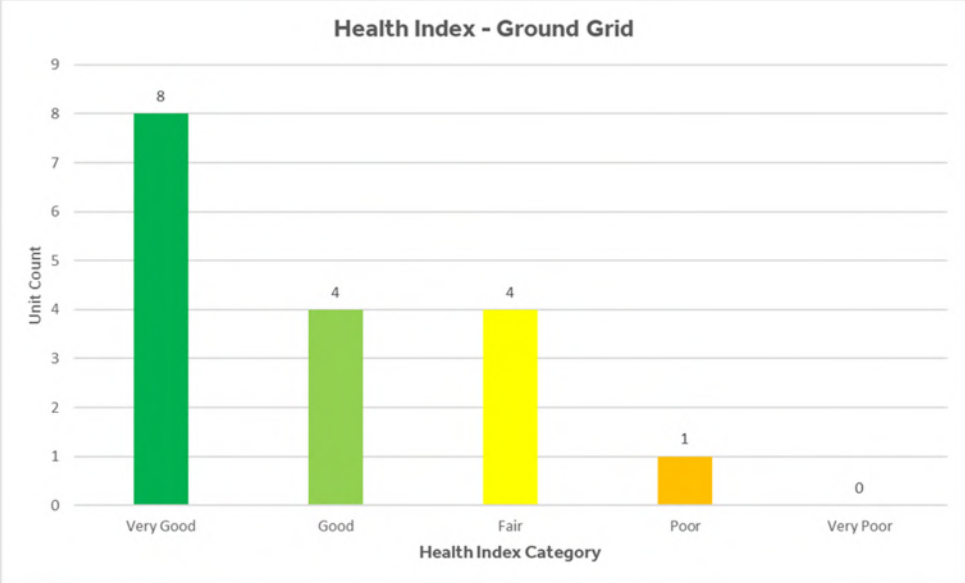
Figure 3-9: Protection Relay Health Index Demographic



Station Ground Grid

The purpose of a substation ground grid is to provide a low resistance ground electrode for system neutral, for equipment case grounding and to maintain safe potential gradients within the station yards during abnormal operating conditions, i.e. line-to-ground faults. NBHDL owns 17 stations within its service territory, each equipped with a ground grid. More than half of the grids are younger than 40 years old. The recent assessment determined the majority of ground grids are in acceptable condition with few experiencing subpar conditions shown in Figure 3-10. Ground grids that are planned to be maintained over the DSP period to manage safety risks.

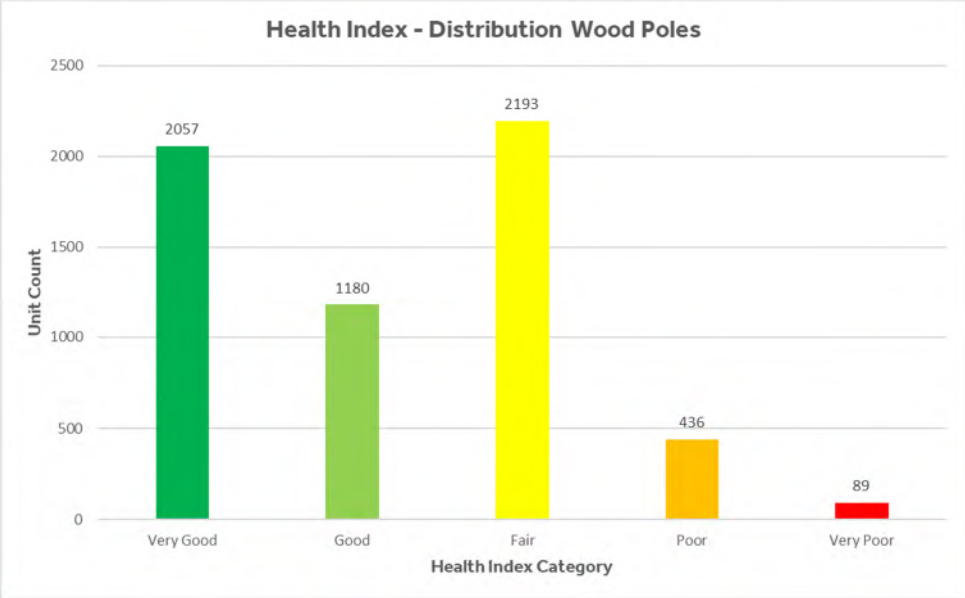
Figure 3-10: Station Ground Grid Health Index Demographic



Distribution Wood Poles

NBHDL owns approximately 10,384 distribution wood poles within its service territory. The recent assessment considered only poles with condition data to approximate a health value with a higher degree of confidence. The output of the assessment indicates that NBHDL's pole population experiences normal degradation which requires regular maintenance and renewal investments to maintain the existing health.

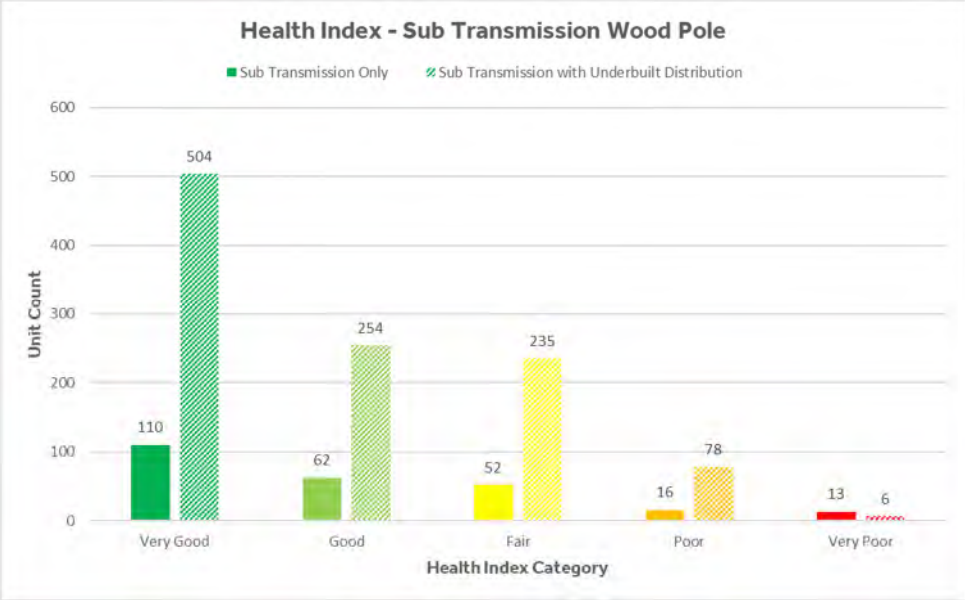
Figure 3-11: Distribution Wood Pole Health Index Demographic



Sub-transmission Poles

NBHDL owns 253 poles with sub-transmission lines only and 1,077 poles with sub-transmission and underbuilt distribution lines. The sub-transmission poles experience a similar degradation rate as distribution poles, in which NBHDL is required to regularly maintain and invest in asset renewal to manage the risk and health of the population.

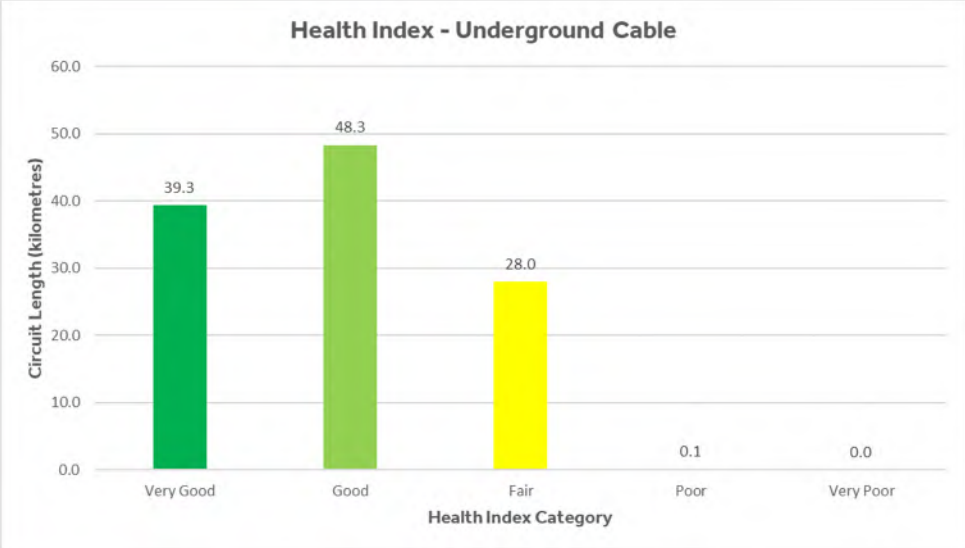
Figure 3-12: Sub-Transmission Pole Health Index Demographic



Underground Primary Cables

For the completed assessment, the underground cable length is measured in kilometres of the circuit, where a 1-km run of three-phase cable is measured as 1 km rather than 3 km. NBHDL owns 116 km of primary underground cables across its distribution system. The oldest cable installations date back to approximately 50 years ago. Figure 3-13 presents the Health Index condition for underground primary cables. NBHDL notes it will explore the possibility of testing their underground cable segments in areas exhibiting an increase in failures to proactively manage the failure risk and to prioritize the investments in ongoing cable renewal.

Figure 3-13: Underground Primary Cable Health Index Demographic



Distribution Transformers

Overhead (pole-mount) transformers are installed on service poles above ground with the primary function to step down power from the medium voltage distribution system to the final voltage rating for customer use. Distribution underground transformers are utilized for similar functionalities as pole-mount transformers. They step down power from the medium voltage distribution system to the final utilization voltage for the customer, however, they are located below ground or on the ground level. Two types of underground distribution transformers are assessed: Pad-Mount transformer and Vault transformer.

NBHDL owns 2,419 pole mount transformers, 676 pad mount transformers, and 22 vault transformers within its service territory. Figure 3-14 presents the Health Index condition for pole mount transformers. Figure 3-15 presents the Health Index condition for underground transformers. NBHDL's distribution transformers experience a normal degradation pattern and require continuous monitoring and renewal investments to manage the population's health and failure risk.

Figure 3-14: Pole Mount Transformer Health Index Demographic

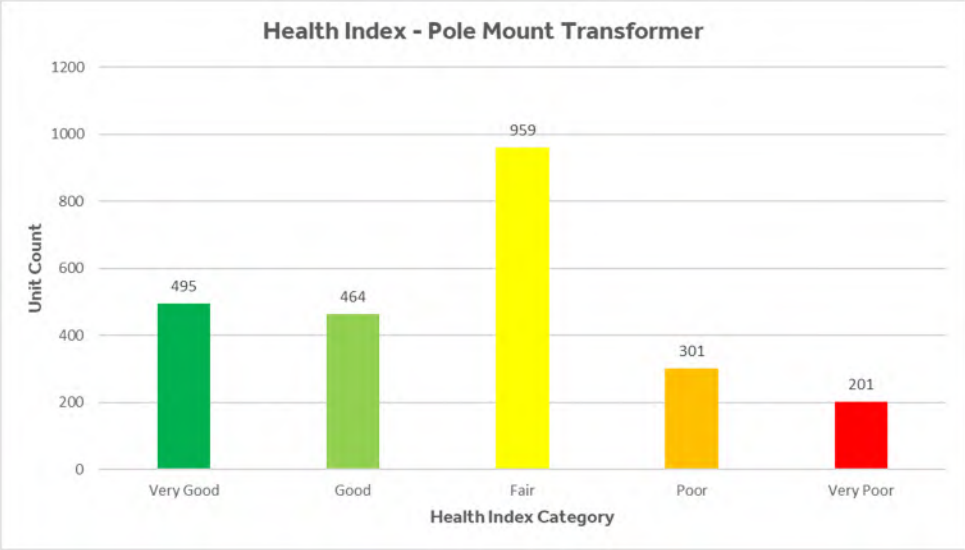
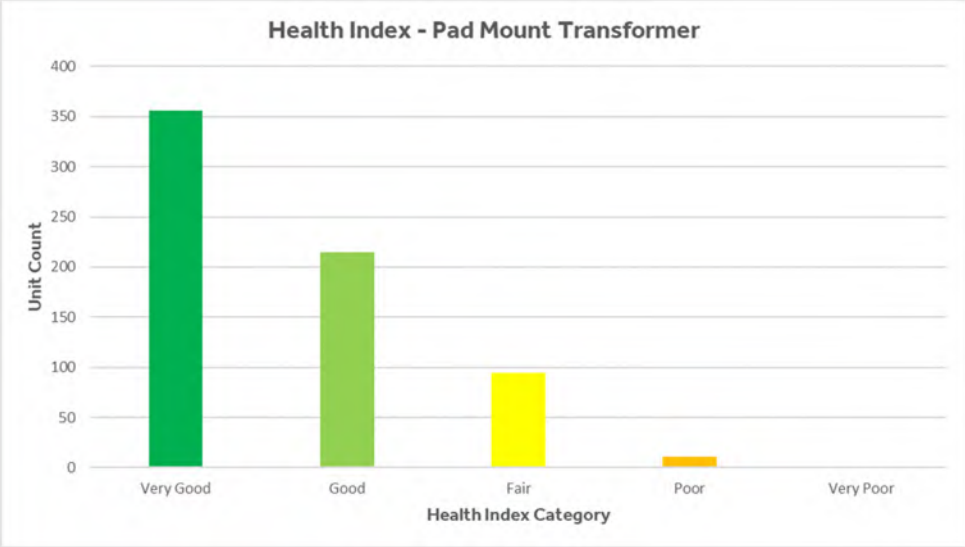


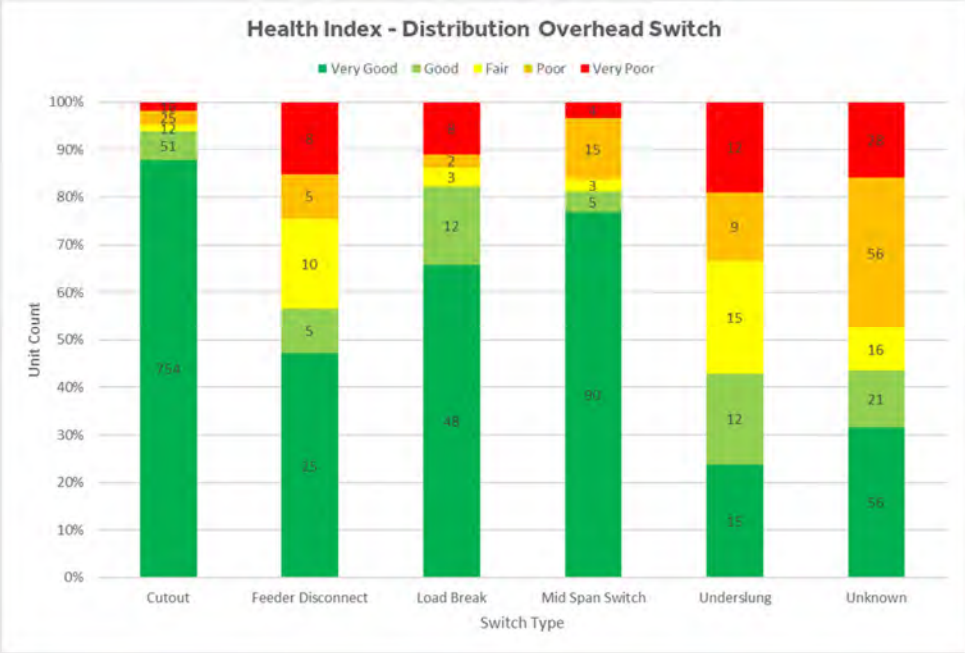
Figure 3-15: Underground Transformer Health Index Demographic



Distribution Overhead Switches

NBHDL's distribution overhead switch types include fused cutout and load break and are located on its service poles. NBHDL owns 1,141 overhead switches within its service territory. The overall Health Index distribution for the overhead switches is presented in Figure 3-16. Across all switch types, approximately 86% of the switches are in Fair or better conditions. NBHDL utilizes its asset lifecycle and maintenance practices to proactively manage the condition and associated risks of units that are below Fair condition.

Figure 3-16: Distribution Switch Health Index Demographic



3.2.4 System Utilization (5.3.2d)

The two HONI owned transmission stations ("TS") that supply the NBHDL system (NBTS, FZ15 and TLTS, FZ18) provide more than enough capacity to serve the area, now and over the entire planning horizon, while accounting for redundancy and future growth. TS transformer capacity constraints are therefore not identified as being an investment driver over the 2021-2025 period.

NBHDL's distribution stations have sufficient capacity to serve current and future loads while still maintaining a high degree of redundancy. Few transformers have peaked or are approaching the 80% threshold NBHDL designs the stations for. This may cause NBHDL to further investigate possible alternatives to manage the risk of overloading a transformer, especially in growth areas. Distribution station transformer capacity constraints are therefore not identified as being an investment driver over the 2021-2025 period. See Table 3-3 for the historical utilization rate of each transformer, reinforcing the fact that there are no capacity constraints observed on the system as a whole.

3.3 Asset Lifecycle Optimization Policies and Practices (5.3.3)

The lifecycle optimization policies and procedures used for the forecast period, including the optimization of the capital investment plan as well as optimization of the preventative maintenance practices are described in the following sections.

3.3.1 Asset Lifecycle Optimization Policies and Practices (5.3.3a)

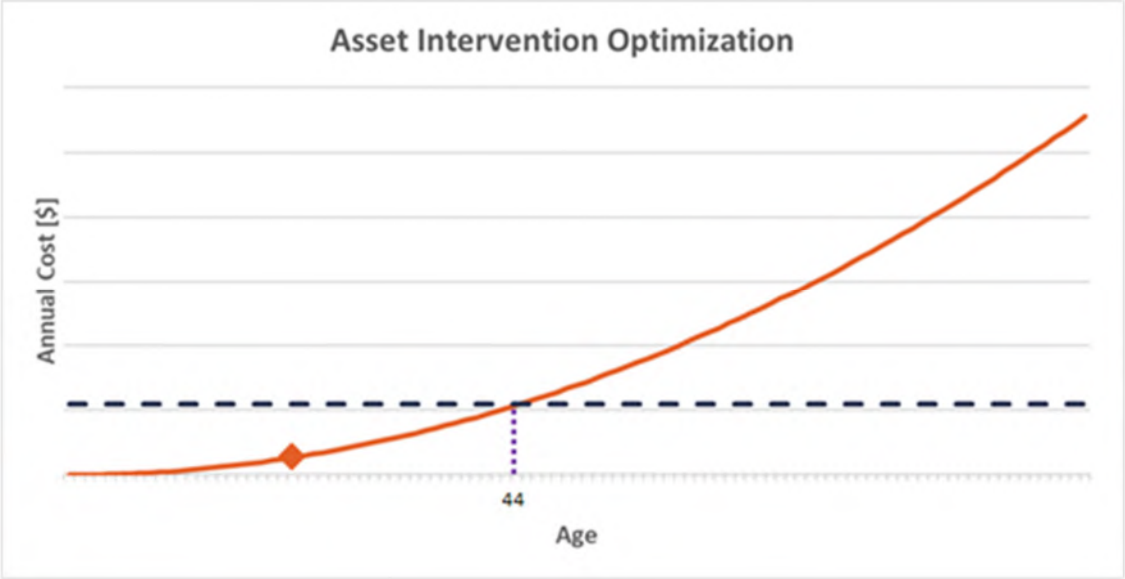
Asset Replacement Policies and Prioritization of Capital Investments

An overview of the AM principles employed to achieve the economic efficiency of the investments is provided in Section 3.1. The identified principles contribute to the optimization of capital investments into fixed assets. To determine the scope and timing of investments into asset renewal, NBHDL first identifies the assets that have reached the end of their economic life and are due for replacement or refurbishment. The basic concept is that during the decision process to replace an ageing asset, a utility faces two competing objectives. On one hand, NBHDL would like to wait as long as possible to replace to minimize capital spending. On the other hand, if NBHDL waits longer it will face higher risk due to possible in-service failures as the asset ages and its health deteriorates and it becomes more likely to fail. The strategy that optimizes this trade-off is to minimize life-cycle costs, which includes O&M. Routine system O&M tasks contribute to NBHDL's understanding as to when an asset has reached a deteriorated state and requires renewal. If there is an increase of deteriorated assets, the renewal investments would be increased. This is applicable to distribution assets where once an asset has reached a deteriorated state, no O&M tasks can be applied to extend the service life. For station assets, NBHDL evaluates each asset's investment need on a case-by-case basis to determine overall benefit of the replacement and the O&M impacts of those investments.

The full range of relevant technical and economic considerations is integrated into this approach. Asset age and condition are used to estimate failure probability. Criticality (i.e. customer impact) is used to define the consequence of failure. Direct costs such as maintenance and capital replacement cost are integrated as well. All costs are defined from the perspective of the customer, which supports rate making and budgeting with the regulator. In particular, the risk of failures captures the estimated customers' cost due to lost service.

Figure 3-17 shows graphically how the optimization is performed, using an example of a station transformer. The horizontal, blue-dashed line is the levelled lifecycle cost of a new asset which is the overall cost of the asset divided by the number of years. The overall cost is usually the sum of capital, maintenance, risk and operating costs over the planned/designed lifespan of the asset. These vary by asset. The orange curve is the risk plus maintenance cost of the existing asset as it ages. This is known as the marginal cost. Risk is defined as the probability of failure, which increases as the asset ages, multiplied by the consequence cost of failure. As long as the marginal cost of the existing asset is lower than the levelled cost of the new one, it is cheaper to leave the existing asset in operation. When the curves intersect, the marginal cost of the existing asset is higher than the cost of a new one and the asset is at the end of its economic life. In the example below, the transformer is estimated for replacement approximately at age 44. Using this methodology, NBHDL determines how spending is optimized, prioritized and scheduled to align with budget envelops in accordance with NBHDL's processes. The graph is not meant as a reference to actual data, but to illustrate the theory.

Figure 3-17: Asset intervention optimization strategy (example shown for power transformer)



Maintenance Planning Criteria and Assumptions

NBHDL's approach to maintenance planning is asset-specific and location-specific. It does not assign a constant economic life to all assets but determines the economic life of each asset based on its unique role in the operation of the distribution system. For example, it is not possible to say that all station reclosers have an economic service life of 30 years. Rather, NBHDL follows the industry-accepted useful life of reclosers to be 30 years, but each unique reclosers has varying conditions and hence affect the service life of the asset.

Generally, maintenance is not performed in a similar way as the capital program. Most of the crews' capacity typically go towards the execution of capital investments with the remainder being available for O&M. Estimating the capacity and cost of the O&M work is comprised of estimating the resourcing of employees, equipment, costs of disconnects/reconnects, locates and reactionary maintenance (such as trouble calls).

NBHDL projects the majority of its maintenance program activities to be continued into the forecast period similar to its historical period with additional maintenance and testing as described in the next section. NBHDL assumes that the preventative and reactionary maintenance protocols it has engaged through the historical period is the minimal amount of maintenance that could be completed to maintain the overall system given that it does not anticipate any capacity constraints or significant O&M increases/decreases coming from capital investments. In order to obtain optimal efficiency for the forecast period, improve asset utilization and management, and maximize investment value, NBHDL must enhance its maintenance program as described below.

Maintenance and Safety Inspections

Proper maintenance is essential to prolong asset lifecycles and maintain system reliability. NBHDL's maintenance program employs equipment manufacturer's recommendations as well as best industry practices in determining the scope and frequency of maintenance for its assets. Maintenance programs comply with the regulated requirements for maintenance established by the Distribution System Code. Maintenance activities are divided into two categories: reactive and preventative.

Reactive Maintenance

This type of maintenance consists of activities that involve addressing infrastructure that is operating outside of normal specifications, in a state that can lead to imminent failure, is inoperable and/or has failed. Reactive maintenance is not planned and therefore is budgeted for using historical incidents and cost trends.

Preventative Maintenance

This type of maintenance consists of planned activities that address assets on a cyclical basis to ensure continued reliable operation while managing premature failure. The following preventative maintenance activities used by NBHDL are listed and described.

I. Substation inspections

The substation inspection program occurs monthly throughout the year. Each substation is visited by NBHDL's substation personnel to complete a visual inspection on all major assets including substation grounds comprised of fencing, grounding, and the control building. There is no de-energizing of assets to complete a thorough visual inspection. The inspection is documented on a form and filed for future reference. Deficiencies are noted and contribute to the assessment of the asset's condition which feeds into NBHDL's risk framework. Significant deficiencies are addressed on time and are prioritized based on severity and resources.

II. Substation preventative maintenance

The substation preventative maintenance program is on a four-year cycle. The work comprises of the following activities:

- Power transformer testing
- Leakage testing of all underground cables
- Resistance testing of all connections
- Cleaning of all major equipment, with attention to the contact area
- Thorough visual inspection of all major assets, with attention to insulators and buss work
- Torqueing of all required connections
- Lubrication of moving parts
- Refurbishment of assets with identified deficiencies

To complete the maintenance activities, de-energizing and isolating the station from the grid is required to safely complete the tasks.

III. Power transformer oil testing

The oil used in all power transformers is sampled by NBHDL substation personnel every spring and submitted for laboratory analysis. The oil analysis includes:

- DGA
- Dielectric breakdown
- Interfacial tension
- Specific gravity
- Colour
- Visual condition
- Water content
- Power factor @ 25°C

A report provided from the laboratory summarizes the results and recommends a course of action with consideration only to the oil of the transformer. Trending over 10 years is also provided for each

transformer. In cases where the oil is unsatisfactory, the power transformer is removed from service and additional thorough testing is performed as required.

The Furan analysis is performed occasionally when there are evident signs of insulation stress. For NBHDL's Furan analysis, NBHDL gets a recommendation from the sampling company. When the results of the analysis indicate no signs of paper stress, the transformer is acceptable for continued use until a resampling is completed. The Furan analysis is completed on a three-year cycle. Should the analysis indicate marginal or bad results, NBHDL would be required to remove the transformer from service. NBHDL then consults a transformer expert to ensure the transformer did not reach failure and can cause any outages, damage, or place any person in a safety risk.

IV. 44kV load break switch maintenance

The reliable operation of the 44kV system is crucial to the overall performance of the grid. The 44kV system directly services all of NBHDL's substations and all customers over 1MW in size. Due to the critical nature of the system, NBHDL performs maintenance on all 44kV load break switches. The switches are inspected and maintained on a three-year cycle. The maintenance involves isolating the switch, exercising the closing mechanism, realignment if necessary, cleaning all contact areas, visually inspecting the arc chutes and snuffers, ensuring all grounding is adequate, making any necessary repairs, and lubricating all moving parts. Deficiencies are noted and contribute to the assessment of the asset's condition which feeds into NBHDL's risk framework. Significant deficiencies are addressed on time and are prioritized based on severity and resources. There are instances where the maintenance activity can lead to direct replacement of the switch to maintain the reliability of the network.

V. Pole inspection program

As prescribed by the DSC, NBHDL conducts visual pole inspections each year with all poles visited every three years. In other terms, each pole is on a three-year visual inspection cycle. The visual inspection includes an assessment of the pole condition and any undue safety hazard to the public and the workers. This includes the opportunity to assess all attachments (dips, crossarms, guys, insulators, transformers, switches). Deficiencies pertaining to safety are addressed within a timely manner

In addition to the visual inspection, NBHDL completes a condition assessment of their poles. The entire system is assessed on a five-year cycle. The completed assessments feed into NBHDL's risk framework for capital planning and prioritization.

VI. Wood Pole Testing Program

The goal of this maintenance program is to perform non destructive testing to diagnose the current health of wood poles in NBH's distribution system. This testing will collect information not available through visual inspections such as internal pole decay (at and below the ground line) as well as make a determination on the remaining strength of the pole. Many utilities in Ontario (at least 11) are performing ongoing pole testing using contractors.

Pole testing will collect information on the remaining strength of the poles and will use the information to reproduce a health index on pole assets based. Remaining strength is one of the most important factors in determining pole failure risk. This information is important for North Bay Hydro for its long-term project planning. It will help to develop a solid asset management program that prioritizes pole replacements. It will also improve safety as information on poles indicating rot might not be visible. A failed pole can potentially result in energized high voltage conductors being brought to ground level where they might come in contact with the public.

In order to minimize costs, NBHDL intends to conduct these tests only on high voltage conductors and equipment and poles that are over 10 years old.

VII. GIS Program

NBHDL's GIS is the main repository for the organization's asset information and critical to the operation, data collection and asset management of the company. NBHDL has identified the need to upgrade its GIS license to the "Small Utility Enterprise Licensing Agreement" with our supplier (ESRI). This would provide the following benefits:

- Increase number of license users to access GIS for more Engineering and Operations staff (only 7 licenses at this time);
- Access to a server supported version of the software which improves the performance of the system. The current version is becoming increasingly obsolete and struggles to keep up with the increased data that can be stored;
- Ensure continued access to essential tools. As ESRI moves its technology forward, changes to the licensing program means that NBHDL will gradually lose access to essential tools such as "Geometric Network";
- Support of the old ArcMap which is provided in NBHDL's current GIS version has been extended past its original expiry date and will likely become unsupported within the next few years;
- NBHDL utilizes GIS for its Electronic Asset Inspection Program. This program was started with the visual Pole Inspection Program (see item V. above) and will be moving to other assets' inspections. The elimination of manual data entry from paper records has already saved numerous hours of staff time, reduced errors in duplicating/entering information into database and made information readily available for viewing and analyzing results. In order for NBHDL to continue with this program, it requires an enterprise agreement or it will have to revert to manual paper information collection.

VIII. Feeder inspection program

As prescribed by the DSC, NBHDL conducts a patrol on a third of its feeders each year. In other terms, the feeder inspection program is on a three-year cycle. The patrol of each feeder starts at the substation and involves driving and walking (in certain locations) the path of the entire feeder until all sections of the circuit are covered. Deficiencies are noted and contribute to the assessment of the asset's condition which feeds into NBHDL's risk framework. Significant deficiencies are addressed on time and are prioritized based on severity and resources.

IX. Pad-mount and vault inspections

As prescribed by the DSC, NBHDL conducts visual inspections on a third of the pad-mount transformers and vault locations each year. In other terms, the pad-mount and vault inspection programs are on a three-year cycle. Each inspection involves a site visit where all aspects are visually inspected, both externally and under the lid of the unit (i.e. bushings, elbows, secondary connections). Deficiencies are noted and contribute to the assessment of the asset's condition which feeds into NBHDL's risk framework. Significant deficiencies are addressed promptly and are prioritized based on severity and resources.

X. Thermographic infrared inspection

NBHDL carries out thermographic infrared ("IR") inspections every year on its overhead system. The sub-transmission system including substations is inspected on a one-year cycle whereas the overhead

distribution system with a focus on overhead transformers and switches is inspected on a three-year cycle. Additionally, the oldest operating pad-mount transformers may also be scanned if resourcing permits it. IR inspections are completed by an external contractor who is accompanied by NBHDL staff.

A report is produced identifying all the areas that require attention. Issues found are categorized with a time indication as to by when the issue should be addressed to avoid any significant deterioration or faults. NBHDL corrects all issues within the recommended timelines.

XI. Vegetation management

Vegetation management is the largest preventative maintenance activity performed by NBHDL. It includes the complete removal or trimming of trees. This provides significant benefits, including safety (meeting the obligation set out in O.Reg. 22/04 to manage the vegetation around its conductors (Distributor Safety Bulletin DSB-02/09)) and improving system reliability metrics (tree contacts are one of NBHDL's highest contributors to its SAIDI metric).

Currently, NBH has not been able to maintain its vegetation management schedule due to budget constraints. The original 4-year program is currently in year 10 and it is anticipated that it will not be completed until 2021 (11 years in total). Standard industry and ESA guidelines recommend that a vegetation management cycle should be 4 to 5 years and should not exceed 6 years. NBH is seeing the consequence of this prolonged cycle by having to jump around the city (off cycle) to address lines with overgrown vegetation before they present a significant hazard to the public. This is operationally less efficient (more costly) than cycle work and further eats away at the available budget.

In order to limit the increase in funding requirement to maintain a 4-year cycle program, NBHDL has increased its vegetation management program so that it could achieve a 5-year sustainable cycle starting in 2022. On the longer term, NBHDL customers will benefit, if this can be achieved, since annual costs from 2026 onward will be reduced.

Vegetation management becomes more expensive the longer it is deferred. Vegetation grows every year and deferring an area means more work (higher cost) in the future. The work can only be deferred for so long until it becomes a public safety hazard and a liability risk.

The goal is to divide the City service area into five sections which NBHDL will service one of these areas completely each year. The vegetation management program is one of the more critical maintenance activities for completion to provide safe and reliable operation of the distribution system. A significant amount of overhead line is in rural and off-road areas, which most often have a high density of trees and experience significant growth each year. To adopt a five-year cycle, NBHDL will be increasing its vegetation clearance budget to complete the program effectively.

XII. Arc Flash Study

The purpose of an arc flash study to a perform an engineering analysis on North Bay Hydro's distribution system to determine the potential incident energy of an arc flash event at a given point or on a specific piece of equipment. The incident energy is proportional the available fault current and the duration of the fault before it is cleared. As such, a short circuit study and a coordination study is part of the analysis.

The main benefit of an arc flash study is to ensure worker safety. In order to properly assess the risk and hazard of an arc flash, a study must be performed to quantify the incident energy and its ability to injure a person. This information will allow North Bay Hydro to properly categorize the risk, provide hazard information, and select appropriate PPE to protect its workers from potential injury. The information can also be used to ensure that any equipment installed is properly rated and can withstand the available maximum fault current level without being damaged.

XIII. Cable Testing

The goal of this program is to perform non destructive testing to diagnose the current health of underground XLPE high voltage cables. This program will collect information on the degradation of underground cables. Cable degradation leads to breakdown of insulation and causing a cable fault. XLPE cable is used in the majority of its high voltage underground system.

Performing this test will identify at risk cables and will allow North Bay Hydro to take corrective action to prevent cable fault causing outages. Periodic cable testing will allow NBHDL to plan for more strategic investments into the renewal of the underground infrastructure. Underground infrastructure replacement is some of the most expensive assets to replace and this type of testing can maximize the use of expenditures through better planning and scheduling just in time replacements of the asset.

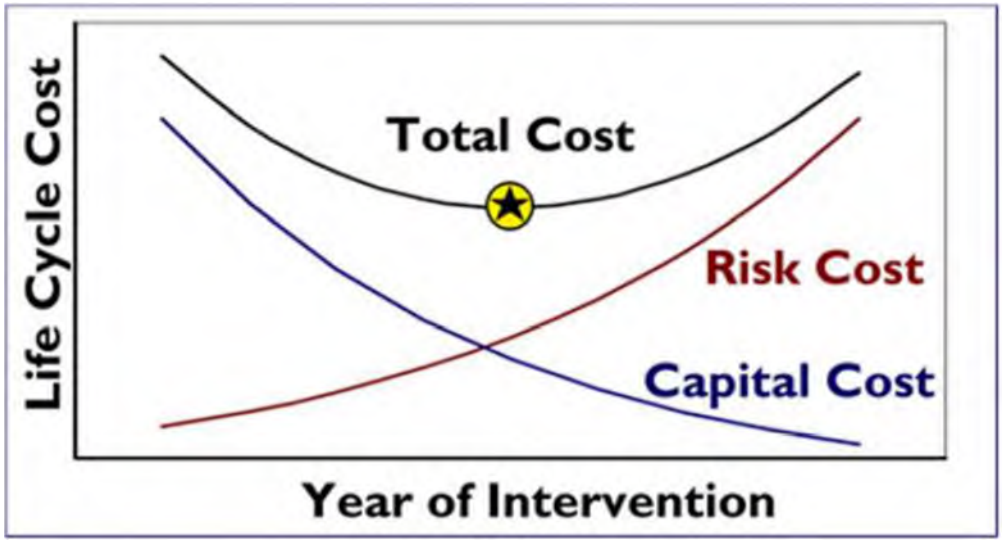
3.3.2 Asset Lifecycle Risk Management Policies and Practices (5.3.3b)

Risk management is a fundamental activity in any business and in the electrical distribution industry it requires a systematic approach to assess the following attributes of each asset:

- Condition data analysis
- Age and life expectancy
- Location
- Operational and maintenance data
- Reactive maintenance
- Preventative maintenance
- Asset replacement based on condition/age to minimize failures

It is the systematic approach of inspections, condition and age assessment, data analysis and maintenance that allow NBHDL to identify and mitigate the risk of its assets and distribution system. NBHDL's risk-based strategy assumes that the optimal time to replace an asset is at the minimum total cost when considering both the asset capital cost and the risk of failure of the asset. For each asset, a risk cost is calculated and compared with the minimum total cost, and the asset is recommended for replacement when the costs are equivalent as is demonstrated in the following Figure 3-18.

Figure 3-18: Risk-Based Decision Support System



The risk costs are based on the consequence costs of failure and the probability of that failure. The consequence costs are built up from a combination of the asset replacement costs plus additional costs likely to be incurred due to emergency asset replacement requirements, potential collateral damage due to catastrophic failure and customer impact costs associated with an unplanned outage.

The current condition as per the asset condition assessment study modifies the demographic age of the asset to arrive at an "effective age". The probability of failure is determined by plotting the "effective age" against the typical asset ageing characteristics for that asset. With the described assessment methodology prepared, NBHDL can prioritize its projects.

Additionally, certain asset classes have a tailored risk assessment. Substation assets are prioritized based on their condition, criticality to the system and the customer impact it can contribute (i.e. station load). Linear assets (conductors and cables) are predominately based on how soon or past the asset's service life is to the mean life expectancy. Poles' risk is assessed by considering the condition of the poles as well as the location of the pole in a feeder (i.e. poles closer to the substation are more critical than poles found at the end of the feeder). Distribution transformers and switches are largely operated as a run to failure approach, with their risk assessment being of the lowest importance.

3.4 System Capability Assessment for Renewable Energy Generation (5.3.4)

NBHDL's distribution system is fully capable of accommodating REG. At this time, there are no specific network locations where constraints are expected to merge due to forecast changes in load and/or connected REG capacity.

Under conservative assumptions of the maximum permissible generation capacity at a distribution station being equal to 60% of the power transformer nameplate rating plus the minimum station load (equal to 15% of station rating) and 90% power factor, the approximately available capacities for connecting renewable energy generation to various municipal stations.

Based on the applications currently in hand or anticipated to be received during the next five years, no system constraints exist, preventing the connecting of green energy generation developments

within NBHDL's service territory. Hence, no capital investments are needed for capacity upgrades to facilitate the connection of renewable energy generation plants.

NBHDL's *Renewable Energy Generation Plan* is attached in Appendix D which contains further details associated with connecting REG in the existing system.

3.4.1 Applications Over 10 kW (5.3.4a)

As of January 1, 2020, there were no current applications from renewable generators over 10kW for connection in the NBHDL's service area.

3.4.2 Forecast of REG Connections (5.3.4b)

There is a total of 57 REG installations presently connected to NBHDL's distribution system under the province's Feed-In-Tariff ("FIT") and micro FIT programs:

- Three FIT installation with a generating capacity of 1.88 MW
- 49 micro FIT installations with 438.74 kW installed capacity
- One RESOP installation with 10 kW installed capacity
- Five solar net-metering installations with 28.15 kW installed capacity

In addition to the above, 21 micro-Fit installations are currently registered with IESO but have not yet proceeded to the development stage. There are currently no additional applications in the queue. NBHDL expects an equal or less amount of applications from REG's over the rate filing period to what has been connected to date due to the reduced incentives and the limited participation to date. NBHDL's service territory has a high rural component and a lot of open land for potential solar farm developments. However, there have not been any large solar farm applications or proposed solar farm developments.

3.4.3 Capacity Available (5.3.4c)

NBHDL can connect at a minimum of 4 MW of individually connected REG project to any station, with the exclusion of MS23. On the sub-transmission system, up to 20 MW of individually connected REG projects would be permitted per feeder, where upstream coordination and approvals with HONI is required.

3.4.4 Constraints – Distribution and Upstream (5.3.4d)

There are no constraints on the NBHDL system related to the connection of REG. Additionally, the two Hydro One TS's that supply the NBHDL system are not constrained.

3.4.5 Constraints – Embedded Distributor (5.3.4e)

There are no constraints for an embedded distributor that may result from connections of REGs.

4 CAPITAL EXPENDITURE PLAN (5.4)

This section describes NBHDL's five-year capital expenditure plan over the forecast period, including a summary of the plan, an overview of NBHDL's capital expenditure planning process, an assessment of NBHDL's system to connect new REG, a summary of capital expenditures, and a justification of capital expenditures.

4.1 SUMMARY

NBHDL's DSP details the programme of system investment decisions developed based on information derived from NBHDL's AM and capital expenditure planning process. Investments, whether identified by category or by a specific project, are justified in whole or in part by reference to specific aspects of NBHDL's AM and capital expenditure planning process.

NBHDL's DSP includes information on prospective investments over a five-year forward-looking period (2021 – 2025) as well as planned and actual information on investments over the historical period (2015 – 2020).

4.1.1 Capital Expenditures over the Forecast Period

The following table summarizes the planned capital expenditures, by investment category, throughout the DSP:

Table 4-1: Planned capital expenditures by investment category

Category	2021($)	2022($)	2023($)	2024($)	2025($)
System Access	$950,931	$968,999	$987,410	$1,006,171	$1,025,288
System Renewal	$4,543,868	$4,008,248	$4,057,393	$4,153,500	$4,221,130
System Service	$288,148	$293,623	$299,202	$304,886	$310,679
General Plant	$909,096	$587,222	$666,100	$1,040,843	$649,114
Gross Capital Expenses	$6,692,043	$5,858,092	$6,010,105	$6,505,400	$6,206,211

Planned capital expenditures throughout the forecast period vary each fiscal year based on the following:

System Access – 2022-2025 increase by inflation over the test year and 2021 is based on a 5-year historical average

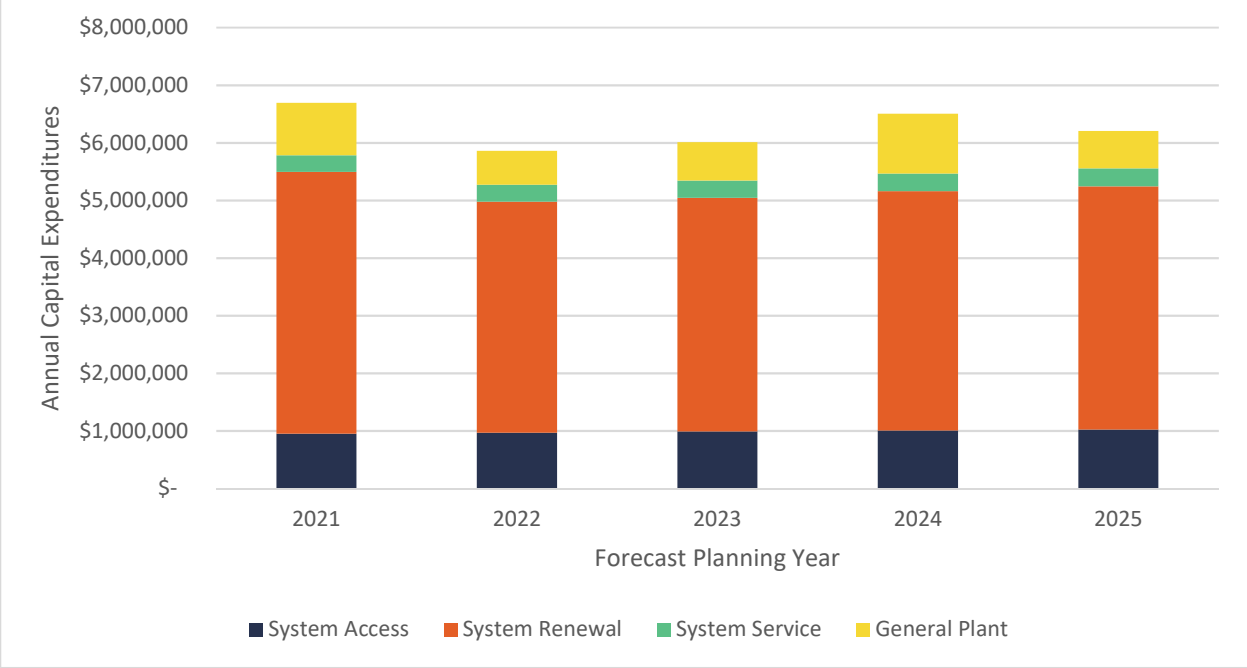
System Renewal – 2021 costs include high priority sub-transmission line rebuilds (see Section 4.1.2.2) and 2022-2025 increase by inflation utilizing an average renewal spend driven by Metsco's ACA

System Service – 2022-2025 increase by inflation over the test year and 2021 is based on a 5-year historical average

General Plant – based on annual needs for NBHDL's building, fleet, tools, and IT requirements. Fleet variances are primarily driven by bucket truck replacements (Fleet Replacement Schedule included in Appendix "E"). Building investments are kept at a minimal individual spend over the 2022-2025 timeframe as NBHDL undertakes a study of future needs. The IT Strategy is explained in Appendix "G".

Please see Section 4.4.1.1 and 2021 detailed capital project information in Section 4.4.2, including capital project justifications that follow in Appendix "I" for additional information.

Figure 4-1: 2021-2025 capital expenditures



The figures and table above demonstrate that over the forecast period of the DSP, NBHDL plans to pace and prioritize capital expenditures to produce a predictable impact on rates and prevent spikes in spending. NBHDL plans to invest an average of $5.8M in capital expenditures per year across all four investment categories.

4.1.2 Capital Planning for 2021-2025

The AM and capital investment process identify System Access, System Renewal, System Service and General Plant requirements. These requirements result in a list of mandatory and added value investments to be executed over the investment period. Mandatory capital investment needs are documented, cost, and scheduled according to timeline needs. Added value investments that provide benefits to the system are documented, cost, and prioritized according to the risk of deferral and the benefit each investment has towards achieving corporate Asset Management Objectives, regardless of which investment category they reside in. In general, investments with a high safety risk and benefit projections often take precedence over other investments. The capital budget is allocated among the categories according to the mandatory and prioritized investments in the final capital investment portfolio. The final investment portfolio considers the balance between achieving NBHDL's Asset Management Objectives and the impact on customer rates.

The combination of NBHDL's AM and capital expenditure planning process leads to a capital expenditure plan consisting of a five-year capital expenditure forecast which includes a one-year detailed capital budget.

4.1.2.1 *System Access*

System Access projects have not been a significant concern for this DSP as NBHDL is currently experiencing no capacity constraints for connection requests which are completed on an as-requested

basis. With the limited growth in the customer base that NBHDL has experienced and expects to experience in upcoming years, limited capital expenditures are anticipated for the forecast period.

Furthermore, capital contributions relating to road relocates and other municipal driver projects are expected to remain stable for the forecast period. Hence, the output of NBHDL's AM and capital planning processes is expected to have a minimal effect on System Access investments.

To reach an informed start point for the forecast period, NBHDL used the five-year historical averages of customer service requests and road relocation. The customer service request is based on the following subcategories: transformer purchases, primary and secondary services, subdivisions, and minor betterment projects.

Transformer Purchases

This category represents the purchase of new overhead and underground distribution transformers used for the following reasons:

- Asset renewal & rehabilitation
- New/upgraded services
- Special Projects

Although NBHDL maintains a small stock due to long lead times, backup, and emergency use, distribution transformers are for the most part ordered as required.

Primary & Secondary Services

Primary services comprise of capital work necessary to rehabilitate and/or expand infrastructure to service new customers or maintain existing customers, residential and general service, over the 400A threshold available from the secondary system. These projects involve primary (high voltage) servicing and overhead or pad-mounted transformation.

Additionally, secondary services represent the capital work required to upgrade existing or install new secondary (low voltage) service wires, overhead and underground, from distribution plant located on the municipal street or in easements on private property to customer's premises. Most of the work involves the services to the residential class.

Subdivisions

This category comprises the capital work required in subdivisions due to developer-driven demand. The expenditure represents costs to provide material to developers and NBHDL labour to install transformers and deliver service connections. Where possible, capital contributions toward the cost of these projects are collected by NBHDL in accordance with the DSC and the provisions of its COS. NBHDL uses the economic evaluation methodology from the DSC to determine the level of capital contribution for each project which supports the development of the annual capital budget.

Road relocations

This category comprises of capital expenditures required to comply with statutory obligations related to the relocation of overhead and underground facilities installed within municipal or provincial owned road allowances. Based on a legislated cost-sharing formula, the City or MTO, contribute 50% of all labour, labour-saving devices, and equipment costs. In the case where the governing body directs NBHDL to replace the overhead plant with an underground plant, the governing body funds the cost differential between overhead and underground.

Minor Betterment

Minor Betterment projects (“MINBET”) are minor lines and engineering-related projects the NBHDL undertakes including the rehabilitation or expansion of HV lines required to service new residential and general service customers (5 or fewer poles in scope). These projects are often unplanned when NBHDL discovers that a new user is not able to receive service and the nearby assets require renewal.

4.1.2.2 *System Renewal*

System Renewal projects and related capital expenditures are driven by a series of factors, metrics and methods including the AM strategy, prioritization matrix and the condition assessments. The renewal projects are directly linked with the AM capital expenditure planning processes. The allocation of the budget is dependent on the outcomes derived from the processes.

Substations

Investments in the substation category are driven by the requirement to replace the end of life assets that are in Poor and Very Poor condition. Substation assets affect the greatest number of customers upon failure and need to be treated with high priority to mitigate potential reliability, safety, and cost issues.

Investments in the test year include rehabilitation of MS15. Three new reclosers with their relays (including modifications to the supporting structure) as well as new SCADA equipment will be replacing the existing units. The existing reclosers are at end of life and obsolete with spare parts no longer available. The same conditions apply to the existing Remote Terminal Unit (RTU) which will be replaced with a modern RTU.

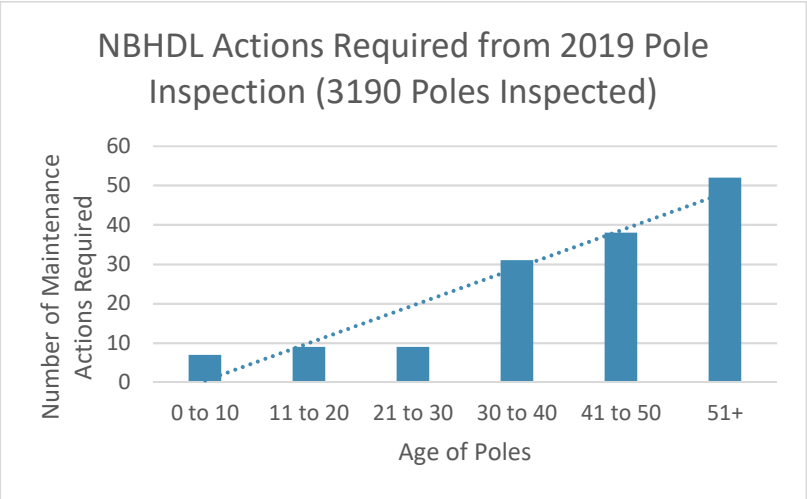
Overhead System

Investments in the overhead system category are driven by the requirement to replace the end of life assets that are in Poor and Very Poor condition. If deteriorated assets on the overhead network are not managed appropriately, they can present serious safety and reliability issues. Furthermore, unplanned replacements generally are at a higher cost than planned replacements due to reprioritizing crew staff, ordering assets in a rush and forcing an outage.

Effect on System Operation Efficiency and Cost-Effectiveness

Through NBHDL’s pole inspections, performed under its maintenance program, issues are identified and assets with actions required are flagged for maintenance. NBHDL has observed that there is a correlation between the age of the asset and likelihood it would have an issue and a maintenance action will be required. In 2019, NBHDL inspected 3190 poles and 146 maintenance actions were generated, distributed over the pole age demographics shown in the figure below.

Figure 4-2 : NBHDL Actions Required from 2019 Pole Inspections



The information shows that the number of issues discovered trends upwards as the pole line assets age.

Common issues requiring maintenance action include, but are not limited to, rotten cross arms, faulty porcelain insulators, broken / loose anchors and down guys, blown lightning arresters, damaged guarding for underground cables, significant rust on transformers, damaged / broken switches, and displacement of the pole footing (leaning poles).

Pole Failure Risk

In assessing the failure risk of a pole line asset, NBHDL utilizes asset condition data collected from inspections to establish a health index and also refers to a report titled “Critical Factors for Determining Wood Pole Health” prepared by EDM International Inc. and submitted to USF (of which NBHDL is a member of). It is used as a guideline for assessing appropriate times to plan for the renewal of pole line assets. This information is similar and consistent to the Asset Depreciation Study for the OEB performed by Kinetrics but provides more depth specifically into wood poles. The report shows the useful life of a wood pole with no proactive maintenance to be approximately 43 years with an exponential decrease in pole survival rate which starts to decrease sharply at that point. The survival rate of different species of wood poles vary with some performing better than others, but on average, poles of 55 years of age only have a survival rate of 70%. Survival rate or end of life criteria is characterized by when a pole is deemed to no longer able to meet safety or functional requirements and is removed from service.

Investments in the test year include the renewal of aged and deteriorated overhead lines as well as the phase-out of backlot configurations in NBHDL’s system. For the test year, a higher than usual composite pole installation is planned for sub-transmission lines to improve the lines’ resiliency and life expectation. These poles provide additional benefits in off-road locations, harsh environments and/or woodpecker prone areas.

NBHDL’s plan is to replace a similar number of poles every year.

NBHDL's ideal pole replacement recommendation is 200 poles. This is determined through an evaluation where a significant amount of wood poles are beyond 50 years of age (1709 units to be exact at the time of the Asset Condition Assessment Study). 1090 poles of those poles were assessed to have a Health Index (HI) of 60% or less (60% was chosen as this allows to capture enough of the unit counts that are approaching the halfway mark where they can easily degrade faster to a lower HI score within a short time frame). Dividing 1090 units by 6 years (2020 to 2025), the result is approximately 182 poles/year. Since the DSP was being completed in 2020 for a 2021 to 2025 period, the replacement timeline reduced to 5 years, which yields an approximate result of 218 poles/year. The median value of 200 poles/year was taken to be shown as an ideal number of pole replacements.

However, due to various resource constraints, the above recommendation does not make it feasible to perform and NBHDL developed a reduced pole replacement program that can be managed with the current resourcing structure based on planning and historical experience.

The Asset Replacement Plan recommends a total of 127 poles for replacement in 2021-2023 and 135 from 2024-2025. 129 poles are planned to be replaced in 2021 as part of the system renewal of which 44 will be replaced with composite poles. The City of North Bay has locations where woodpecker damage leads to premature replacement of poles (sometimes a few years only after installation). NBHDL encounters significant replacement expenditures to replace those poles on a one-off basis. For this reason, NBHDL has determined that power lines carrying its sub-transmission lines located in woodpecker-prone areas of the city require the use of composite poles. Composite poles have an extended life-expectancy and NBHDL has calculated a long-term positive cost-benefit for their use.

Underground System

The underground system is managed for similar reasons as the overhead system with the addition of managing replacement costs. Cable failures, especially cables that are directly buried, a characteristic of cables in this age demographic, are extremely costly to repair, as excavation in built-up urban areas is very expensive. The program is aimed to proactively replace cables to avoid the high customer impact that is associated with their failure.

Investments in the test year include spot renewal of aged and deteriorated assets as well as the phasing out of backlot configurations and replacing them with an underground system.

Transformers

This project category represents the investment into distribution transformers, both overhead and underground, throughout the given year. All new transformers are brought into inventory and are included in the overall PP&E gross assets, they do not then begin to depreciate until put into service. Transformers are then assigned to different projects as required.

Minor Betterments

Minor Betterment projects represent small unplanned projects over the year which focuses on replacing assets found in very poor condition and require immediate replacement (five poles or less). This type of project arises from trouble calls, maintenance programs, and information provided by third parties (ESA, customers, communication companies).

4.1.2.3 *System Service*

System service projects are typically driven by capacity constraints. These projects can include capital investments aimed at improving customer value, reliability and operational efficiencies through voltage

upgrades, distribution automation, intelligent devices, or equipment. However, NBHDL has not identified any anticipated capacity constraints and therefore not proposing any material investment for the upcoming filing period. NBHDL intends to explore and assess tools and newer technology that may benefit the system performance or grow the system's capabilities with regards to automation, outage location, grid modernization and storm hardening. However, these projects are expected to be below the material threshold and only explored if there is a compelling reason to do so.

4.1.2.4 *General Plant*

General Plant investments differ from the other OEB defined investment categories. In the past, NBHDL retained several third-party consultants to prepare assessments on NBHDL's general plant assets. These assessments were transitioned to NBHDL's long-term plan and continue to be maintained over the current forecast period.

Motor Fleet

The Fleet Assessment, attached as Appendix E, identified which fleet assets required replacement and for what reasons. Typically, the assets were identified based on age and condition. The Fleet Assessment provided output specifications such as replacement schedules, duty cycles and priority of assets.

General Building Work

NBHDL retained consultants to provide the Building Assessment, attached as Appendix F, to identify whether there is any major work required during the forecast period. The purpose of the assessment is to identify the high-level issues and maintenance required to maintain NBHDL's buildings.

The proposed work entails various maintenance items for the building as identified in the 2019 Building Condition Assessment Report. Some of the main components of the work involve installing a French Drain around the building to prevent further degradation of the building exterior, replace flashing to ensure that it slopes properly to prevent water from pooling towards the building, repair metal siding to prevent water ingress in the building envelope and accelerated degradation.

Additionally, NBHDL has identified their current facility is no longer servicing its needs and cannot accommodate future staffing or building extensions/modifications for growth. Within the forecast period, NBHDL intends to initiate an evaluation process of its current and future needs for a facility as well as to identify the path forward to achieve those needs. The study is below the material threshold and NBHDL has no intention of beginning to plan any major projects within this DSP period.

4.1.3 Customer Engagement and Preferences (5.4a)

4.1.3.1 *Customer Engagement*

NBHDL undertakes ongoing informal customer engagement activities to interact with its customers. The following includes the several methods NBHDL utilizes to engage with its customers:

I. Direct Engagement
   - Telephone calls, emails, written notices, in-person interactions at offices

II. Online Engagement
   - Corporate website
   - My Account online bill portal for residential and commercial customers
   - Online outage map
   - Social Media (Twitter, Instagram, LinkedIn, YouTube)

III. Customer Survey Program

- Customer Satisfaction Surveys

NBHDL responds to a variety of calls daily from customers in relation to events taking place in the field. Calls regarding all types of issues - power outages, car accidents, fires, equipment issues, traffic lights not working, lines down on a roof, objects touching power lines, etc. are received daily. Calls are transferred to NBHDL's Operations Dispatcher and the service truck is dispatched within 30 minutes of the call to address the issue. If the service truck is unavailable to respond to the customer within a relatively short amount of time, the Operations Supervisor will dispatch another truck to the site. During evenings and weekends, an answering service will contact a single operations staff on duty – who would typically arrive at the location within an hour. That person assesses the situation before deciding on what, if any, incremental resources are required to respond to the situation quickly and safely. If incremental resources are required, the person on call consults first with the supervisor on duty.

NBHDL also receives a significant amount of calls related to tree trimming which are transferred directly to the individual responsible for the program in the Engineering department, who contacts the customer and then determines the next steps in terms of resolving the issue.

These informal measures allow NBHDL to engage customers on a case-by-case basis and respond as necessary. Whether responding to an acute residential concern, or a meeting with a larger commercial customer, NBHDL can ascertain the needs of the customer and leverage that information against its O&M procedures and future decisions as warranted.

In preparation for NBHDL's upcoming rate file application, NBHDL began a more formal process of engaging customers to gather information on preferences and customer to inform NBHDL of the investments required over the forecast period. This process included customer engagement initiatives, performed through multiple mediums and phases.

Customers participated in a telephone survey performed by UtilityPULSE, as well as an online survey. The online survey was offered in two phases. The first phase was used to gather initial feedback and customer preferences. The second phase is devoted to obtaining more specifications regarding the questions asked and responses received from the first phase.

The sample of telephone numbers for the telephone survey was drawn randomly to ensure that both residential and business numbers had an equal chance at being chosen and stratified so that 85% of the interviews were with residential customers and 15% with businesses. Interviewers reached 2,173 households and businesses; the 400 who completed the interview represent an 18% response rate.

The online survey was hosted by a temporary survey service and advertised on the North Bay Hydro website, as well as through paid advertising on Facebook. There were approximately 500 people who responded to phase one, and only slightly fewer responses to phase two. Most responses are from residential customers, with 0.17% describing themselves as 'Business/Commercial Customer in phase one, and 0.62% in phase two.

The feedback received from the customer engagement was used to ensure that the DSP was aligned with the customer preference and validate the decision-making protocols of NBHDL.

4.1.3.2 *Customer Preference*

Overall, customers are satisfied with NBHDL and aside from issues with the cost of services, there were little to no additional concerns, with many of the respondents to the online survey citing no changes needed whatsoever. When a response is given outside of the cost of services, or no changes needed, the concerns were around hours of customer service availability, communication preferences, climate change concerns and hopes for more information regarding decreasing consumption, all of which are pursued further in phase two of the survey.

While 32% of telephone survey respondents experienced an outage problem in the past 12 months - a smaller percentage than previous years the survey was commissioned and a lower than the national and provincial averages. Overall, 93% of respondents agree, either strongly or somewhat, that the utility's standard of reliability is consistent with their expectations. This is echoed in the online survey results, where 85% of respondents felt that NBHDL reacted well to the power outage and 87% felt they restored power quickly. In terms of providing information about the outage, 74% rated NBHDL somewhat or very effective.

For customer preferences regarding updates on unplanned outages, a majority of those who answered the online survey chose Social Media as their preferred medium for information. The online survey did not include the option for texting notices, but it was included by several respondents under the '*other*' option. Texting as an option was included in the telephone survey and garnered 23% support for the outage communication method. In phase two of the online survey, a follow-up question was asked regarding an investment in the ability to offer texting as a method of communication during unplanned outages, but the respondents were fairly split on the idea. When told that a text notification system would require '*a substantial investment for system upgrades*,' 55% said yes, they would be interested in the search for a way to offer this convenience, while 45% did not feel it was necessary.

Though 36% of customers who took part in the telephone survey said that one of the most important things their local utility could do to improve service was '*better prices/lower rates'*, with the remaining respondents felt that paying for electricity was '*not a worry*' When presented with the opportunity to reduce costs through NBHDL's offering of incentives to encourage customers to go paperless, saving on supplies and postage, 88% of customers agreed with the notion.

Priority Investments

The results from the customer engagements found that priority planning for the next five years centred mainly on maintenance and upgrades of equipment, both in proactive measures and to outages and response times, as well as educating customers and developing better technological systems and supports.

Proactively maintaining and upgrading equipment was considered a '*very high'* or '*high*' priority for 90% of those interviewed within the telephone survey and was additionally referenced in the online survey, where customers were asked to rate their priorities. 49% of respondents felt '*modernizing the electrical system – especially in regard to net-metering and electric vehicles – to support the reduction of greenhouse gases*' was their most important priority, and 28% made it their second most important priority.

Reliability and Response Time

Customers felt that reducing response time (80% responses) and the number of outages (78% responses) were important priorities. Survey takers were asked about the automation of the electrical grid, a measure that would improve reliability, as well as their feelings towards an investment based on five specific scenarios regarding investment versus the potential to lower costs.

Of the responses, 79% answered the question with an affirmative answer, but preferences for payback period and timing of lowered consumer costs varied, while 21% of respondents felt the current reliability of the network was acceptable.

As to reduced response times, respondents to phase two of the online survey were asked for their feelings regarding unexpected outages outside of normal business hours and the handling of that situation. Survey takers were informed of the Lineman/Operator system currently in place, as well as the cost savings within this system, and asked if they would like to see a control room monitored 24/7

in the hope it would reduce the duration of the outages, even with the increased associated costs. There was an almost equal split in answers, with 53% responding '*No*' and 47% responding '*Yes*'.

Additionally, concerning outages, 69% of telephone respondents rated '*investing more in tree trimming to help reduce the number of outages*' as '*high*' or '*very high*' priority. In phase two of the online survey, customers received a detailed explanation of the Vegetation Management program at NBHDL, and when asked if they were aware of the program that includes tree-trimming, tree removal and consultation etc. before reading said explanation, 63% of respondents said '*No*'.

Customers completing the online and telephone survey were asked questions regarding burying overhead wires, namely, the importance of doing so, and at what cost. While 56% of telephone respondents believed that burying overhead wires should be a five-year priority, phase two of the online survey found that number changed based on the price point of the underground cabling. Although 19% said that they would consider '*two times the cost of overhead infrastructure*' as the price point, they are comfortable with, 72% felt that overhead infrastructure should be used if it is the most cost-effective.

4.1.3.3 *Projects in Response to Customer Preference, Technology, and Innovation*

Through NBHDL's customer engagement, certain factors such as safety, reliability and cost have all been identified as concerns at a residential and business level. Customers have indicated that they would like reliability maintained and have an obvious and demonstrated preference for maintaining safety. NBHDL's infrastructure System Renewal projects address these at a broad level. Through the DSP however, there are no projects that address specific customer preferences concerning capital spending and the costs included in the DSP. NBHDL uses the information derived from customer engagement pieces to ensure its decisions are aligned with customer preferences and that its decisions are valid based on the customer feedback generally, but no specific projects are implemented as a direct and/or sole result of any particular feedback or customer engagement as part of this DSP. This makes up most projects identified by NBHDL for the current DSP capital expenditures.

NBHDL will continue to ensure that its prioritization of capital expenditure projects is aligned with customer preferences for the forecast period and anticipates that its goal of maintaining reliability within the system will achieve that alignment.

In taking advantage of technology-based opportunities to improve operational efficiency, NBHDL continues to evaluate options with respect to technology as it becomes available throughout the filing horizon. In the historical period, the SCADA system was installed to all municipal substations in addition to upgrading the SCADA system communication medium to a WIMAX based system. At this time, plans do not exist for the implementation of any other communication-based projects in the forecast rate period, but the WIMAX system will easily allow for the following systems to be implemented in the future:

- Fleet Management
- Distribution Automation
- Integration of Distributed Generation
- Outage Management System

The technology currently in place easily allows the integration of distributed generation and complex loads, but NBHDL continues to evaluate new technologies as they are presented. At this time no immediate material projects are scheduled over the forecast rate period.

Specific examples of innovative efforts of NBHDL include Mobile Notebooks for use in fleet vehicles, the purchase of an 'analyzer' for Smart meters which allows for GPS coordination, upgrades to system PCs and server upgrades. However, no significant material investments are proposed for the DSP forecast period. NBHDL continues to utilize 'just in time' delivery to manage stores and material levels. Furthermore, NBHDL's Engineering and Operations departments are closely integrated to increase efficiency and productivity. Every capital project designed by Engineering is reviewed or co-designed with Operations to make sure the required work can be completed quickly and safely. Often real-time adjustments are made to designs as crews send in pictures via mobile communications for review by Engineering.

4.1.4 System Development over the Forecast Period (5.4b)

4.1.4.1 *Ability to Connect New Load/Generation*

NBHDL's system services a city that has seen very flat growth over the past 20 years. There is very limited development in the City, however, NBHDL is capable of handling all-new or upgraded connections quickly. NBHDL can do this through the implementation of efficient internal processes, appropriate resourcing requirements, and a system that has excess capacity and is in a state, for the most part, that does not inhibit service requests.

Due to the flat growth trend and excess capacity in the system, very minimal expenditures have been planned over the five-year horizon to address the capability to connect the new load. The costs that are included are based on historical information. In the same vein, the system is also able to allow easy connection of generator customers. The number of generator connections to the system has been minimal and therefore excess capacity remains throughout the entire system to allow connection of any perspective generation project. As with the connection of a new load, very limited expenditures have been planned to address the ability to connect generation customers.

4.1.4.2 *Load and Customer Growth*

NBHDL expects growth of the system over the next five years, both with respect to the customers and the loading perspective, to follow a near-flat trend, which is consistent with the previous five years.

4.1.4.3 *Grid Modernization*

Concerning smart grid development, aside from the implementation of SCADA, very few smart grid initiatives are planned over the forecast period. Projects that are planned are centred on enabling an easier exchange of data to and from the customer, and leveraging information gathered via smart meters and SCADA, or can involve very small, low-cost ideas that can improve efficiencies with respect to grid operation (i.e. installation of fault indicators, and/or voltage and line current sensors). The cost-benefit to customers to automate high voltage switches cannot be justified currently for the NBHDL system.

4.1.4.4 *REG Accommodation*

NBHDL has sufficient capacity to connect renewable energy projects and therefore can accommodate the majority of generation requests easily and with very little capital investment into the system. The expectation is that the number of connections over the next five years should be equivalent to the number of connections over the historical period.

4.1.4.5 *Climate Change Adaptation*

NBHDL employs proven storm hardening techniques such as installing stainless steel equipment for below-grade applications, moving below grade equipment to above grade (where possible) where flooding is a strong possibility, designing the system to Canadian Standard Association ("CSA") Heavy Loading conditions and utilize stronger, treated poles in new constructions.

4.2 CAPITAL EXPENDITURE PLANNING PROCESS OVERVIEW (5.4.1)

The capital expenditure planning process employed by NBHDL consists of the following steps:

- Determination of investment level needed for NBHDL to meet its regulatory obligations (i.e. the level of investments required for System Access projects).
- Determination of investment level needed to maintain adequate capacity margins to supply system security and to improve operation efficiency (i.e. investments required for System Service projects).
- Determination of investments required to maintain general plant operating safely, reliably and efficiently to support services.
- Determination of economically efficient investments into the system to maintain safety, and reliability while minimizing O&M costs i.e. the level of investment required for System Renewal.
- Summation of all investment components to determine the overall investment needed.
- Assessment of capacity to complete all planned investment and adjusting investment levels if needed.
- Evaluation of capital investment impacts on rates and scaling back of the investment levels if needed.

The level of non-discretionary investments required for System Access projects is determined through consultations with the municipal government and major residential and commercial developers in the region, and the use of a five-year rolling historical average. The level of investments needed for System Service projects is determined through load forecasts and identification of capacity constraints and operating inefficiencies in the power supply system. The investments into System Renewal are determined through condition assessment of assets and identification of economically efficient investments, which is further assisted through the prioritization matrix and future prioritization protocols being developed by METSCO. Investment requirements into General Plant are determined through condition assessment of motor vehicles, building facilities and IT systems.

Due to the system's capacity to easily allow the connection of renewable generation facilities, there are currently no specific objectives set to address the accommodation of new REG projects.

4.2.1 Tools and Methods for Risk Management (5.4.1a)

NBHDL prepares its capital plans with consideration to business risks discussed throughout the DSP. These include consultations with key parties, incorporating historical performances into actionable items for the forecast plan, tailoring asset management goals, processes and practices and adopting latest industry standards to achieve the best value out of its system while managing the risk categories such as safety, cybersecurity, and changing environments.

NBHDL relies on a set of tools such as asset condition assessments, feeder performance data, and inspection programs to identify at risk components of its system. Health modeling of its assets is used to evaluate the likely hood of failure and in combination with the consequence of failure, used to determine risk. This risk is an input in NBDHL's project prioritization tool to assist NBHDL in achieving the desired goals in managing risk in which the elimination of risk is considered a project driver.

The tools and methods are further explained in sections 3.1, 3.3 and 4.2.2. To support the tools and methodologies, a set of planning objectives, assumptions and criteria are applied to reflect NBHDL's system. The supporting items are explained in the description below.

Planning Objectives, Assumptions, and Criteria

NBHDL planning objectives are tailored to be focusing on customer preferences, sustain operational efficiency, maintain system performance (i.e. reliability, safety, capacity) all while complying with applicable codes, standards, and regulations.

NBHDL's planning objective can be summarized as determining the optimum level of investment and configuration of distribution capacity while having due regard to alignment with the corporate objectives and the overarching AM system. This includes coordinating and consulting with third parties, engaging and meeting customer expectations, maintaining the system performance, minimizing rate impacts, and modernizing the system where possible.

The following key assumptions form the basis of the development of this DSP:

- Historical trends continue unless the information is available otherwise.
- The level of activity in REG continues to be in alignment with historical trends.
- External assumptions such as limited growth found in the municipality and developers of the region are held constant and up to date.

In terms of the overall planning criteria, NBHDL, like most Ontario utilities, has adopted a deterministic or redundancy standard for distribution system planning. The redundancy standard will trigger an investment when the capacity of an asset, such as a station transformer, is exceeded under normal or contingency operating standards depending on the type of asset. Redundancy, in terms of capacity, is built into the distribution system to deal with unique contingency situations. However, customers will experience an interruption, upon loss of a distribution system element, while backup capacity is engaged, or an asset is replaced.

NBHDL, like other distribution utilities, strives to ensure its distribution system provides a reliable level of service to existing customers and connection capacity for forecasted demand growth and as such must be able to handle customer supply needs during normal and certain contingency situations. Overloading of distribution equipment, as a result of inadequate investment, is avoided as much as possible.

As part of the DSP and the plans outlined, the following assumptions are applicable:

- Equipment maintenance, refurbishment and replacement programs are in place to ensure that the capacity and capability of the distribution system are maintained at a reasonable level of risk of disruption due to lifecycle related equipment failure.
- Incidences of extreme weather continue to be manageable under existing standards of design and construction.

4.2.2 Processes, Tools, and Methods (5.4.1b)

Project Identification

System Access projects such as development and municipal plant pole relocation projects are identified throughout the year by way of engagement with external proponents. These projects are mandatory and are budgeted and scheduled to meet the timing needs of the external proponents.

System Renewal projects are identified through NBHDL's AM process. The project needs for a specific period are supported by a combination of asset inspection, individual asset performance, substation assessments and asset condition assessments.

System Service projects are identified through NBHDL's AM process and operational needs to ensure that any system constraints are managed promptly or if there is a significant benefit to the utility to upgrade the system such as reducing line losses or improving reliability performance in specific areas.

General Plant projects are identified internally by specific departments (engineering, finance, operations, administration, etc.). The projects are further supported through specific business cases and third-party assessments to justify the required investment need.

Project Selection and Prioritization

System Access projects are all mandatory and must be completed as required to comply with the DSC and NBHDL's conditions of service. These projects are prioritized based on DSC requirements and with all things equal on a queue basis: first in, first out.

The remaining capital investments planned for System Renewal and System Service are discretionary and are prioritized through NBHDL's AM process with consideration to the annual budget and project costs. These projects are prioritized against NBHDL's AM objectives and their respective weights shown in Table 4-2. The primary goal is to provide a list of prioritized projects in a given planning year that would maintain the system's performance and meeting customer preferences.

Table 4-2: Project prioritization criteria and weightings

Decision Criteria	Weight	Link to Asset Management Objective (From Table 3-1)
Monetary Internal Rate of Return (MIRR) Ranking	25 (3.3%)	i. Managing, maintaining and operating the distribution system in a manner that is cost-effective, and minimizes the duration and frequency of interruptions. ii. Providing good value service for money while providing a fair rate of return to the City of North Bay.
Net Present Value (NPV) Ranking	25 (3.3%)	i. Managing, maintaining and operating the distribution system in a manner that is cost-effective, and minimizes the duration and frequency of interruptions. ii. Providing good value service for money while providing a fair rate of return to the City of North Bay.
Reliability Impacts	70 (9.1%)	i. Managing, maintaining and operating the distribution system in a manner that is cost-effective, and minimizes the duration and frequency of interruptions. ii. Managing and maintaining the distribution system to meet power quality standards in accordance with good utility practise, all applicable standards and guidelines and NBHDL's Conditions of Service. iii. Maintaining service quality and customer satisfaction rates at or above industry targets.

		iv.	Continuously improve efficiency and productivity performance to provide better value-for-money.
Momentary Interruptions	30 (3.9%)	i.	Managing, maintaining and operating the distribution system in a manner that is cost-effective, and minimizes the duration and frequency of interruptions.
		ii.	Maintaining service quality and customer satisfaction rates at or above industry targets.
Corporate Image	50 (6.5%)	i.	Managing, maintaining and operating the distribution system in a manner that is cost-effective, and minimizes the duration and frequency of interruptions.
		ii.	Managing and maintaining the distribution system to meet power quality standards in accordance with good utility practise, all applicable standards and guidelines and NBHDL's Conditions of Service.
Regulatory Compliance	90 (11.7%)	i.	Maintain compliance with all relevant ESA standards and guidelines.
		ii.	Actively support provincial and local public policy objectives.
Environmental Impacts	90 (11.7%)	i.	Environmental consideration in the design and management of the distribution system.
Public Safety	100 (13.1%)	i.	Minimize public safety incidents caused by factors within NBHDL's control.
Employee Safety	100 (13.1%)	i.	Minimize lost time due to accidents involving NBHDL employees or contractors.
Operational Efficiency	70 (9.1%)	i.	Managing, maintaining and operating the distribution system in a manner that is cost-effective, and minimizes the duration and frequency of interruptions.
		ii.	Continuously identifying and implementing measures that lead to sustainable long-term efficiencies that utilize resources more effectively.
		iii.	Providing good value service for money while providing a fair rate of return to the City of North Bay.
		iv.	Continuously improve efficiency and productivity performance to provide better value-for-money.
Asset Health Impacts	65 (8.6%)	i.	Continuously improve efficiency and productivity performance to provide better value-for-money.
Substandard Conditions	50 (6.5%)	i.	Managing and maintaining the distribution system to meet power quality standards in accordance with good utility practise, all applicable standards and guidelines and NBHDL's Conditions of Service.
Total	*765 (100%)*		

Note:

a) *Table 3-1 titled RRFW Outcomes – Core Values – Asset Management Linkages* identifies *Asset Management Objectives. Item "Customer Focus – Customer Service Quality - ii. Facilitating local economic development by providing timely responses to new customer connection or service expansion requests"* is not utilized in the priority tool because Customer Demand Projects are prioritized over any System Renewal projects.

Prioritization Approach

NBHDL's approach to the prioritization of capital projects begins by collecting asset inspection data, reliability data (feeder performance), loading information, the Asset Condition Assessment (ACA) report (health indexes) prepared by Metsco, and all other operational information. NBHDL then uses this information to identify all areas of its distribution system with the lowest health index that will require capital investment (renewal projects) in the near future (within 5 years) or a requirement to increase system capacity due to load growth. NBHDL also looks for opportunities to increase system operation efficiencies. With this information, North Bay Hydro's Engineering team prepares a project proposal, which includes the cost and other pertinent decision-making information, for each end-of-life asset identified. In 2019, approximately 50 project proposals for system renewal projects were prepared. Large projects are broken down into multiple phases, if practical, when they cannot be completed within a single calendar year. The project proposals are then entered into a Project Planning Optimization Tool developed by Metsco.

The Project Planning Optimization Tool considers a wide variety of information and produces a score for project benefits and impact probability that will be realized, as well as the net present value (NPV) of the project. The tool then prioritizes the projects accordingly. Information the tool takes into account includes the following:

- The Project Cost Estimate – The estimated cost to perform the work prepared by the Engineering department;
- The Economic Benefits – This includes information on risk cost which is modelled by the asset's probability of failure vs. the consequence of failure as well as O&M cost avoidance (if known), estimated % decrease in system losses, the value of avoided energy unsupplied, and any other one-time economic benefit;
- Project Reliability Benefits - This includes estimated improvements to SAIDI / SAIFI as well as momentary interruptions (if any);
- Intangible Impacts - This includes risk to corporate image, regulatory compliance, environmental impacts, public safety impacts, employee safety impacts, project impacts to asset health and life expectancy;
- Operational Efficiencies – This includes any function or feature of the project that will allow NBHDL to operate its system more efficiently; and
- Elimination of Sub-Standard Conditions – This includes the correction of any condition that would not meet present day design and safety standards.

The assigned weights (level of importance) to the decision-making criteria are as follows:

- Public Safety (100 Points Total) - Public safety is of the utmost importance to NBHDL and typically represents the most significant consequences. It is an unwavering fundamental core value of NBHDL;

- Employee Safety (100 Points Total) – Along with public safety, employee safety is of critical importance to NBHDL and, as such, has the largest point allotment;

- Regulatory Impacts (90 Points Total) – Regulatory compliance is a significant factor to project prioritization and typically focuses on achieving mandatory objectives set out by the OEB in the Distribution System Code;

- Environmental (90 Points Total) – Environmental responsibility is a core value of NBHDL. Adverse impacts to the environment will typically result in significant consequences;

- Reliability Impact (70 Points Total) – Opportunities to improve the reliability of its system is an important factor in NBHDL's project prioritization. These constitute improvement to SAIDI and SAIFI metrics;

- Operational Efficiency (70 Points Total) – Operational efficiencies are significant benefits and allows NBHDL to better manage and optimize its system, improve restoration times, reduce power losses, and will generally lead to an avoidance of increased O&M costs over time. NBHDL assigns significant value to this category as it continuously strives to improve its efficiency;

- Asset Health Impacts (65 Points Total) – The asset condition is an important factor that considers the potential impacts of further degradation and the avoidance of an adverse impact to reliability or safety with the increased possibility of failure;

- Substandard Conditions (50 Points Total) – Elimination of substandard conditions will typically have benefits in improved design and safety but do not represent a significant imminent risk;

- Corporate Image (50 Points Total) – NBHDL values its corporate image and the reputation it has established with customers around the stewardship of maintaining a safe and reliable distribution system;

- Momentary Interruptions (30 Points Total) – Momentary interruptions are a nuisance and inconveniences customers, but do not have as major of an impact as sustained outages;

- Modified Internal Rate of Return (MIRR) Ranking (25 Points Total) – The MIRR ranking is only a small component of NBHDL's project prioritization but is still considered an important factor from a sustainable business perspective; and

Net Present Value (NPV) Ranking (25 Points Total) – Similar to the MIRR ranking, the NPV is only a small component of NBHDL's project prioritization but is still considered as an important factor from sustainable business perspectiveThe result of this system is a ranked project priority listing which is compared to the available budget developed during the planning process. This list will determine the planned projects for that year. The calculated project score is an index to measure the value of each capital project to other capital project values. The highest valued projects for each year, that fit the annual budget, are selected. Projects that do not meet the budget are allocated for the following year.

Figure 4-3 below illustrates NBHDL's optimized project prioritization methodology. As shown in the figure, once the list of prioritized projects has been made, additional inputs such as the annual capital budget, project interdependencies and project resources are considered to determine the appropriate project timing and pacing to construct the proposed capital investment plan.

Figure 4-3: Project Prioritization Criteria and Weightings



Investments identified in the General Plant category, are based on NBHDL's firsthand knowledge and completed assessments of its vehicles, buildings and IT infrastructure. If NBHDL believes that a specific aspect of the General Plant was required, NBHDL would first seek out a third-party consultant to assess the project.

NBHDL completed a fleet replacement schedule in 2015 based on the Fleet Assessment completed in 2013. The external consultant hired by NBHDL provided distinct schedule regimes for the assets as well as detailed reasons for the schedule (including information on reliability, condition, age, safety, among other things). In general, fleet replacements are recommended to follow the following:

- NBHDL pickup trucks are to be replaced on a 7-year schedule.
- Large NBHDL vehicles are to be placed on a 12-year replacement schedule.
- Radial Boom Devices ("RBD") can be placed on a 15-year replacement schedule as they do not maintain a similar duty cycle as other large vehicles.

A Building Assessment was completed in 2019 and is still used for the current forecast period to select and prioritize investments. The investment levels identified in the Building Assessment are for typical building maintenance costs for such issues as exterior lighting, emergency systems, HVAC, parking lot asphalt, doors, roof and interior. NBHDL prioritizes such tasks on an as-required basis.

Tool expenditures are prioritized and paced on an as-needed basis. The General Plant budget typically affords extra capacity for such projects and when they are required, based on the end of life or poor condition of the equipment, NBHDL ensures the expenditure is properly allocated. Furthermore, a complete IT Assessment recommends and prioritizes IT investments for NBHDL. NBHDL prioritizes such investments on an as-required basis and would communicate to its customers the effect of implementing new technology that impacts them.

NBHDL retains discretion in its decisions to implement the schedules for General Plant investments based on its own industry know-how and knowledge of budgetary concerns and pacing with other investments. However, NBHDL acknowledges that in many cases, the schedule is set based on an imminent need to replace or renew an asset and follows it as necessary.

Project Pace

Project pace for System Access projects is generally determined by external schedules and customer needs. System Service and General Plant projects tend to be lumpy and are paced to begin and complete within a specific budget year. System Renewal projects planned for the distribution system are smaller in scope and are preferably completed within a planning year. Substation renewals can be larger in scope and can be spread over multiple years. However, renewal projects are paced to meet the AM objectives, with consideration of available resources and managing the project impacts on the customer's bill. Furthermore, NBHDL's System Renewal projects have been prepared and paced based on the ACA report prepared by METSCO.

4.2.3 REG Investment Prioritization (5.4.1c)

NBHDL does not use a separate prioritization for REG investments. In addition, due to sufficient capacity in the system and minimal forecasted connections, the analysis does not indicate a requirement for material capital expenditures over the rate filing period. NBHDL does not have plans over the forecast period to connect distributor-owned renewable generation projects.

4.2.4 Non-Distribution System Alternatives to Relieving System Capacity (5.4.1d)

NBHDL's implementation of Conservation and Demand Management ("CDM") projects is an example of a non-distribution system alternative to scaling the system to meet new system demand. However, NBHDL does not have capacity related constraints and therefore currently does not have a formal policy to relieving system capacity constraints with distribution system alternatives.

NBHDL continues to support CDM initiatives following regulatory requirements, monitor results of CDM projects and accommodate renewable energy connections because of the inherent benefits to both NBHDL and its partners. Currently, no CDM initiatives are relied upon to address system capacity, as there are no system capacity limitations. Should any unanticipated system capacity issues arise beyond the forecast period, NBHDL intends to actively address these constraints to ensure continued reliability in the system.

4.2.5 System Modernization (5.4.1e)

NBHDL plans to modernize its grid by replacing assets that no longer meet NBHDL's design standards with assets that will contribute to operational efficiencies, where applicable, such as automated switches and to maintain the integrity of the system. Additionally, through system renewal investments, NBHDL may investigate options and take action where it can modernize its system to alleviate feeder capacity constraints in specific areas forecasted to experience growth beyond the DSP forecast period. However, system modernization depends on multiple factors and limits and should be evaluated on a project-by-project basis.

In the current forecast, NBHDL does not intend to enhance customer access to consumption data, nor enhance mechanisms that facilitate real-time data access. These activities may increase customer bills and customers have indicated through surveys that they do not want to experience significant cost increases. Investments related to distributed generation and distributed energy resources are managed on a project-by-project basis, though NBHDL does not expect any major connections over the forecast period.

In summary, NBHDL is listening and responding to its customer engagement to prioritize investments to maintain system performance and address identified concerns in a timely manner. In the interim, NBHDL will evaluate each modernization opportunity and assess the benefit and impact it may have on the business.

4.2.6 Rate-Funded Activities to Defer Distribution Infrastructure (5.4.1f & 5.4.1.1)

Over the historical period, NBHDL has completed the majority of its voltage conversion plans within its distribution system with only a few sections anticipated to be completed in 2021. The projects supported NBDHL in addressing reliability, loading and line loss performance as well as operational efficiency.

In the current DSP forecast period, NBHDL does not have any extraordinary activities proposed within the current forecast period that may defer distribution infrastructure. However, NBHDL notes that on a case-by-case scenario for each scoped project, NBHDL considers alternative solutions in which a few cases may result in deferring infrastructure capital.

Furthermore, NBHDL has sampled its meters to determine if they are operating and reading at acceptable levels. Should the meters be tested positive, NBHDL can extend the seal life of its meters by eight years, further reducing the costs and allowing NBHDL to invest in its assets. If the metered sample returns a negative test, a meter replacement program will be planned and initiated. To date, all sampling has returned as meeting Measurement Canada requirements and the extension was obtained on all meters that fell within that sampling group. NBHDL recognizes this is a small risk and expects the sampling test to return as positive.

4.3 Capital Expenditure Planning Summary (5.4.2)

The Capital Expenditure Summary provides a ‘snapshot’ of NBHDL’s capital expenditures over a 11-year period, which includes six historical years and five forecast years. The costs of individual projects or activities are allocated to one of four investment categories based on the primary (i.e. initial or ‘trigger’) driver of the investment.

Table 4-3: Historical planned capital expenditures and system O&M

Category	Historical															
	2015			2016			2017			2018			2019			2020
	Plan	Act.	Var.	Plan	Act.	Var.	Plan	Act.	Var.	Plan	Act.	Var.	Plan	Act.	Var.	Plan
	$ '000		%	$ '000		%	$ '000		%	$ '000		%	$ '000		%	$ '000
System Access	779	966	*24*	1,167	725	*-38*	1,190	778	*-35*	1,214	1,306	*8*	1,238	1,757	*42*	966
System Renewal	5,187	4,448	*-14*	4,180	4,412	*6*	4,236	5,109	*20*	4,266	3,141	*-26*	4,054	3,788	*-6*	3,986
System Service	364	554	*52*	215	342	*59*	127	681	*436*	89	1,839	*1965*	136	273	*101*	407
General Plant	772	714	*-8*	373	824	*121*	549	607	*11*	351	330	*-6*	642	771	*20*	1,030
Total	7,102	6,682	*-6*	5,935	6,302	*6*	6,102	7,175	*18*	5,920	6,615	*12*	6,070	6,589	*9*	*6,388*
Capital Contributions		703			352			728			559			483		*560*
Net Capital Expenditures		5,979			5,950			6,446			6,057			6,106		*5,828*
System O&M		2,369			2,500			2,370			2,298			2,755		2,982

* There were no planned Capital Contributions, Net Capital Expenditures and System O&M values in the 2015 DSP, therefore no past comparisons are available.

Table 4-4: Historical annual budget capital expenditures and system O&M

Category	Historical											
	2016			2017			2018			2019		
	Budg.	Act.	Var.	Budg.	Act.	Var.	Budg.	Act.	Var.	Budg.	Act.	Var.
	$ '000		%	$ '000		%	$ '000		%	$ '000		%
System Access	1,010	725	*-28*	903	778	-14	963	1,306	36	1,567	1,757	12
System Renewal	4,904	4,412	*-10*	4,898	5,109	4	4,061	3,141	-23	3,566	3,788	6
System Service	418	342	*-18*	610	681	12	995	1,839	85	235	273	16
General Plant	473	824	*74*	587	607	3	375	330	-12	879	771	-12
Total	6,806	6,303	*6*	6,999	7,175	3	6,395	6,615	3	6,247	6,589	5
Capital Contributions		353			728			559			483	
Net Capital Expenditures		5,950			6,446			6,057			6,106	
System O&M		2,500			2,370			2,298			2,755	

* DSP years have the same planned and budget values (2015 and 2020) and are therefore excluded from this comparison.

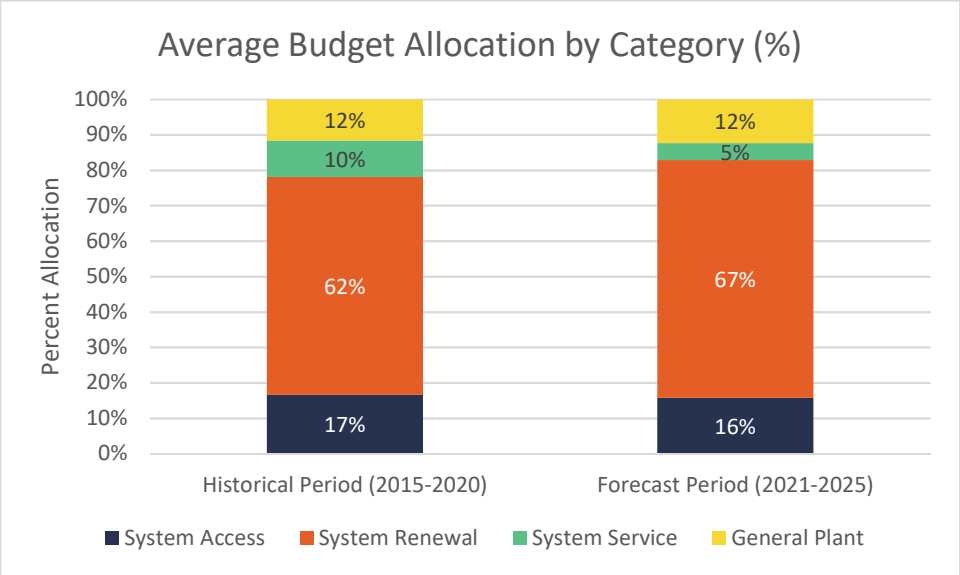
Table 4-5: Forecast capital expenditures and system O&M

Category	Forecast				
	2021	2022	2023	2024	2025
	$ '000	$ '000	$ '000	$ '000	$ '000
System Access	951	969	987	1,006	1,025
System Renewal	4,544	4,008	4,057	4,154	4,221
System Service	288	294	299	305	311
General Plant	909	587	666	1,041	649
Total	6,692	5,858	6,010	6,505	6,206
Capital Contributions	551	562	572	583	594
Net Capital Expenditures	6,141	5,296	5,438	5,922	5,612
System O&M	3,642	3,713	3,785	3,859	3,935

A comparison can be made of NBHDL's annual budget allocation between the historical period and the forecast period. It is evident NBHDL wants to continue business operations near the historical distribution of the budget amongst all project categories. A slight reduction is applied to System Renewal, System Service and General Plan categories to account for an increase in System Access expenditures. This is in part due to the five-year rolling average for System Access has been larger than expected and hence NBHDL is accommodating a larger budget. If the budget does not get used within the planning year, NBHDL intends on diverting the funds to renewal investments where appropriate to meet the safety standards as well as meeting the customer's expectation of the system's performance.

There are no expenditures for non-distribution activities in NBHDL's budget.

Figure 4-4: Average Budget Allocation by Category



Life Cycle Greater than One Year

NBHDLs accounting policy is to include projects in fixed assets when they are completed. Capital projects which are not yet completed are included in WIP. Capital projects with a life cycle greater than one year will be carried over from one year to the next in WIP. Once completed, expenditures are removed from WIP and capitalized to fixed assets at which point they begin depreciating. There are no expenditures for non-distribution activities in the capital spending budget for 2021, or historical spending.

4.3.1 Variances in Capital Expenditures

Assessing and understanding the variances is an important step for NBHDL to promote continuous improvements in its estimation and budgeting process. Excluding projects identified as mandatory, NBHDL creates each project budget based on preliminary designs and historical costs for planning its programs annually. Once detailed designs are complete and ready to be issued for construction, the project estimate is revised to reflect any changes in the design. The revised estimate is used to track against the actual costs, which is reviewed monthly. Customer demand projects are budgeted using

averages from previous years. These projects are mostly unplanned and tracked in real-time to balance the total annual budget with other discretionary projects (i.e. NBHDL plans to reduce System Renewal projects to ensure the overall actual expenditures remain in line with the proposed budget).

NBHDL develops an annual budget each year for the following year based on actual needs for the expenditures. This budgeted amount provides a better indicator of NBHDL's capability to deliver on its plans compared to the previous DSP planned budget. The further away the work is from the previous DSP plans, the more uncertainty there is regarding the specific work requirements. When reviewing Table 4-4, it can be observed that the variances are significantly reduced between the budgeted and actual expenditures compared to the DSP planned budget vs actual expenditures. Every year's total variances are below 10%.

The breakdown below is provided by each category for each year. Variances that exceed +/- 10% are explained and are in reference to Table 4-3 and 4-4. The explanations compare the variance from the 2015 DSP Plan against actual only. The Annual Budget is included to demonstrate that NBHDL's budgeting process is significantly more accurate than the plan.

System Access

System Access projects are customer driven and are typically not planned. They are budgeted based on a rolling five-year historical average. The expenditures are typically comprised of three main categories: subdivisions, road relocations, and service requests (both primary & secondary). No sub-category can be accurately planned for. However, NBHDL attempts to minimize the variances with proactive engagements with developers, city departments and customers. NBHDL is often aware of future proposed subdivisions and road relation projects, but development can often be slower in North Bay and projects remain in the preliminary stages for many years before implementation which is beyond NBHDL's control. The years leading up to 2019, subdivision work was lower than originally communicated which resulted in actual figures being much lower. However, in 2019, a two-fold increase in primary services connections was requested along with one large new subdivision and two major road relocations resulting in a larger spend than planned for.

Except for 2018, the variances between the annual budget and actual values as shown in Table 4-4 are less than the DSP planned values due to increased certainty in the timing of the above-mentioned projects.

System Renewal

<u>2015 Budget Variance (2015 DSP Plan and Annual Budget were the same for that year: - 14%)</u>

- The variance was largely driven due to budget and resources needing to be reallocated due to an increase in expenditures/demand in System Access and System Service projects, which typically involve NBHDL meeting customer obligations and servicing requirements. The customer-driven work had engineering and construction resources diverted away from delivering the planned schedule for system renewal projects and cause them to be deferred.
- NBH constructed MS22 to replace MS09, which was above the estimated budget.
- Due to intense winter weather conditions in North Bay, underground construction projects which started in 2015 were no longer cost-effective or practical to continue as they carry into the winter months, thus having them deferred to spring 2016.

<u>2017 Budget Variance (2015 DSP Plan: 20%, Annual Budget: 4 %)</u>

- The variance was contributed by an increase in underground capital and civil contracted services.
- The variance was also contributed from a higher actual cost for replacing a power transformer and switchgears at MS16 than initially planned for.

2018 Budget Variance (2015 DSP Plan: -26%, Annual Budget: -23%)

- The variance was mainly driven due to the budget needing to be reallocated due to the increase in expenditures in System Service projects. To expand, this was mainly caused by the construction of MS23 to connect the Community Energy Park (CEP). The budget change did not allot NBHDL to execute its full plan for System Renewal resulting in many projects being deferred into later years.

2019 Budget Variance (2015 DSP Plan: -6%, Annual Budget: 6%)

- An increase in customer demand work in the System Access category diverted budget and resources away from executing the System Renewal plan.
- Shore Acres UG Rebuild and the Norman Backlot Elimination were the two most substantial projects to be removed from the plan. These projects both require underground work that would no longer have been cost-effective as the project pushed into the winter months and were deferred to the spring of 2020. The L5H 44kV OH Rebuild was also delayed and pushed into 2020 due to long lead times in ordering composite poles required for the project.
- The annual budget projections were therefore reduced and two overhead projects were added to the plan to fill in for the removed / deferred project.
- In the end, the total projects exceeded the planned budget, but were still less than the DSP planned budget

System Service

2015 Budget Variance (2015 DSP Plan and Annual Budget are the same for the year: 52%)

- System Service expenditures budgeted in 2015 was based on a historic five-year rolling average as well as the implementation of metering infrastructure modernization (Util-Assist strategy from the 2015 DSP).
- NBHDL took advantage of an opportunity to implement a WiMAX communication network for SCADA and eliminate its wireless radio network, reducing operational costs (i.e. no longer needs to pay licensing fees for the radio signals/equipment). The 2015 implementation cost was approximately $114K. This was a one-time and unforeseen opportunity. Had NBH passed on this, it would not have been able to obtain the bandwidth and would have lost the opportunity for future cost savings and system efficiency.
- The additional variance was contributed by approximately $123K spent on voltage conversion implementation work outside of rebuild projects. Much of the work was coordinated after hours to limit the impact to business customers.

2016 Budget Variance (2015 DSP Plan: 59%, Annual Budget: -18%)

- The variance was largely driven by NBHDL’s Voltage Conversion, Metering, and Sub Station control/communication equipment (SCADA / WiMAX) projects

- Furthermore, metering infrastructure upgrades continued into 2016 which resulted in higher actuals than forecasted in the DSP budget largely driven by customer servicing and upgrades to smart meters.

2017 Budget Variance (2015 DSP Plan: 436%, Annual Budget: 12%)

- The variance was contributed by many projects which were required for ongoing operations and could not have been deferred. The larger items include:
    - Metering infrastructure upgrades which exceeded the DSP budget amount at $192K
    - A new 90' composite pole for a repeater antenna needed to be installed for the WiMAX network (SCADA) at $48K
    - Additional WiMAX equipment + Installation at $42K
    - Voltage conversion continued for another $152K approximately
    - 44kV switching improvements were $131k
- These projects were planned in the annual budget preparation, but were not forecasted at the time of the 2015 DSP.

2018 Budget Variance (2015 DSP Plan: 1965%, Annual Budget: 85%)

- The main reason for the variance in the 2018 System Service category was due to the construction of MS23 to connect the Community Energy Park (CEP). Construction costs for MS23 came to be approximately $1.3M in 2018. There was another $537K in connection cost that was captured in System Access related to the CEP.
- The CEP was an unforeseen project in the 2015 DSP horizon. At the time in which the 2015 DSP forecast was created, the idea for the creation of the CEP had not yet materialized nor been discussed as a concept.
- The revised budget was significantly closer to the actual spending.

2019 Budget Variance (2015 DSP Plan: 101%, Annual Budget: 16%)

- The variance was contributed solely from metering infrastructure upgrades and ongoing voltage conversion projects
- The revised annual budget was significantly closer to the actual expenses than the DSP planned budget.

General Plant

2016 Budget Variance (2015 DSP Plan: 121%, Annual Budget: 74%)

- Variation was contributed by increased costs for upgrading the office. The expenditures for the Office Upgrades/Facilities were $455K compared to the $25K planned. See below for details:
    - Although parking lot work was completed in 2015, there were still significant deficiencies and it was determined that the whole parking lot needed to have full reconstruction in 2016 at a cost of $362K.
    - The store upgrade was initially budgeted for 2015, but due to additional costs to the 2015 budget, the upgrade was reported to 2016 at an additional cost of $49K.
- As a result of unforeseen issues with one of the vehicles, NBHDL had to replace a truck promptly ultimately leading to adding a truck replacement this year.

2017 Budget Variance (2015 DSP Plan: 11%, Annual Budget:-12%)

- The variance was contributed from IT costs above budget due to the cost of the purchases and unplanned modifications for the OESP billing software. IT requirements often evolve on a year to year basis based on software manufacturers changes in licensing fees and infrastructure needs.
- Over the last few years, the importance of investing in cybersecurity has become extremely high. Breaches in a company's infrastructure can cause significant damage to a company that could take years to repair. These issues were not foreseen at the time of creating the DSP in 2014 and NBH has had to increase spending to remain protected.

2019 Budget Variance (2015 DSP Plan: 20%, Annual Budget: -12%)

- Variance is driven by IT upgrades not planned in the original DSP budgeted forecast similarly seen in 2016. This includes server replacement and license requirements evolution since 2014.

4.4 JUSTIFYING CAPITAL EXPENDITURES (5.4.3)

This section provides the necessary data, information, and analyses to support the capital expenditure levels proposed in this DSP.

4.4.1 Overall Plan (5.4.3.1)

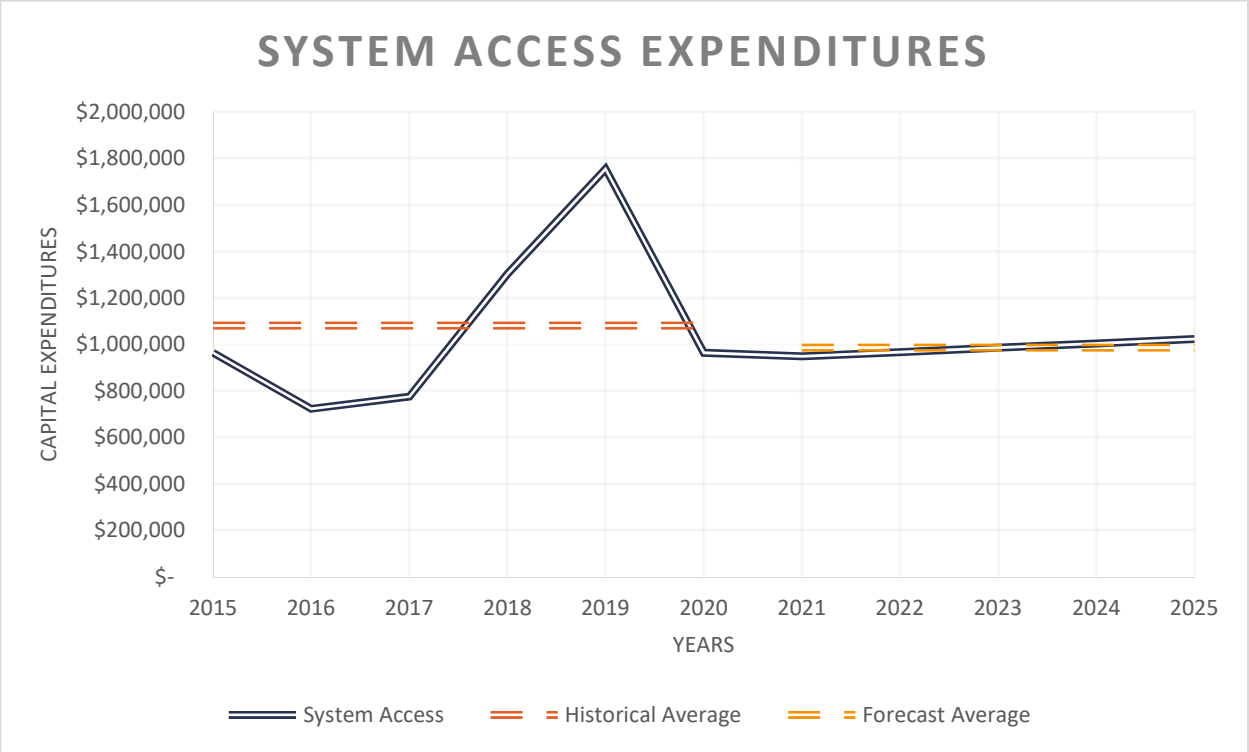
NBHDL has prepared its Capital Plan with a focus on its core values and objectives. NBHDL believes the corporate objectives have been met through the application of thorough and sound planning, prudent, justified budgeting, and ongoing oversight, documentation, and review of all efforts and expenditures while implementing the documented capital, and operating plans. NBHDL believes that it has met these objectives, as outlined in this Distribution System Plan. Additionally, NBHDL's system capability has not experienced any major issues with the connection of existing microFIT or small FIT projects to its system and does not expect any issues within the current five-year plan. NBHDL expects that connection requests during the period covered by its DSP is limited to a small number of net metering projects in the < 10 kW capacity category.

4.4.1.1 *Comparative Expenditures by Category over the Historical Period*

System Access

The historical trend with System Access was significantly variable year over year due to customer connection service requests and metering upgrades. Shown in Figure 4-5, the forecast average is 8.8% less than the historical average. This allows for NBHDL to have adequate resources and funds in place that better reflect the historical expenditures and services required. Forecast projects are expected to be similar to those completed in the past and are often difficult to predict with high accuracy.

Figure 4-5: Comparative expenditure of System Access

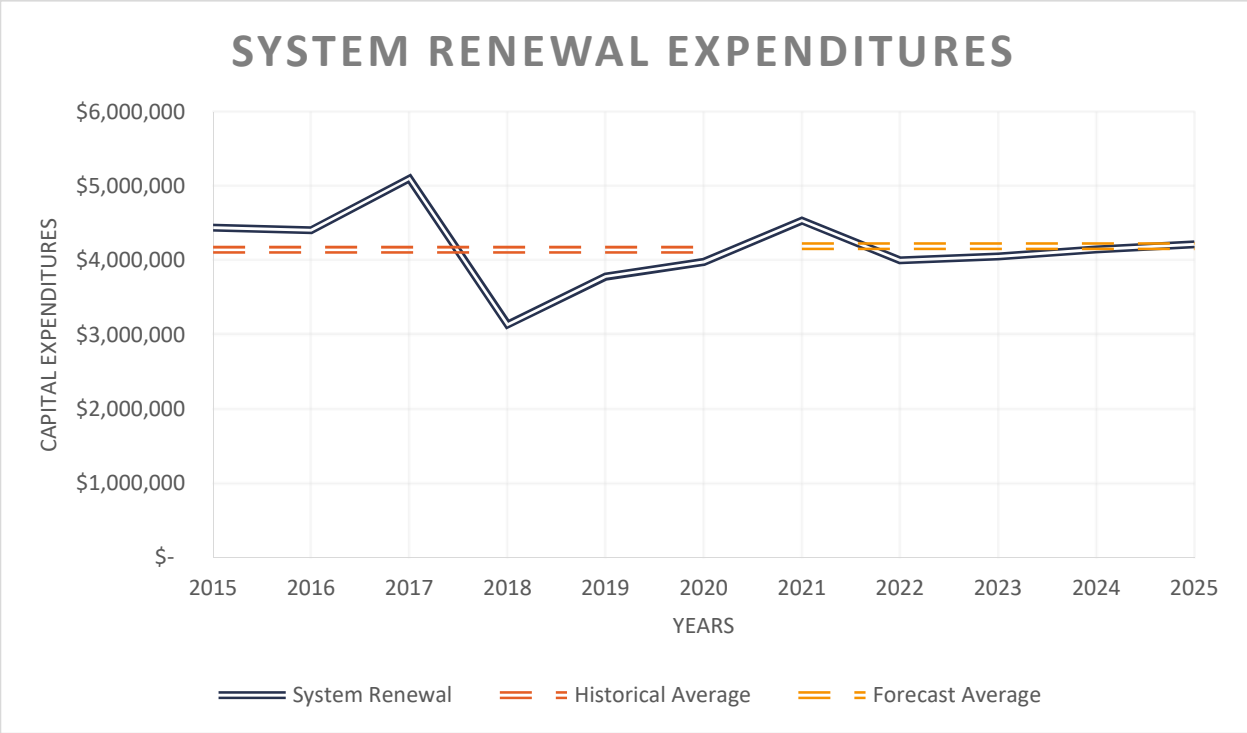


System Renewal

Expenditures for System Renewal were occasionally shifted to System Access to meet the demand of customer service requests which were required to be completed. This had resulted in a backlog of renewal investments that NBHDL attempted to address. Shown in Figure 4-6, the forecast average remains virtually the same as the historical average with a 1.2% increase. Though the average is lower, NBHDL intends on having a more constant level of spending on renewal projects to manage the system's health and performance. Should additional funds be remaining from System Access due to lower than planned for customer service requests, NBHDL intends to re-allocate funds into renewal projects to address additional at-risk assets.

The System Renewal cost for 2021 is higher than the planned subsequent years due to several factors. The Project Prioritization Tool prioritized the need to replace poles for 2 sub-transmission line projects (Priority #1 and #3). These projects are the most expensive type of pole line replacements due to their height/size, number of transfers, devices on them and overall work. Both those lines are also located in an area affected by woodpeckers which requires the use of composite poles. One of those projects is located in an off-road wetland area which will require specialized equipment to be used for installation. Refer to Section 3.2.3 on page 40 for asset requirement details and Table 4-7 for the prioritized list of projects.

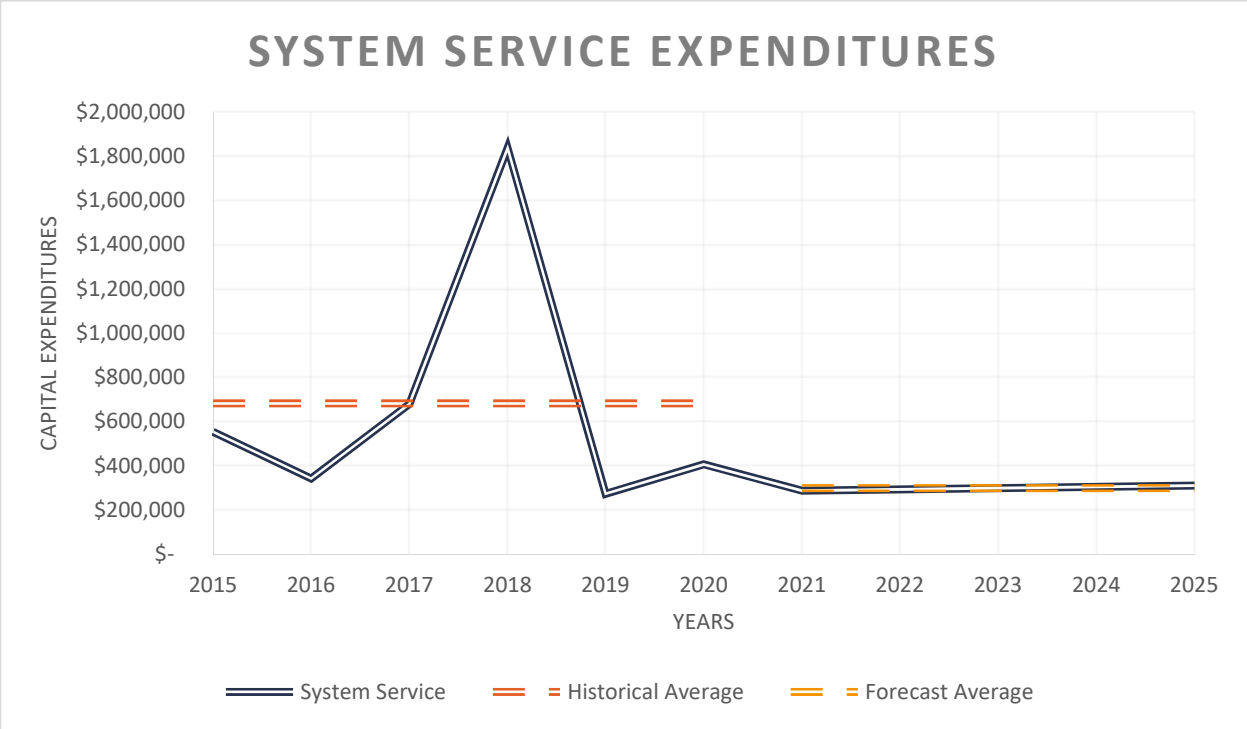
Figure 4-6: Comparative expenditure of System Renewal



System Service

Shown in Figure 4-7, the forecast average is 56% less than the historical average. However, the historical average is high due to the large investment in 2018 and the voltage conversion project which is scheduled for completion in 2020. Moving forward, the NBHDL intends to plan minor investments within System Service to manage the bill impacts of customers at a minimum. Furthermore, NBHDL currently does not identify any major issues with its system performance that would benefit from large investments such as feeder automation. Single point assets may be installed throughout the forecast period as well as completing studies of the system performance if it is warranted to do so.

Figure 4-7: Comparative expenditure of System Service



General Plant

Shown in Figure 4-8, the forecast average is 8% less than the historical average. The historical expenditures had variable spending, addressing only critical items that were needed to maintain safe operations at NBHDL. NBHDL continues to use the same framework moving forward to address only the critical issues needed to maintain the existing facilities, fleet, and IT assets.

Facilities

The facilities expenditures entail general maintenance as well as a new yard fabric structure. It also includes a Building Master Plan. The purpose of this plan is to identify NBHDL's current and long-term facility infrastructure needs. The current facility was developed over multiple years from a pre-existing garage where 1 office and 1 shop addition were added as well as numerous interior renovations over the years to accommodate the changing needs of the business.

At the present time, there are no available areas to add new staff to improve the efficiency of the company. Closets have been turned to office space in order to fit people. This poses an undesirable, unpractical and poor organization structure. Due to the limited amount of office space, NBHDL is not capable of adapting its office space to the COVID-19 situation. It cannot have one-way traffic in the hallways and the hallways are too narrow to ensure proper separation between people as they walk through it.

The Master Plan will review and compare the needs of the business based on work required with the available space and plan. Ultimately, the outcome could be to renovate, reconstruct or find a new facility to operate its business from. In the meantime, NBHDL will only be performing critical maintenance to the facility based on the Building Condition Assessment Report created by Induspec (Appendix F). Once the needs of the company are identified, NBHDL will proceed with preliminary planning for the future development to present to the OEB for its next COS application.

Transportation

NBHDL is following the recommendations of the "John Saunders Utility Services Fleet Report" dated December 5, 2013. Although the report recommends replacing the small vehicles between 5 and 7 years of age, NBHDL is taking a more risk-management approach based on fleet management experience, usage and performance of the vehicles in order to maximize service use. NBHDL plans for its small fleet replacement between 7-12 years of age. Vehicles that have higher kilometres and maintenance costs will be replaced sooner. The fluctuations in fleet spending mostly reflect the years where line trucks are being replaced.

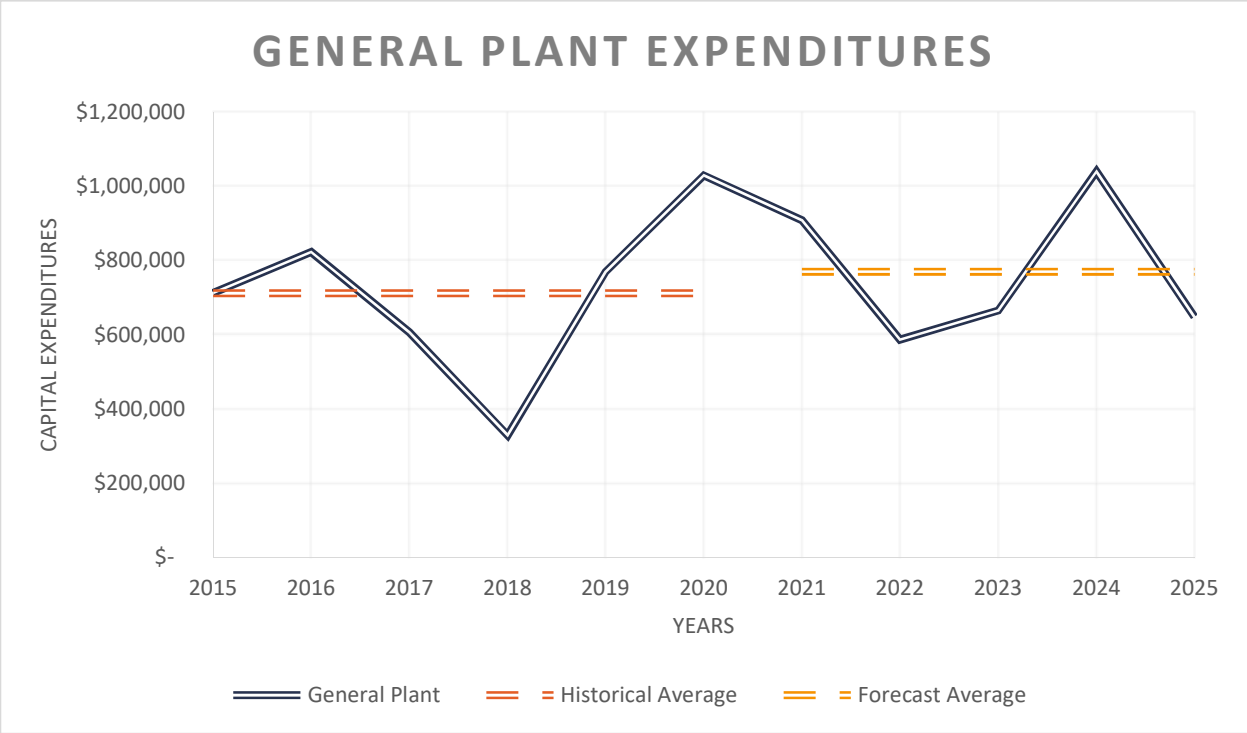
Tool Requirements

NBHDL developed a tool replacement budget based on previous years' spending and specific planned needs. For the next 5-years, there are no special tool needs anticipated, therefore a standard tool budget is allocated.

IT Requirements

NBHDL's IT needs are based on security and operational needs including license renewals and infrastructure improvements.

Figure 4-8: Comparative expenditure of General Plant



4.4.1.2 *Forecast Impact of System Investment on System O&M Costs*

NBHDL expects that the impact of investments on system O&M can vary from project to project. Some projects are being undertaken to replace or renew ageing infrastructure within the NBHDL distribution system. As these assets continue to reach the 'effective age' they are increasingly burdensome on O&M. NBHDL is addressing several underground projects which have been driving O&M costs up with failing underground services. Renewal of these underground assets is anticipated to reduce future O&M costs since NBHDL has to react immediately to outages caused by faults in underground lines in order to restore power to customers. NBHDL focuses its underground restoration efforts in locations where the infrastructure is past its useful life and recurring faults occur. For clarity, O&M costs are inversely correlated with the declining asset condition; therefore, NBHDL anticipates a reduction in future O&M costs as these assets are replaced and increasingly onerous maintenance conditions are alleviated.

4.4.1.3 *Investment Drivers by Category*

<u>System Access</u>

System Access investments include the following drivers:

- Customer Service Requests - The continued requirement for new customer connections. Forecasts assume relatively consistent connections year over year. Connections often include pole replacement, reframing, or other upgrades to meet the requirements of Ontario Reg. 22/04.

System Renewal

System Renewal investments include the following drivers:

- Failure Risk - Multiyear planned asset replacement programs that address assets at the end of life condition. Includes priority replacement of one-off items as a result of high-risk issues identified during inspection and maintenance programs.
- Failure - Emergency reactive replacement of distribution system assets (poles, transformers, switches, switchgear, cable, conductor, insulators, guys, anchors, etc.) due to unanticipated failure, storms, motor vehicle accidents, vandalism, etc.

System Service

System Service investments include the following drivers:

- Reliability– Investments allocated for innovation, system reliability and efficiency that provide a large benefit to the system's overall performance. Additionally, investments have a positive side impact on power quality, support for REG projects and future cost savings.

General Plant

General Plant investments include the following drivers:

- System Maintenance Support – Replacement of items ensuring that adequate tools, equipment and systems are in place to support the day to day operations of NBHDL's business. The replacement of major fleet units is also included.

4.4.2 Material Investments (5.4.3.2)

The focus of this section is on 2021 projects that meet the materiality threshold set out in Chapter 2 of the Filing Requirements. The table below is a consolidated list of applicable project names categorized. Refer to Appendix 2-AA and 2-AB for details.

Table 4-6: Test Year Material Investments

Category	Project Name/Description	Category Project Priority	Overall Project Priority
System Access	Secondary Services	1	2
	Primary Services	2	3
	Road Relocations	3	4
	Subdivisions	4	5
	Minor Betterments	5	6
System Renewal	Minor Betterments	*Safety or Failure Related*	1
	WF0525291 - Wallace Rd 44kV Rebuild (sub-transmission)	1	7
	WF0551060 - Hwy 11N (Sunshine to Berkley) Rebuild	2	8
	WF0551900 - MS10 to HWY 11 44 kV Rebuild (sub-transmission)	3	9
	WF0551387 - MacBeth Cres	4	10
	WF0525501 - Ski Club Rd Part 3	5	11
	WF0525435 - Gertrude West Rebuild	6	16
	WF0551261 - Dane Ave Rebuild	7	17
	WF0551260 - Montrose Ave Rebuild	8	18
	Primary Services	9	19
	MS15 Rehabilitation (Construction)	1 *(Substation)*	15
	MS18 Rehabilitation (Engineering)	2 *(Substation)*	21
	Transformers	*As Required for Projects*	N/A
General Plant	Customer Portal	1	12
	Truck 43 Replacement	2	13
	Truck 34 Replacement	3	14
	General Building Work	4	20
	Yard Fabric Structure	5	22

Table 4-7: 2021 Capital Projects Table

2021 Capital Projects Table		
Projects	**Project Costs**	**2021 Test Year**
Reporting Basis		**MIFRS**
System Renewal:		
Transformer Purchases - Various Jobs		229,240
Major Betterment Projects - Subtotal		3,318,334
Macbeth Backlot Elimination	*949,317*	
Wallace Road - 63 to Seymour - Line Rebuild	*811,240*	
MS10 to Hwy 11 - 44kV Line Rebuild	*629,884*	
Hwy 11 North - Sunshine Lane to Berkely	*337,164*	
Ski Club 3 -Chapais to O'Brien	*201,271*	
Dane Ave - Rebuild	*177,414*	
Gertrude St East - Line Rebuild - LSD to Parsons	*106,113*	
Montrose	*105,930*	
Minor Betterment Projects - Various Jobs		295,359
Distribution Substation Improvements & Rehabilitation - Subtotal		507,020
MS15 Rehab	*424,402*	
MS18 Rehab	*82,619*	
Primary Services		132,411
Misc. Projects <$75k on individual project basis		61,503
Sub-Total		4,543,867
System Service:		
Transformer Purchases - Various Jobs		40,816
Minor Betterment Projects - Various Jobs		51,219
Meters Installs and Upgrades - Various Jobs (<$75k on individual project basis)		130,134
Misc. Projects <$75k on individual project basis		65,979
Sub-Total		288,148
System Access:		
Transformer Purchases - Various Jobs		61,061
Minor Betterment Projects - Various Jobs		212,096
Primary Services Projects - Various Jobs		198,457
Secondary Services - Various Jobs		296,183
Subdivisions - Various Jobs		83,757
Road Relocation Projects - Various Jobs		99,378
Sub-Total		950,932
General Plant		
Rear Yard Cover		136,947
General Building (asphalt, windows, masonry, doors, etc.)		130,300
Customer Portal		75,000
Building & General Office Upgrades, including Furniture		26,766
Fleet Replacement - Cab & Chassis		119,649
Fleet Replacement - Boom & Bucket		214,084
Servers, PC, Other Hardware		8,200
Software <$75k on individual basis		158,150
Work Equipment		40,000
Sub-Total		909,096
Contributed Capital from Customers		(551,144)
Total		**6,140,899**
Less Renewable Generation Facility Assets and Other Non-Rate-Regulated Utility Assets *(input as negative)*		
Total		**6,140,899**

Appendix A - IESO Letter of Comment

IESO response to North Bay Hydro Distribution Limited REG Investment Plan 2021 – 2025

In accordance with the Ontario Energy Board's (OEB) Chapter 5 filing requirements to submit a Distribution System Plan (DSP) with its Cost of Service application, on September 9, 2020, North Bay Hydro Distribution Limited (NBHDL) sent its Renewable Energy Generation (REG) Plan as part of its DSP, to the Independent Electricity System Operator (IESO) for comment. The IESO has reviewed NBHDL's REG Plan and notes that it contains no investments specific to connecting REG for the Plan period 2021 - 2025.

The IESO notes that NBHDL's service territory is within two regional planning groups: Sudbury/Algoma Region and North/East of Sudbury Region. For both of these regions the IESO confirms that NBHDL has been a participating member of the Study Teams[1]. The status of regional planning activities for these regions can be found on the IESO's website.

NBHDL's REG Plan Section 5 - Proposed Investments to Facilitate New Connections states the following: "Based on the evaluation of the distribution system to accept green energy generation connections, no constraints have been identified in the system, preventing the connection of renewable energy generation installations. Therefore, NBHDL is not proposing any capital investments for capacity upgrades on the distribution system to accommodate the applications for the connection of renewable energy generation plant, over the next five years from 2020 to 2025."

The IESO submits that as NBHDL has no REG investments during the 5-year Distribution System Plan period, no comment letter from the IESO is required to address the bullets points in the OEB's Filing Requirements for Electricity Distribution Rate Applications - Chapter 5, Section 5.2.2 Coordinated Planning with Third Parties[2].

The IESO appreciates having had the opportunity to review NBHDL's REG Plan and looks forward to working together during the next regional planning cycles.

[1] Study Team members along with the IESO and Hydro One (Distribution and Lead Transmitter): **Sudbury/Algoma** - NBHDL (embedded LDC), Greater Sudbury Hydro Inc.; **North/East of Sudbury** – NBHDL, Greater Sudbury Hydro Inc., Northern Ontario Wires Inc., and the IESO.
[2] OEB's Filing Requirements for Electricity Distribution Rate Applications - Chapter 5, Section 5.2.2, page 10: https://www.oeb.ca/sites/default/files/Chapter-5-DSP-Filing-Requirements-20200514.pdf

Appendix B - 2019 Scorecard NBH

Scorecard - North Bay Hydro Distribution Limited

9/1/2020

Performance Outcomes	Performance Categories	Measures		2015	2016	2017	2018	2019	Trend	Target: Industry	Target: Distributor
Customer Focus Services are provided in a manner that responds to identified customer preferences.	Service Quality	New Residential/Small Business Services Connected on Time		100.00%	100.00%	100.00%	100.00%	100.00%	➡	90.00%	
		Scheduled Appointments Met On Time		100.00%	99.90%	100.00%	100.00%	100.00%	⬆	90.00%	
		Telephone Calls Answered On Time		82.10%	83.60%	86.56%	91.13%	95.65%	⬆	65.00%	
	Customer Satisfaction	First Contact Resolution		6	14	6	4	3			
		Billing Accuracy		99.88%	99.70%	99.74%	99.72%	99.87%	➡	98.00%	
		Customer Satisfaction Survey Results		A	85%	85%	89%	89%			
Operational Effectiveness Continuous improvement in productivity and cost performance is achieved; and distributors deliver on system reliability and quality objectives.	Safety	Level of Public Awareness		81.00%	81.00%	81.00%	81.00%	81.00%			
		Level of Compliance with Ontario Regulation 22/04 [1]		C	C	C	C	C	➡		C
		Serious Electrical Incident Index	Number of General Public Incidents	0	0	0	0	0	➡		0
			Rate per 10, 100, 1000 km of line	0.000	0.000	0.000	0.000	0.000	➡		0.000
	System Reliability	Average Number of Hours that Power to a Customer is Interrupted [2]		1.10	2.29	1.11	1.95	1.16	⬇		2.10
		Average Number of Times that Power to a Customer is Interrupted [2]		0.88	1.98	0.94	1.40	1.35	⬇		1.99
	Asset Management	Distribution System Plan Implementation Progress		94%	106%	118%	112%	119%			
	Cost Control	Efficiency Assessment		3	3	3	3	3			
		Total Cost per Customer [3]		$675	$659	$672	$695	$732			
		Total Cost per Km of Line [3]		$28,297	$27,680	$28,233	$29,208	$30,928			
Public Policy Responsiveness Distributors deliver on obligations mandated by government (e.g., in legislation and in regulatory requirements imposed further to Ministerial directives to the Board).	Conservation & Demand Management	Net Cumulative Energy Savings [4]		20.96%	102.04%	129.07%	146.00%	151.00%			20.26 GWh
	Connection of Renewable Generation	Renewable Generation Connection Impact Assessments Completed On Time						50.00%			
		New Micro-embedded Generation Facilities Connected On Time		100.00%	100.00%	100.00%	100.00%		➡	90.00%	
Financial Performance Financial viability is maintained; and savings from operational effectiveness are sustainable.	Financial Ratios	Liquidity: Current Ratio (Current Assets/Current Liabilities)		2.07	2.09	1.92	1.84	1.69			
		Leverage: Total Debt (includes short-term and long-term debt) to Equity Ratio		0.94	0.95	1.01	1.00	1.03			
		Profitability: Regulatory Return on Equity	Deemed (included in rates)	9.30%	9.30%	9.30%	9.30%	9.30%			
			Achieved	10.65%	9.01%	8.56%	10.17%	6.14%			

1. Compliance with Ontario Regulation 22/04 assessed: Compliant (C); Needs Improvement (NI); or Non-Compliant (NC).
2. The trend's arrow direction is based on the comparison of the current 5-year rolling average to the distributor-specific target on the right. An upward arrow indicates decreasing reliability while downward indicates improving reliability.
3. A benchmarking analysis determines the total cost figures from the distributor's reported information.
4. The CDM measure is based on the now discontinued 2015-2020 Conservation First Framework. 2019 results include savings reported to the IESO up until the end of February 2020.

Legend:

5-year trend
⬆ up ⬇ down ➡ flat

Current year
target met target not met

Performance Outcomes	Performance Categories	Measures		2015	2016	2017	2018	2019	Trend	Target	
										Industry	Distributor
Customer Focus Services are provided in a manner that responds to identified customer preferences.	**Service Quality**	New Residential/Small Business Services Connected on Time		100.00%%	100.00%%	100.00%%	100.00%%	100.00%%		90.00%	
		Scheduled Appointments Met On Time		100.00%%	99.90%%	100.00%%	100.00%%	100.00%%		90.00%	
		Telephone Calls Answered On Time		82.10%%	83.60%%	86.56%%	91.13%%	95.65%%		65.00%	
	Customer Satisfaction	First Contact Resolution		6	14	6	4	3			
		Billing Accuracy		99.88%	99.70%	99.74%	99.72%	99.87%		98.00%	
		Customer Satisfaction Survey Results		A	85%	85%	89%	89%			
Operational Effectiveness Continuous improvement in productivity and cost performance is achieved; and distributors deliver on system reliability and quality objectives.	**Safety**	Level of Public Awareness		81.00%%	81.00%%	81.00%%	81.00%%	81.00%%			
		Level of Compliance with Ontario Regulation 22/04 [1]		C	C	C	C	C			C
		Serious Electrical Incident Index	Number of General Public Incidents	0	0	0	0	0			0
			Rate per 10, 100, 1000 km of line	0.000	0.000	0.000	0.000	0.000			0.000
	System Reliability	Average Number of Hours that Power to a Customer is Interrupted [2]		1.10	2.29	1.11	1.95	1.16			
		Average Number of Times that Power to a Customer is Interrupted [2]		0.88	1.98	0.94	1.40	1.35			
	Asset Management	Distribution System Plan Implementation Progress		94%	106%	118%	112%	119%			
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	Connection of Renewable Generation	Renewable Generation Connection Impact Assessments Completed On Time						50.00%			
		New Micro-embedded Generation Facilities Connected On Time		100.00%%	100.00%%	100.00%%	100.00%%			90.00%	
Financial Performance Financial viability is maintained; and savings from operational effectiveness are sustainable.	**Financial Ratios**	Liquidity: Current Ratio (Current Assets/Current Liabilities)		2.07	2.09	1.92	1.84	1.69			
		Leverage: Total Debt (includes short-term and long-term debt) to Equity Ratio		0.94	0.95	1.01	1.00	1.03			
		Profitability: Regulatory Return on Equity	Deemed (included in rates)	9.30%	9.30%	9.30%	9.30%	9.30%			
			Achieved	10.65%	9.01%	8.56%	10.17%	6.14%			

1. Compliance with Ontario Regulation 22/04 assessed: Compliant (C); Needs Improvement (NI); or Non-Compliant (NC).
2. The trend's arrow direction is based on the comparison of the current 5-year rolling average to the distributor-specific target on the right. An upward arrow indicates decreasing reliability while downward indicates improving reliability.
3. A benchmarking analysis determines the total cost figures from the distributor's reported information.
4. The CDM measure is based on the now discontinued 2015-2020 Conservation First Framework. 2019 results include savings reported to the IESO up until the end of February 2020.

Legend:

5-year trend
up | down | flat

Current year
target met | target not met

Appendix C – Asset Condition Assessment

METSCO

MAKING IT POSSIBLE



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ASSET CONDITION ASSESSMENT FINAL REPORT 2020

Prepared by

METSCO
MAKING IT POSSIBLE

P-19-148

September 2020

Disclaimer

This report was prepared by METSCO Energy Solutions Inc. ("METSCO") for the sole benefit of North Bay Hydro Distribution Limited ("NBHDL" or the Client), in accordance with the terms of the METSCO proposal and the Client Agreement.

Some of the information and statements contained in the Asset Condition Assessment ("ACA") are comprised of, or are based on, assumptions, estimates, forecasts and predictions and projections made by METSCO and NBHDL. In addition, some of the information and statements in the ACA are based on actions that NBHDL currently intends it will take in the future. As circumstances change, assumptions and estimates may prove to be obsolete, events may not occur as forecasted, predicted, or projected, and NBHDL may at a later date decide to take different actions to those it currently intends to take.

Except for any statutory liability which cannot be excluded, METSCO and NBHDL will not be liable, whether in contract, tort (including negligence), equity or otherwise, to compensate or indemnify any person for any loss, injury or damage arising directly or indirectly from any person using, or relying on any content of the ACA.

Asset Condition Assessment Report 2020

Final Report

September 2020

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Executive Summary

Context of the Study

North Bay Hydro Distribution Limited ("NBHDL") is an electricity distributor operating a system made up of 17 substations and 515 km of distribution lines delivering electricity to approximately 24,200 residential and commercial customers in the City of North Bay. NBHDL engaged METSCO Energy Solutions to prepare a comprehensive Asset Condition Assessment ("ACA") study for the assets comprising NBHDL's distribution system. The ACA is required as one of the key inputs for the preparation of NBDHL's five-year Distribution System Plan ("DSP"), developed in accordance with the filing requirements enacted by the Ontario Energy Board ("OEB").

Scope of the Study

METSCO's work included interviews with NBHDL subject matter experts to define the Health Indices appropriate for the asset types, review and consolidation of the client's data sets, analysis of NBHDL's asset records to calculate the Health Index values, and preparation of the final document. In total METSCO assessed and calculated Health Index values for the following asset classes:

- Distribution Wood Poles
- Sub-transmission Wood Poles
- Overhead Primary Conductors
- Underground Primary Cables
- Distribution Pole Mount Transformers
- Distribution Pad Mount Transformers
- Distribution Vault Transformers
- Distribution Overhead Switches
- Station Power Transformers
- Station Switchgears
- Reclosers
- Station Protection Relays
- Station Overhead Switch
- Station Buildings
- Station Ground Grids

All asset condition data used in the study are maintained by NBHDL as part of its regular asset management practices and collected in compliance with the Distribution System Code requirements. METSCO received NBHDL's data between July 2019 and August 2020. The results from "Substation Condition Assessment of All 17 North Bay Hydro Stations"

(Costello Utility Consultants, 2019) and "North Bay Hydro Asset Condition Assessment – Further Rating Review" (CIMA+, 2020), which employ METSCO's methodology, are extracted and leveraged within this assessment.

Methodology and Findings

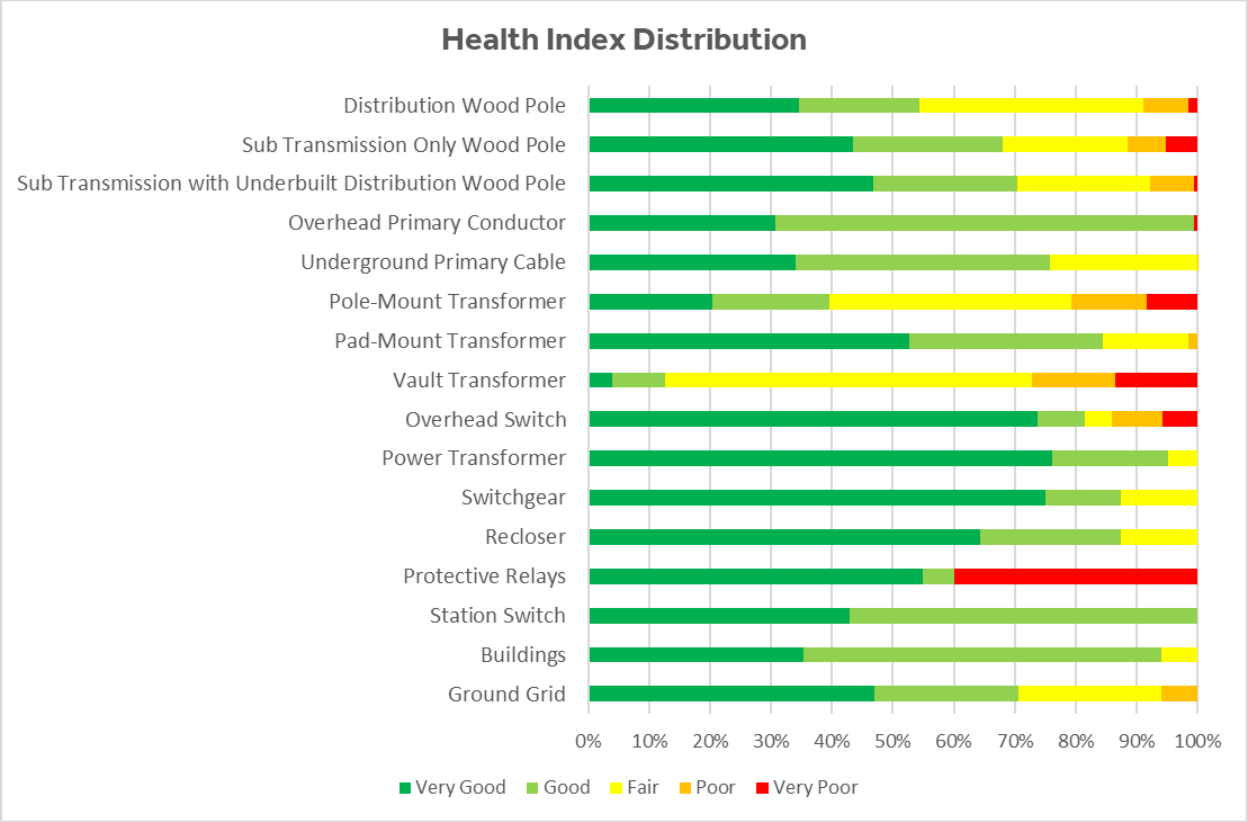
For all asset classes that underwent assessment, METSCO used a consistent scale of asset health from Very Good to Very Poor. The numerical Health Index ("HI") corresponding to each condition category serves as an indicator of an asset's remaining life, expressed as a percentage. Table 0-1 presents the HI ranges corresponding to each condition score, along with their corresponding implications as to the follow-up actions required by the asset manager at NBHDL.

Table 0-1: Health Index Ranges and Corresponding Implications for the Asset Condition

Health Index Score (%)	Condition	Description	Implications
[85-100]	Very Good	Some evidence of ageing or minor deterioration of a limited number of components	Normal Maintenance
[70-85)	Good	Significant Deterioration of some components	Normal Maintenance
[50-70)	Fair	Widespread significant deterioration or serious deterioration of specific components	Increase diagnostic testing; possible remedial work or replacement needed depending on the unit's criticality
[30-50)	Poor	Widespread serious deterioration	Start the planning process to replace or rehabilitate, considering the risk and consequences of failure
[0-30)	Very Poor	Extensive serious deterioration	The asset has reached its end-of-life; immediately assess risk and replace or refurbish based on assessment

Using this scale, METSCO calculated the HI for every asset in the scope of the assessment using the applicable and available "condition parameters" – individual characteristics of the state of an asset's components. Each condition parameter has its own sub-scale of assessment and a weighting contribution that represents the percentage in the overall HI made up by the particular parameter. METSCO's findings for each asset class were developed using this methodology, as described in more detail in Section 3 and Section 4. The consolidated results of the Asset Condition Assessment are summarized in Figure 0-1.

Figure 0-1: Health Index Results



As the figure above indicates, the majority of NBHDL's distribution system is in Good or better condition, with several specific asset classes containing units found to be in Poor and Very Poor condition – most notably pole-mount transformers, vault transformers, overhead switches and station protective relays. Table 0-2 on the following page presents the numerical Health Index summary for each asset class. The distribution of Health Indices is based on the total population count of a given asset class. For each asset class, the following details are listed: total population, average Health Index, average Data Availability Index ("DAI"), and the Health Index distribution.

A DAI is a percentage of condition parameter data available for an asset or asset class, as measured against the condition parameters considered in the Health Index Formulation. A DAI of 100% for an asset indicates that data was available for all assets and all condition parameters in an asset class. DAI is also calculated for individual condition parameters used in the Health Index Formulation.

Table 0-2: Asset Condition Assessment Overall results

Asset Class	Population	Health Index Distribution (%)					Average Health Index	Average DAI
		Very Good	Good	Fair	Poor	Very Poor		
Distribution								
Distribution Wood Pole	5955	34.54%	19.81%	36.83%	7.32%	1.50%	73.49%	39.57%
Sub Transmission Only Wood Pole	253	43.47%	24.61%	20.36%	6.28%	5.27%	76.23%	48.72%
Sub Transmission with Underbuilt Distribution Wood Pole	1077	46.79%	23.57%	21.83%	7.23%	0.59%	78.49%	49.96%
Overhead Primary Conductor (m)	407103	30.70%	68.69%	0.00%	0.06%	0.55%	81.41%	99.99%
Underground Primary Cable (m)	115669	34.01%	41.71%	24.20%	0.08%	0.00%	76.56%	99.85%
Pole-Mount Transformer	2419	20.46%	19.17%	39.63%	12.44%	8.30%	60.88%	97.77%
Pad-Mount Transformer	676	52.61%	31.83%	13.97%	1.60%	0.00%	86.41%	82.84%
Vault Transformer	52	3.88%	8.74%	60.19%	13.59%	13.59%	98.08%	51.75%
Overhead Switch	1341	73.68%	7.90%	4.40%	8.35%	5.67%	84.93%	81.56%
Station								
Power Transformer	21	76.19%	19.05%	4.76%	0.00%	0.00%	88.47%	98.75%
Switchgear	8	75.00%	12.50%	12.50%	0.00%	0.00%	92.71%	100.00%
Recloser	56	64.29%	23.21%	12.50%	0.00%	0.00%	91.48%	96.89%
Protective Relays	20	55.00%	5.00%	0.00%	0.00%	40.00%	67.98%	100.00%
Station Switch	14	42.86%	57.14%	0.00%	0.00%	0.00%	87.23%	100.00%
Buildings	17	35.29%	58.82%	5.88%	0.00%	0.00%	82.79%	100.00%
Ground Grid	17	47.06%	23.53%	23.53%	5.88%	0.00%	76.81%	100.00%

NBHDL's Current Health Index Maturity and Continuous Improvement

Overall, NBHDL's asset data collection practices are sufficiently robust to enable calculation of recommended Asset Condition Assessment that is consistent with industry best practices.

In limited cases, such as distribution overhead switches and vault transformers, there are opportunities for NBHDL to introduce additional variables that can provide further insight into the degradation level of a given asset class. For example, there remain a few instances where select recommended parameter data is not collected or is not available across a large enough portion of the population, resulting in certain condition parameters being excluded from the formulation. However, such instances represent relative exceptions rather than the rule, enabling METSCO to classify NBHDL's HI formulation as being closely aligned with best practices.

While the existing framework provides NBHDL with a significant volume of data, certain procedural and technological enhancements could further the granularity of its asset condition data and facilitate calculation of a greater proportion of numerical degradation

scores. To this end, Section 5 of this study includes a set of METSCO's recommendations for incremental data collection enhancements that NBHDL can consider going forward based on its assessment of their relative cost-benefit tradeoffs. METSCO prioritized the individual items according to the significance of the additional insights they would enable NBHDL to generate.

In providing these recommendations, METSCO is cognizant of the fact that regulated utilities are facing cost constraints across numerous facets of their operations, while contending with the effects of ageing infrastructure, changing climate, evolving customer needs, and many other priorities. As such, adoption of any incremental enhancement to the existing asset data collection practices must be grounded in management's assessment of the incremental value of such enhancements, relative to the opportunity cost of advancements elsewhere in the utility's operations. METSCO makes this observation to highlight its position that the sole fact of a gap between a utility's current process state and the industry best practices need not necessarily indicate that an action to remedy that gap is required in short order.

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1 Introduction

METSCO Energy Solutions Inc. ("METSCO") is an industry expert in Asset Condition Assessment ("ACA") and Asset Management ("AM") practices due to our extensive experience in conducting ACAs, developing AM plans, and implementing AM frameworks for transmission and distribution utilities across North America. METSCO's collective record of experience in these areas is among the most extensive in the world, with our AM frameworks gaining acceptance across multiple regulatory jurisdictions. A selection of METSCO's past projects is attached as Appendix A to this report.

North Bay Hydro Distribution Limited ("NBHDL") is an electricity distributor operating in the City of North Bay. NBHDL engaged METSCO to prepare a comprehensive ACA study for the assets comprising NBHDL's distribution system. The ACA is required as one of the key inputs for the preparation of NBHDL's five-year Distribution System Plan, prepared in accordance with the filing requirements enacted by the Ontario Energy Board ("OEB"). The study's primary objective is to generate and report on the Health Indices grounded in the latest condition data of in-service assets – to enable future prioritization of asset renewal investments using objective decision inputs. Supplementary objectives included preparing the ACA results to be used for NBHDL's upcoming rate filing as well as to continuously improve NBHDL's asset management framework.

A unique ACA methodology is applied to each asset class deployed within NBHDL's distribution system. The adoption of the ACA methodology requires identifying end-of-life criteria for various components associated with each asset type, followed by periodic asset inspections and recording of asset condition to identify the assets most at risk at reaching the end-of-life criteria over the relevant planning horizon. Each criterion represents a factor that is influential, to a specific degree, in determining an asset's (or its component's) condition relative to its potential failure. These components and tests are weighted based on their importance in determining the assets' end-of-life.

The report covers the following major asset classes:

- Distribution Wood Poles
- Sub-transmission Wood Poles
- Overhead Primary Conductors
- Underground Primary Cables
- Distribution Pole Mount Transformers
- Distribution Pad Mount Transformers
- Distribution Vault Transformers
- Distribution Overhead Switches
- Station Power Transformers

- Station Switchgears
- Reclosers
- Station Protection Relays
- Station Overhead Switch
- Station Buildings
- Station Ground Grids

All the asset condition data is maintained by NBHDL as part of its regular asset management and collected in compliance with the Distribution System Code requirements. METSCO received NBHDL's data for the current condition assessment with date records between July 2019 and August 2020. Station asset condition assessment results are leveraged from "Substation Condition Assessment of All 17 North Bay Hydro Stations" (Costello Utility Consultants, 2019) "North Bay Hydro Asset Condition Assessment – Further Rating Review" (CIMA+, 2020).

The report is organized into six sections including this introductory section:

- Section 2 summarizes the ISO 5500X AM standards, discusses how the ACA fits into the overall AM framework; and provides an overview of METSCO's ACA methodology ;
- Section 3 summarizes the asset Health Index calculation methodology;
- Section 4 provides the Condition Assessment methodology framework and assessment for each of the identified asset classes;
- Section 5 summarizes METSCO's recommendations for NBHDL on data collection improvements for continuous improvement efforts for the ACA; and
- Section 6 summarizes METSCO's concluding remarks.

2 Context of the ACA within AM Planning

The ACA is a key step in developing an asset replacement strategy. By evaluating the current set of available data related to the condition of in-service assets comprising an organization's asset portfolio, condition scores for each asset are determined. The ACA involves the collection, consolidation, and utilization of the results within an organizational AM framework for the purposes of objectively quantifying and managing the risks of its asset portfolio. The level of degradation of an asset, its configuration within the system, and its corresponding likelihood of failure feed directly into the risk evaluation process, which identifies asset candidates for intervention (i.e., replacement or refurbishment). Assets are then grouped into program and project scopes that are evaluated and prioritized.

The ACA is designed to provide insights into the current state of an organization's asset base, the risks associated with identified degradation, approaches to managing this degradation within the current AM framework, and how to best make use of these results to extract the optimal value from the asset portfolio going forward.

2.1 International Standards for AM

The following paragraphs serve as a brief introduction to the ISO standards and provide a brief overview of the applicability of AM standards within an entity.

The Industry Standard for AM Planning is outlined in ISO 5500X (which captures 55000, 55001 and 55002). Each business entity finds itself at one of the three main stages along the Asset Management journey:

1. Exploratory stage - entities looking to establish and set up an AM system ;
2. Advancement stage - entities looking to realize more value from an asset base; and
3. Continuous Improvement stage - those looking to assess and progressively enhance an asset management system already in place for avenues of improvement.

Given that AM is a continuous journey, ISO 5500X remains continuously relevant within an organization; providing an objective, evidence-based framework against which the organizations can assess the managerial decisions relating to their purpose, operating context, and financial constraints over the different stages of their existence.[1]

An asset is any item or entity that has a value to the organization. This can be actual or potential value, in a monetary or otherwise intangible sense (i.e. public safety). The hierarchy of an AM framework is as follows: an asset portfolio, containing all known information regarding the assets, sits as the fundamental core of an organization. The ACA

[1] ISO 55000 – Asset management – Overview, principles and terminology

is the procedure to turn the known condition information into actionable insights based on the level of deterioration.

Around the asset portfolio, the AM system operates and represents a set of interacting elements that establish the policy, objectives, and processes to achieve those objectives. The AM system is encompassed by the AM practices – coordinated activities of the organization to realize maximum value from its assets. Finally, the organizational management organizes and executes the underlying hierarchy.[1]

Figure 2-1: Relationship between key Asset Management terms[1]



2.2 ACA within the AM Process

A well-executed AM strategy hinges on the ability of an organization to classify its assets via comprehensive and extensive data and data collection procedures. This includes but is not limited to: the collection and storage of technical specifications, historical asset performance, projected asset behaviour and degradation, the configuration of an asset or asset-group within the system, the operational relationship of one asset to another, etc. In this way, AM systems should be focused on the techniques and procedures in which data can be most efficiently extracted and stored from its asset base to allow for further analysis and insights to be made. With more asset data on hand, better and more informed decisions can be made to realize greater benefits and reduce the risk across the asset portfolio managed by an organization.[2]

AM is fundamentally grounded in a risk-based evaluation of continued value. The overarching goal of an AM process it to quantify all assets risk by their probability and impact (where possible) and then look to minimize these risks through AM operations and procedures. The ACA quantifies the condition of each asset under study and is an

[2] ISO 55002 – Asset management – Management systems – Guidelines for the application of ISO 55001

appropriate indicator of its failure probability. Making asset replacement decisions directly based on the ACA results constitutes a condition-based intervention strategy.

AM practices can help quantify and drive strategic decisions. A better understanding of the asset portfolio and how it is performing within an organization will allow for optimal decision-making. This is largely due to AM being a fundamentally risk-based approach, which lends it to be a structured framework for creating financial plans driven by data. AM practices should also have goals in mind when framing asset investments, changes in asset configuration, or acquisition of new assets. This can include better technical compliance, increased safety, increased reliability, or increased financial performance of the asset base. ISO 5500X states explicitly that all asset portfolio improvements should be assessed via a risk-based approach prior to being implemented. [1] The criticality of the asset determines its failure impact. A risk-based asset intervention strategy should consider both the probability and impact in the decision-making process.

2.3 Continuous Improvement in the AM Process

The application of rigorous AM processes can produce multiple types of benefits for an organization including, but not limited to: realized financial profits, better classified and managed risk among assets, better-informed investment decisions, demonstrated compliance among the asset base, increased public and worker safety, and corporate sustainability.[1]

AM processes are ideally integrated throughout the entire organization. This requires a well-documented AM framework that is shared between all relevant agents. In this way, the organization stands to benefit the most from its internal resources, whether it be via technical experts, those operating and maintaining the assets or those with an understanding of the financial operations and constraints on the organization as a whole. As a future-state goal, utilities and other organizations alike should strive to document their AM guiding principles within a Strategic Asset Management Plan ("SAMP"). The SAMP should be used as a guide for the organization to apply its AM principles and practices for its specific use case. Distribution of the SAMP should be well-publicized within an organization and updated on a regular basis, in order to best quantify the most current and comprehensive AM practices being implemented. Just as the asset base performance is subject to an in-depth review, the AM process and system should be reviewed with the same rigor.[1]

AM should be regarded as a fluid process. Adopting a framework and an idealized set of practices does not bind the organization or restrict its agency. With time, the goal of any AM system is to continually improve and realize benefits within the organization through better management of its asset portfolio. Continually improved asset data and data collection

procedures, updated SAMPs, and further integration into all aspects of an organization's activities as it grows and changes over time should be the goal of any AM framework. [1]

3 Asset Health Index Calculation Methodology

3.1 Asset Condition Assessment Methodologies

Prior to completing an ACA, a methodology needs to be selected for the current entity. The four most common methodologies that can be employed to assess the condition of the system health include:

1. Additive models – asset degradation factors and scores are used to independently calculate a score for each individual asset, with the Health Index representing a weighted average of all individual scores from 0 to 100;
2. Gateway models – select parameters deemed to be most impactful on the asset's overall functionality act as "gates" to drive the overall condition of an asset, by effectively "deflating" the scores of other (less impactful) components;
3. Subtractive models – consider that a relatively Poor condition for any of several major assets within a broader system of assets could act as a sufficient justification to drive investments into the entire system; and
4. Multiplicative models – a Health Index that dynamically shifts the calculation towards specific degradation factors, if they are a leading indicator to show that an asset is failing.

The additive and gateway models are typically used for assessing individual assets, whereas the subtractive and multiplicative models are typically used for aggregate and composite system-level assessments. The latter models are still in an early stage and require extensive refinement and validation to confirm their applicability. The gateway model assigns gates to criteria or asset subcomponents which are difficult or expensive to replace and maintain, and/or are known to be a major cause of asset malfunctioning. This methodology is commonly used in conjunction with the additive model for major assets such as wood poles, where a "gate" score will act to reduce the Health Index due to a low recorded score for a given criterion. An example would be the "Remaining Strength" condition parameter for the wood pole asset class. If the remaining strength of a wood pole is less than 60%, the final Health Index for that asset is halved.

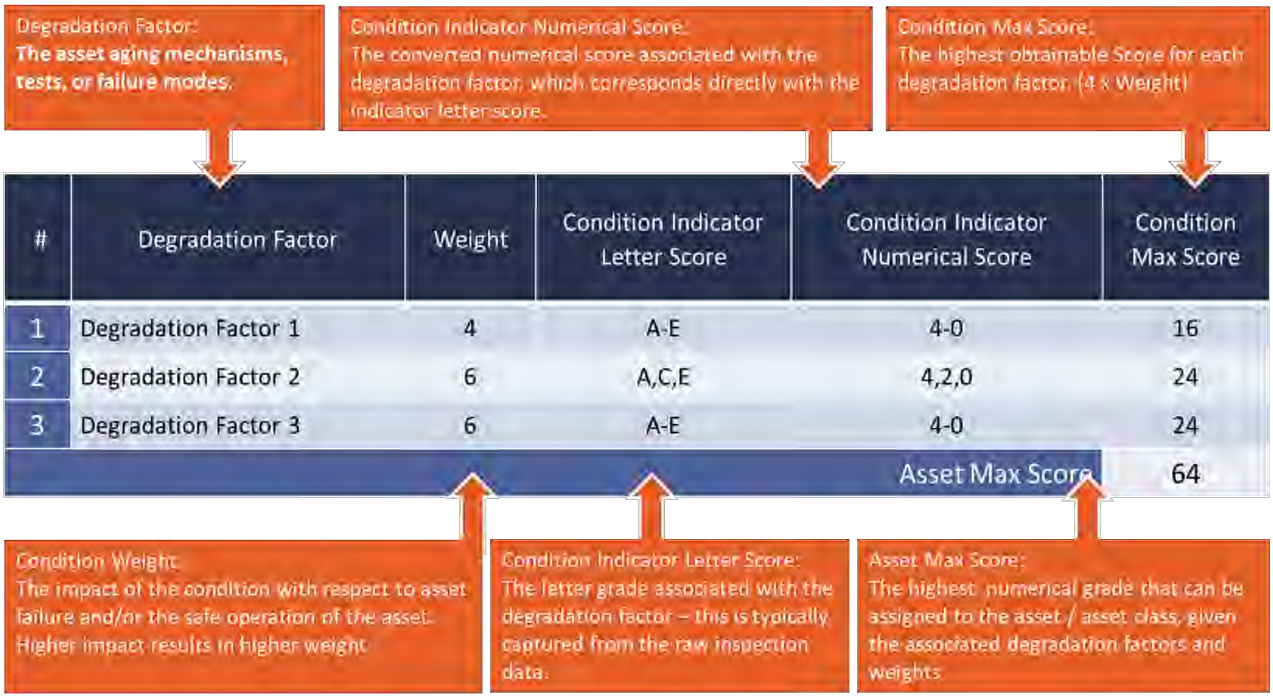
In general, most distribution sector utilities employ an additive model with select gateway model elements. METSCO selected this approach when conducting the ACA, which is in alignment with most of NBHDL's peer utilities.

3.2 Overview of Selected Methodology

3.2.1 Condition Parameters

To determine the overall Health Index for an asset, formulations are developed based on condition parameters that can be expected to contribute to the degradation and eventual failure of that asset. A weight is assigned to each condition parameter to indicate the amount of influence the condition has on the overall health of the asset. Figure 3-1 provides an example of a Health Index formulation table.

Figure 3-1: Health Index Formulation Components



Condition parameters of the asset are characteristic properties that are used to derive the overall Health Index. Condition parameters are specific and uniquely graded to each asset class. Additionally, some condition parameters can be comprised of sub-condition parameters. This is particularly true for power transformers and the associated condition parameter "Oil Quality". The "Oil Quality" condition parameter can include multiple sub-conditions parameters like "Acid Number", "Interfacial Tension", "Dielectric Strength" and "Water Content". The "Oil Quality" condition parameter table is provided in Appendix B. In this case, the lowest sub-condition score is used as the score for the condition parameter.

The scale used to determine an asset's score for a condition parameter is called the Condition Indicator. Each condition parameter is ranked from A to E and each rank corresponds to a numerical grade. The grading criteria for each condition parameter is listed

in Appendix B. In the above example, a condition score of 4 represents the best grade, whereas a condition score of 0 represents the worst grade.

The conversion from alphabetic ranking to numerical grade and a brief character description of the grade is provided below:

A – 4	Best Condition
B – 3	Normal Wear
C – 2	Requires Remediation
D – 1	Rapidly Deteriorating
E – 0	Beyond Repair

3.2.2 Health Index (HI) Formulation

The Health index ("HI"), which is a function of the condition scores and weightings, is calculated based on the following formula:

$$HI = \left(\frac{\sum_{i=1} Weight_i * Numerical\ Grade_i}{Total\ Score} \right) x\ 100\%$$

Where *i* corresponds to the condition parameter number, and the Health Index is a percentage representing the remaining life of the asset.

A gating approach is used for condition parameters that have a significant influence on the health of an asset. If the condition parameter that has been flagged as a gating parameter is below a pre-defined threshold value, the overall Health Index is reduced by 50%. An example would be the "Remaining Strength" condition parameter for the wood pole asset class. If the remaining strength of a wood pole is less than 60%, the Health Index for that asset would be divided by two. This approach enables utilities to efficiently flag severely degraded assets through the identification of condition parameters acknowledged to be critical indicators of overall asset health.

3.2.3 Health Index Results

METSCO's assessment of asset condition uses a consistent five-point scale along the expected degradation path for every asset, ranging from Very Good to Very Poor. To assign each asset into one of the categories, METSCO constructs numerical Health Indices for each asset class that captures information on individual degradation factors contributing to that asset's declining condition over time. Condition scores assigned to each degradation factor are also expressed as numerical or letter grades along with pre-defined scales. The Health Index – expressed as a value between 0% and 100% is a weighted sum of scores of individual degradation factors, with each of the five condition categories (Very Good, Good, Fair, Poor, Very Poor) corresponding to a numerical band that are roughly equivalent to the percentage of remaining useful life for the given asset. For example, the condition score of

Very Good indicates assets with Health Indices between 100% and 85%, whereas assets found to be in a Very Poor condition score are those with calculated Health Indices between 0% and 30%. Generating a Health Index provides a succinct measure of the long-term health of an asset. Table 3-1 presents the Health Index ranges with the corresponding asset condition, its description as well as implications for maintaining, refurbishing or replacing the asset prior to failure.

Table 3-1: Health Index Ranges and Corresponding Asset Condition

Health Index Score (%)	Condition	Description	Implications
[85-100]	Very Good	Some evidence of ageing or minor deterioration of a limited number of components	Normal Maintenance
[70-85)	Good	Significant Deterioration of some components	Normal Maintenance
[50-70)	Fair	Widespread significant deterioration or serious deterioration of specific components	Increase diagnostic testing; possible remedial work or replacement needed depending on the unit's criticality
[30-50)	Poor	Widespread serious deterioration	Start the planning process to replace or rehabilitate, considering the risk and consequences of failure
[0-30)	Very Poor	Extensive serious deterioration	The asset has reached its end-of-life; immediately assess risk and replace or refurbish based on assessment

To put the calculation of Health Indices into the context of available data, METSCO supplemented its Health Index findings with the calculation of a Data Availability Index, which indicates the percentage of total asset population for which the condition information is available.

3.3 Data Availability Index

The Data Availability Index ("DAI") is a measure of the availability of condition parameter data for a specific asset, as they pertain to the construction of the Health Index score. The Data Availability Index is determined by comparing the sum of the weights of the condition parameters available to the total weight of the condition parameters used to construct the Health Index for an asset class. The formula is given by:

$$DAI = \left(\frac{\sum_{i=1} Weight_i * \alpha_i}{\sum_{i=1} Weight_i}\right) x\ 100\%$$

Where i corresponds to the condition parameter number and α is the availability of coefficient (=1 when data available =0 when data unavailable)

An asset with all condition parameter data available will have a DAI value of 100%, independent of the asset's HI score. Assets with a high DAI will correlate to HI scores that describe the asset condition with a high degree of confidence. In the case where the DAI for an asset is less than 70%, a valid Health Index cannot be calculated. This asset is assigned an extrapolated Health Index value based on the valid Health Index calculations of the asset class.

3.3.1 Data Sources

To assess the demographics and establish the unit population of NBHDL's distribution system assets, METSCO was provided with NBHDL's geospatial data from their current Geographic Information System ("GIS"). This data came from NBHDL's corporate asset registries containing information on asset vintage, model and year of commissioning. The database served as the primary asset library that contained asset nameplate information such as age and unique identifiers.

To assess the condition of NBHDL's system, METSCO was provided with NBHDL's asset inspection and maintenance data for all asset classes applicable. Most of this data came from primary sources such as equipment inspection forms completed by NBHDL staff or contractors or results of specific technical tests.

Additionally, METSCO was provided with historical operating data for assets that required operating information for the HI calculation. An example of operating data used includes historical loading information for transformers and failure rates for cables.

In instances where the information available from primary sources was insufficient to construct multi-factor Health Indices, METSCO relied on available secondary sources, such as assessments prepared by other external consultants that opined on, or empirically tested certain assets to determine their condition or continued usability. This report clearly denotes all instances where the findings of other external parties form a part of METSCO's Health Index calculations. Within this ACA study, the only report utilized in this manner was "Substation Condition Assessment of All 17 North Bay Hydro Stations" (Costello Utility Consultants, 2019) for station assets.

3.4 Use of Age as a Condition Parameter

Some industry participants question the appropriateness of including age as a potential condition parameter for calculating asset Health Indices. At the core of the argument

against the use of age in calculating asset, the condition is the notion that age implies a linear degradation path for an asset that does not always match the actual experience in the field.

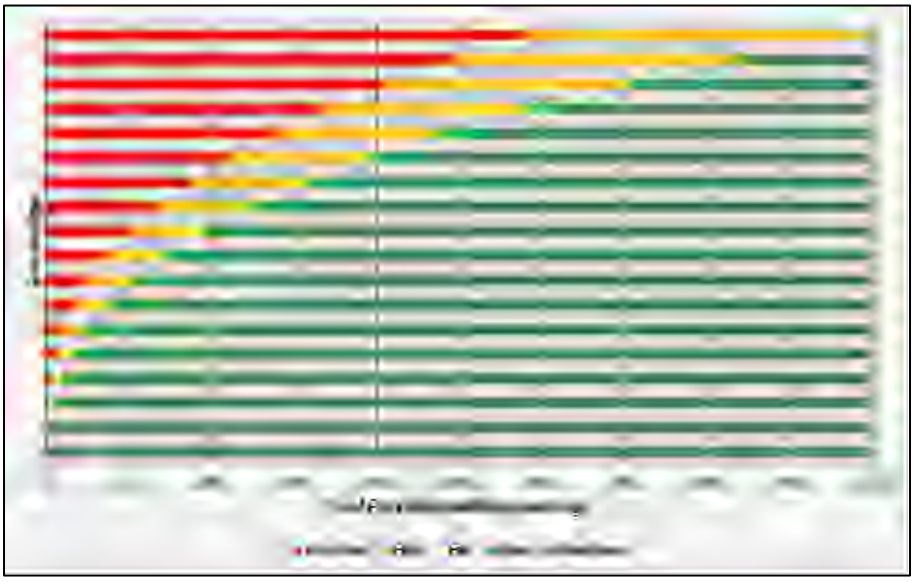
While some assets lose their structural integrity faster than would be expected with the passage of time, others, such as those with limited exposure to natural environmental factors, or those that benefitted from regular predictive and corrective maintenance, may retain their original condition for a longer period of time than age-based degradation would imply.

In recognition of the argument as to the limitations of age-based condition scoring, METSCO limits the instances where it relies on only age as a parameter explicitly incorporated into the calculation of asset Health Indices. However, in some cases, the limited number of condition parameters available for calculation of asset health makes age a useful proxy for the important factors that the analysis would not otherwise capture. In other cases, such as when assessing condition of complex equipment such as power transformers, which contain a number of internal mechanical components that degrade with continuous operation and the state of which cannot be assessed without destructive testing, age represents an important component of asset health calculation irrespective of the number of other factors that may be available for analysis.

In the context of the current study, the availability of data on condition parameters was positive and every asset class, except station chargers, included additional condition parameters other than service age. In all asset classes, except station buildings, age as a parameter was included in the asset health calculation.

Irrespective of the fact that METSCO used age data in calculating the Health Index for a particular asset class, an analysis that compares calculated asset condition with the applicable service age of units comprising the asset population is generally expected to follow the trend depicted in Figure 3-2 below. The figure shows a trend contrasting the age data with the calculated condition results. The trend can indicate to an asset manager that as age increases the condition increasingly becomes worse. However, this is not indicative of any clear action needed to be taken and is ultimately up to the corporation to manage asset health.

Figure 3-2: A Sample Asset Age vs. Condition Comparison Chart



3.4.1 METSCO's Project Execution

METSCO's execution path in completing the ACA study can be separated into four phases described below:

Initial Information Gathering – including initial interviews with NBHDL staff to investigate system configuration and the prominence of certain asset classes, establish the range of available condition data sources at the beginning of the engagement, and confirm the key assumptions regarding these factors with NBHDL subject matter experts through a series of interviews.

Database Construction – activities to construct a single database of condition-related information for each NBHDL asset class using the provided data sources. This includes consolidation of NBHDL's asset inspection records, databases containing results of technical tests performed by NBHDL contractors, and the entire database from the GIS.

HI and DAI Calculation – upon confirming the integrity of its condition dataset along with the accuracy of assumptions made in its preparation, METSCO calculated the Health Indices and DAI for all asset classes. Additional data sources were requested from NBHDL to improve the accuracy of the asset health calculation if applicable.

Results Reporting – the last phase of the project scope was the creation of the ACA report.

4 Health Indices

This section presents the current Health Index formulation for each asset class, the calculated scores for Health Indices, as well as the data available to perform the study.

4.1 Distribution Assets

4.1.1 Wood Pole

Table 4-1: Wood Pole Health Index Algorithm

Condition Parameter	Weight	Ranking	Numerical Grade	Max Score
Woodpecker Holes	4	A,C,E	4,2,0	16
Pole Top Condition	4	A,C,E	4,2,0	16
Pole Shell Condition	2	A,C,E	4,2,0	8
Hammer Test	4	A,E	4,0	16
Defects / Other Damages	3	A,C,E	4,2,0	12
Wash Out / Grading Change	1	A,C,E	4,2,0	4
Service Age	3	A,B,C,D,E	4,3,2,1,0	12
Displacement of Footing	2	A,C,E	4,2,0	8
			Total Score	**92**

Wood poles are an integral part of any distribution system. They support the structure for overhead distribution lines often found with installed assets such as overhead transformers, switches, reclosers, and streetlights. The Health Index for wood poles is estimated by considering a combination of end-of-life criteria summarized in Table 4-1. Each condition parameter represents a factor critical in determining the asset's condition relative to a potential failure to occur. Appendix B-1 provides grading tables for each condition parameter.

Wood, being a natural material, has degradation processes that are different from other assets in distribution systems. The most critical degradation process for wood poles involves biological and environmental mechanisms such as fungal decay, wildlife damage and effects of weather which can impact the mechanical strength of the pole. Any loss in the strength of the pole can present additional safety and environmental risks to the public and to NBHDL. The remaining strength condition parameter is a quantitative measurement that provides adequate evidence of the deterioration of the operational health of the asset.

The condition parameters for Health Index formulation for wood poles include service age, wood rot presence, mechanical defects, and the leaning or displacement of wood poles. A visual inspection record notes the degree of wood rot/decay developed on the pole's top and external. A hammer test record also identifies any decay pockets on the pole, which indicates a great degree of wood rot/decay developed internally. The presence of wood rot signifies there is a high moisture content surrounding the pole and impacts the pole's strength.

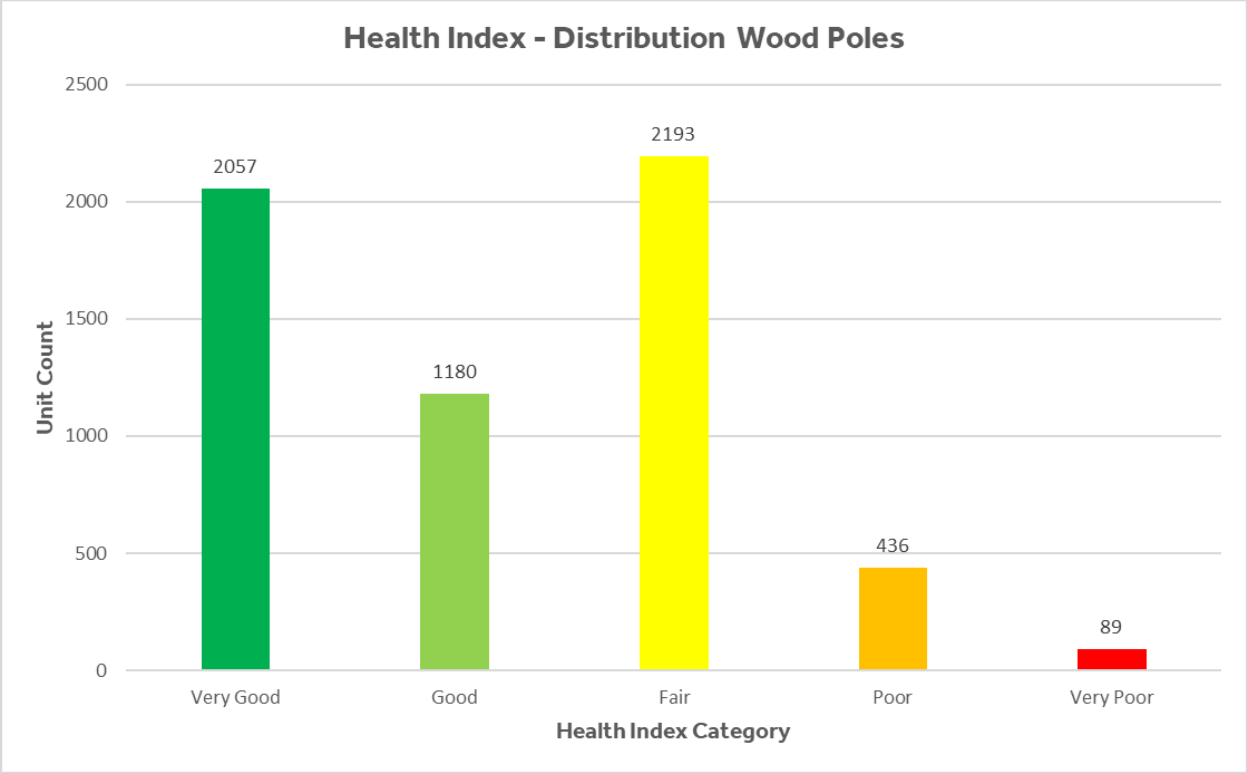
4.1.1.1 Distribution Wood Pole

Figure 4-1: Distribution Wood Poles Age Demographic



NBHDL owns 10,384 wood poles within its service territory. Only 5,955 wood poles, which carry primary circuit, were considered in this assessment. The installation date is unknown for approximately 2% of the total in-service population. The assets with unknown installation dates were extrapolated by the average age of distribution wood poles on the same distribution feeder to show an approximate representation of the age distribution. The assumption for the service age of assets was used in the Health Index calculation and was confirmed with NBHDL. Figure 4-1 presents the age distribution for in-service distribution wood poles.

Figure 4-2: Distribution Wood Poles Health Index Demographic



NBHDL's pole maintenance and nameplate data were used to calculate the Health Index based on the criteria provided in Table 4-1. Poles are visually inspected annually, with all poles being visited every 3 years. Only the 2019 inspection record was used in the Health Index formulation. The 2019-inspected population shared a similar age distribution with the total population.

A valid Health Index was calculated for 31% of the distribution of wood poles. To complete the full analysis, the Health Index for the remaining 69% has been extrapolated based on the Health Index distribution with a valid Health Index score within each age group, at an interval of 10-years, according to the principle of representation by population in the 2019 inspection record. The overall Health Index distribution for the distribution wood poles is presented in Figure 4-2. Over half of the total population are in Very Good or Good condition with one-third of the total population being in Fair condition. Less than 10% of the total population are in Poor or Very Poor condition. The average Health Index for the distribution wood pole population is 73%.

Table 4-2: Distribution Wood Poles condition parameters data availability

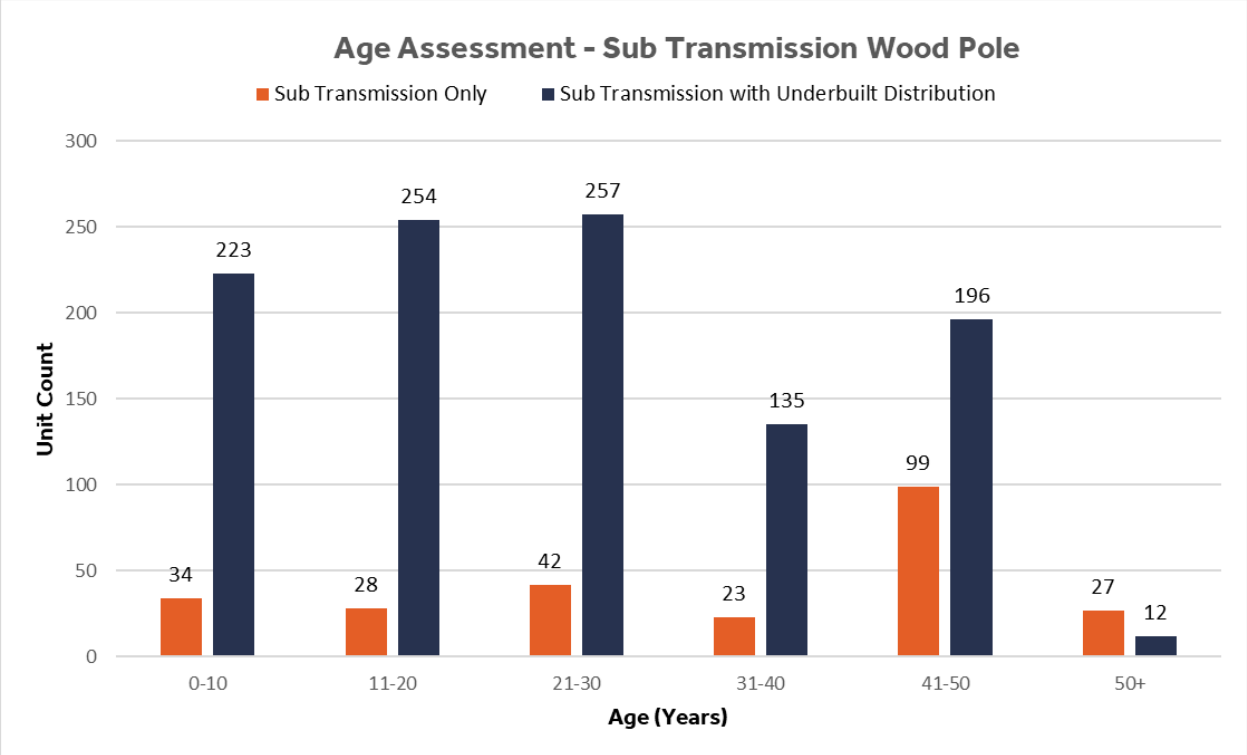
Condition Parameter	% of Assets with Data
Woodpecker Holes	31%
Pole Top Condition	31%
Pole Shell Condition	31%
Hammer Test	30%
Defects / Other Damages	30%
Wash Out / Grading Change	30%
Service Age	100%*
Displacement of Footing	30%

**Note: Extrapolated service age included*

The DAI for most condition parameters regarding the distribution of wood poles is only about 31%. METSCO still included most condition parameters from inspection in the Health Index calculation due to the significant value of the condition parameters for the HI framework for wood poles. The average DAI across the wood pole asset class is 40%. Table 4-2 presents the DAI of individual condition parameters used for the wood pole HI framework.

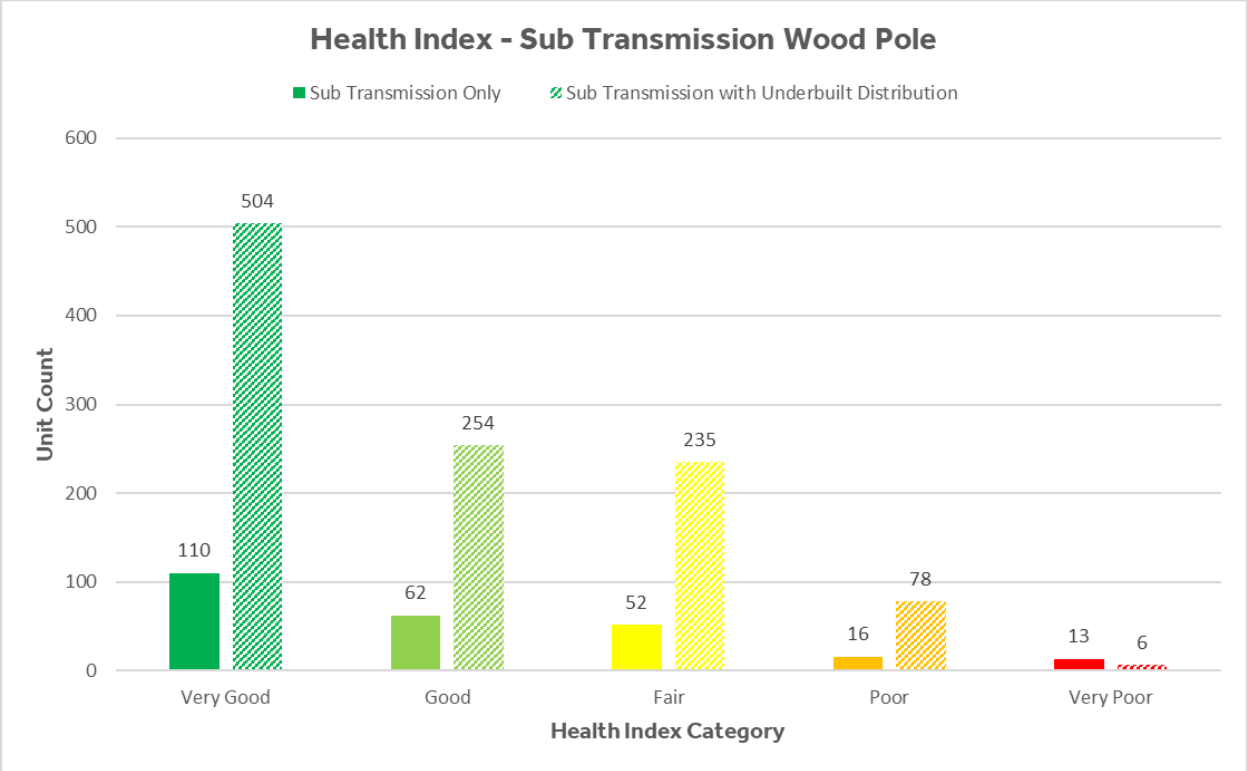
4.1.1.2 Sub-Transmission Wood Pole

Figure 4-3: Sub-Transmission Wood Poles Age Demographic



NBHDL owns 253 sub-transmission only wood poles and 1,077 sub-transmission with underbuilt distribution ("underbuilt") wood poles within its service territory. The installation date is unknown for approximately 4% and 2% of the in-service poles, respectively. The assets with unknown installation dates were extrapolated by the average age of sub-transmission wood poles on the same feeder to show an approximate representation of the age distribution. The applied assumption for the service age of assets was used in the Health Index calculation and was confirmed with NBHDL. Figure 4-3 presents the age distribution for in-service sub-transmission wood poles.

Figure 4-4: Sub-Transmission Wood Poles Health Index Demographic



NBHDL's pole maintenance and nameplate data were used to calculate the Health Index based on the criteria provided in Table 4-1. Poles are visually inspected annually, with all poles being visited every 3 years. Only the 2019 inspection record was used in the Health Index formulation. The 2019-inspected population shared a similar age distribution with the total population.

A valid Health Index was calculated for 41% and 43% of the sub-transmission and underbuilt wood poles. To complete the full analysis, the Health Index for the remaining 59% and 57% has been extrapolated based on the Health Index distribution with a valid Health Index score within each age group, at an interval of 10-years, according to the principle of representation by population in the 2019 inspection record. The overall Health Index

distribution for the wood poles is presented in Figure 4-3. Over half of the total population are in Very Good or Good condition with ~10% of the total population in Poor or Very Poor condition. The average Health Index for the sub-transmission and underbuilt wood pole population are 76% and 78%, respectively .

Table 4-3: Sub-Transmission Wood Poles condition parameters data availability

Condition Parameter	% of Assets with Data	
	Sub-transmission Only	Sub Transmission with Underbuilt Distribution
Woodpecker Holes	41%	42%
Pole Top Condition	41%	43%
Pole Shell Condition	41%	43%
Hammer Test	41%	43%
Defects / Other Damages	41%	42%
Wash Out / Grading Change	41%	43%
Service Age	100%	100%*
Displacement of Footing	41%	43%

**Note: Extrapolated service age included*

The DAI for most condition parameters regarding sub-transmission and underbuilt wood poles is only about 42%. The exception is service age, for which 97% of the assets have data. However, METSCO still included most condition parameters from inspection in the Health Index calculation due to the significant value of the condition parameters for the HI framework for wood poles. The average DAI across the sub-transmission and underbuilt wood pole asset class is 49% and 50%, respectively. Table 4-3 presents the DAI of individual condition parameters used for the wood pole HI framework.

4.1.2 Overhead Primary Conductor

Table 4-4: Overhead Primary Conductor Health Index Algorithm

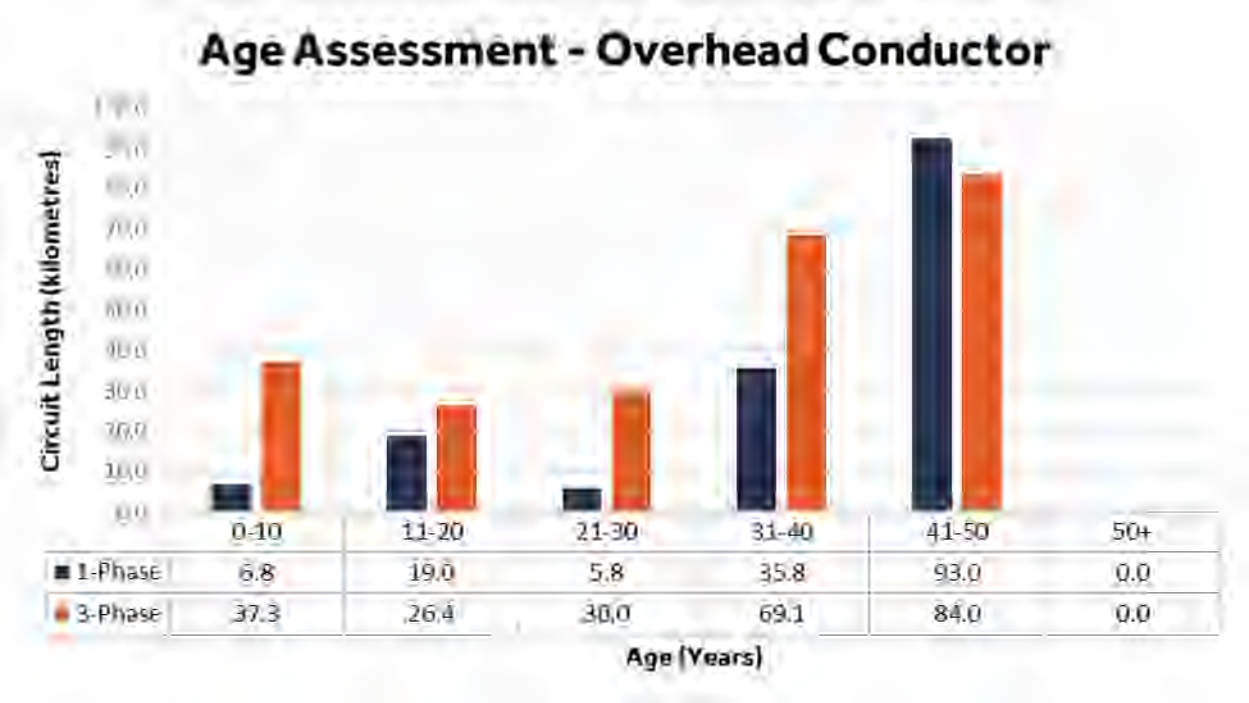
Condition Parameter	Weight	Ranking	Numerical Grade	Max Score
Service Age	5	A,B,C,D,E	4,3,2,1,0	20
Small Conductor Risk	5	A,E	4,0	20
			Total Score	**40**

Overhead primary conductors transmit electricity from substations to customer premises and are supported by service poles. The Health Index formulation for overhead primary conductors is summarized in Table 4-4. Appendix B-2 provides grading tables for each condition parameter.

Although laboratory tests are available to determine the tensile strength and assess the remaining useful life of conductors, distribution line conductors rarely require testing. An appropriate proxy for the tensile strength of the conductor and to determine the remaining life of the asset is the use of service age. In addition to age, an undersized conductor is the additional condition parameter used to evaluate the HI of overhead conductors. Undersized

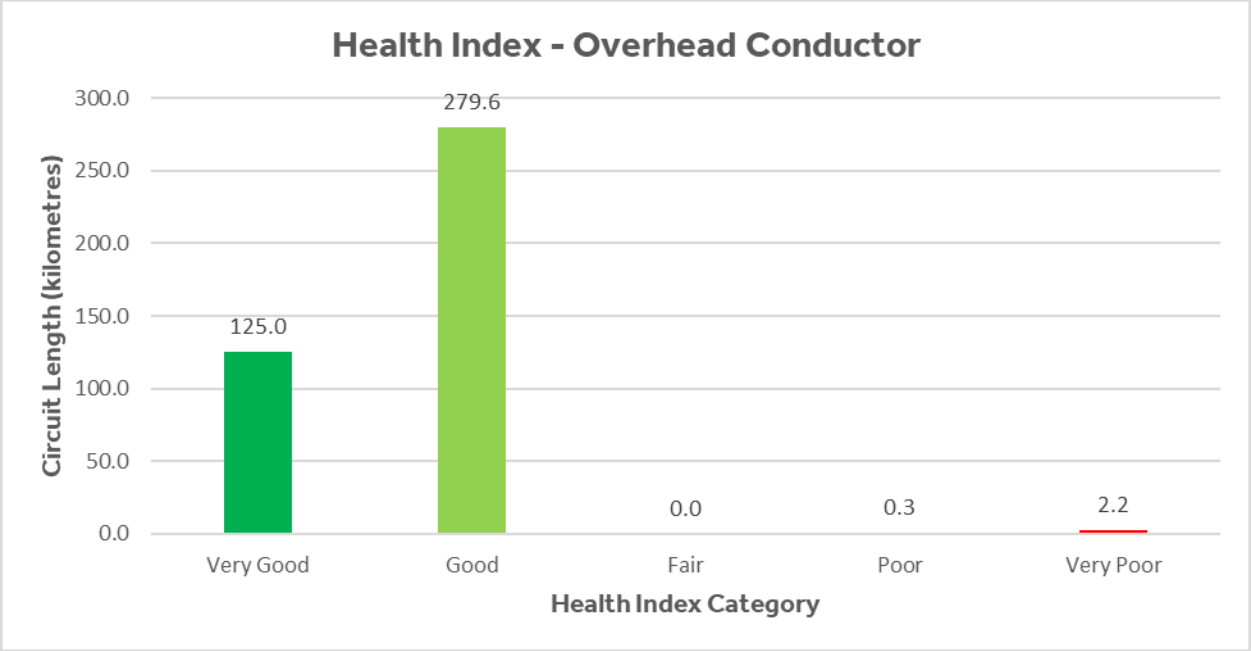
conductors carrying large loads can result in sub-optimal system operation due to high line losses and are susceptible to frequent breakdowns.

Figure 4-5 Overall Overhead Primary Conductor Age Demographic



NBHDL owns approximately 407 km of overhead primary conductor within its service territory. The installation date was unknown for approximately 67% of both 1-phase and 3-phase conductors and was extrapolated by the average age of distribution wood poles on the same distribution feeder to show an approximate representation of the age distribution. The figure presents the total length of overhead primary conductors for each age band. The applied assumption for the service age of assets was used in the Health Index calculation and was confirmed with NBHDL. Figure 4-5 presents the overall overhead primary conductor age demographics.

Figure 4-6: Overhead Primary Conductor Health Index Demographic



The overall Health Index for overhead primary conductors is illustrated in Figure 4-6. A valid Health Index was calculated for nearly 100% of the conductors, using the extrapolated age results. To complete the full analysis, the Health Index for the remaining has been extrapolated based on the Health Index distribution with a valid Health Index score within each age group, at an interval of 10-years. Most of the primary conductors are in Very Good and Good condition with less than 1% in Poor and Very Poor condition. The average Health Index for overhead primary conductors is 81%.

Table 4-5: Overhead Primary Conductor condition parameters data availability

Condition Parameter	% of Assets with Data
Service Age	100%*
Small Conductor Risk	100%

**Note: Extrapolated service age included*

The average DAI across the overhead primary conductor asset class is nearly 100%. Table 4-5 presents the DAI of individual condition parameters used for the overhead primary conductors HI framework.

4.1.3 Underground Primary Cable

Table 4-6: Underground Primary Cable Health Index Algorithm

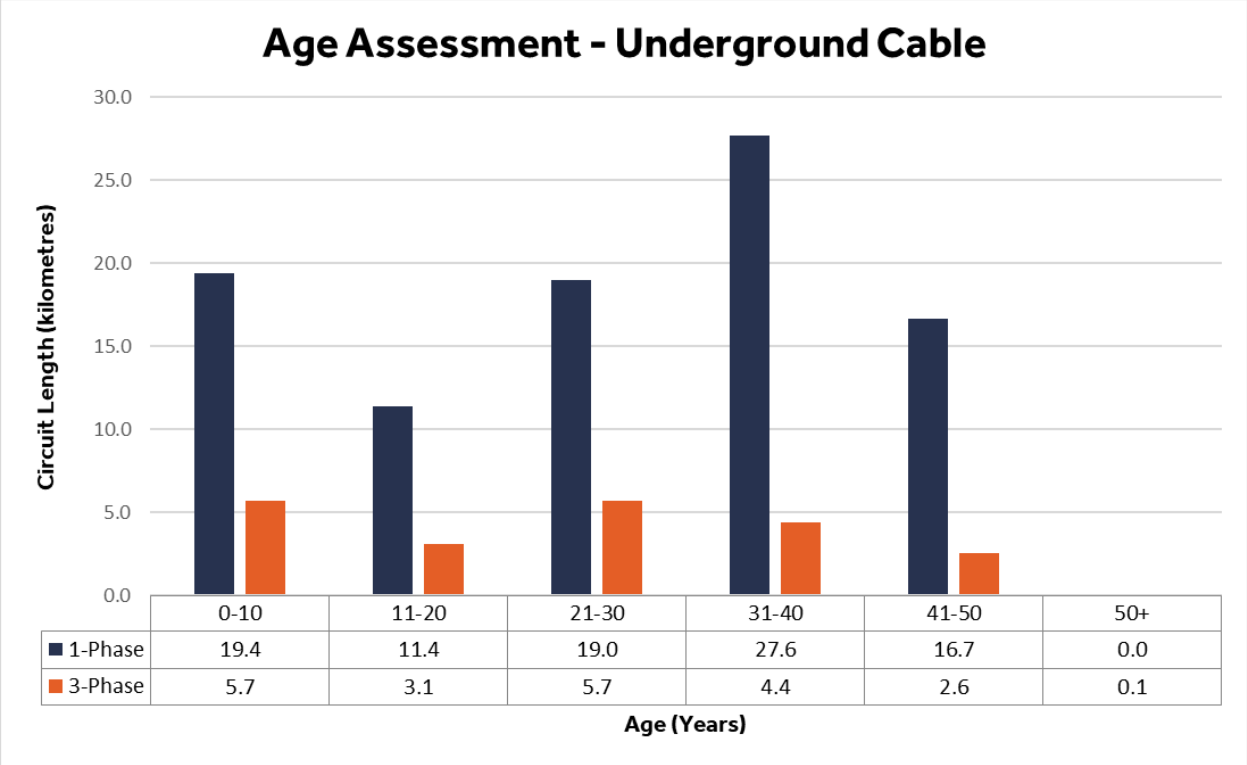
Condition Parameter	Weight	Ranking	Numerical Grade	Max Score
Service Age	5	A,B,C,D,E	4,3,2,1,0	20
Failure Rate	5	A,B,C,D,E	4,3,2,1,0	20

Loading History	2	A,B,C,D,E	4,3,2,1,0	8
			Total Score	**48**

Like overhead conductors, underground cables also transmit electricity within the electrical distribution system, however, they are located below ground. Compared to overhead lines, they are much more reliable since they are not exposed to severe weather conditions, tree contacts or foreign interference. However, distribution underground cables are more expensive and are one of the more challenging assets in electricity systems from a condition assessment and asset management viewpoint. The main driver of underground cable replacement is cable failure. No testing data was provided during this assessment; however, moving forward, NBHDL is planning to implement an underground cable test program to assist identifying problematic cables.

The Health Index for underground primary cable is calculated by considering the service age, historic failure instances, and loading history. Since the service age provides a reasonably good measure of the remaining life of the asset, it may be employed as an assessment parameter for identifying assets for replacement. The rate of insulation degradation is directly related to the operating temperature, which can be assessed through the current loading of circuits measured as the percentage of the circuit's rated current carrying capacity. Table 4-6 summarizes the methodology to combine these criteria into an overall Health Index. Appendix B-3 provides grading tables for each condition parameter.

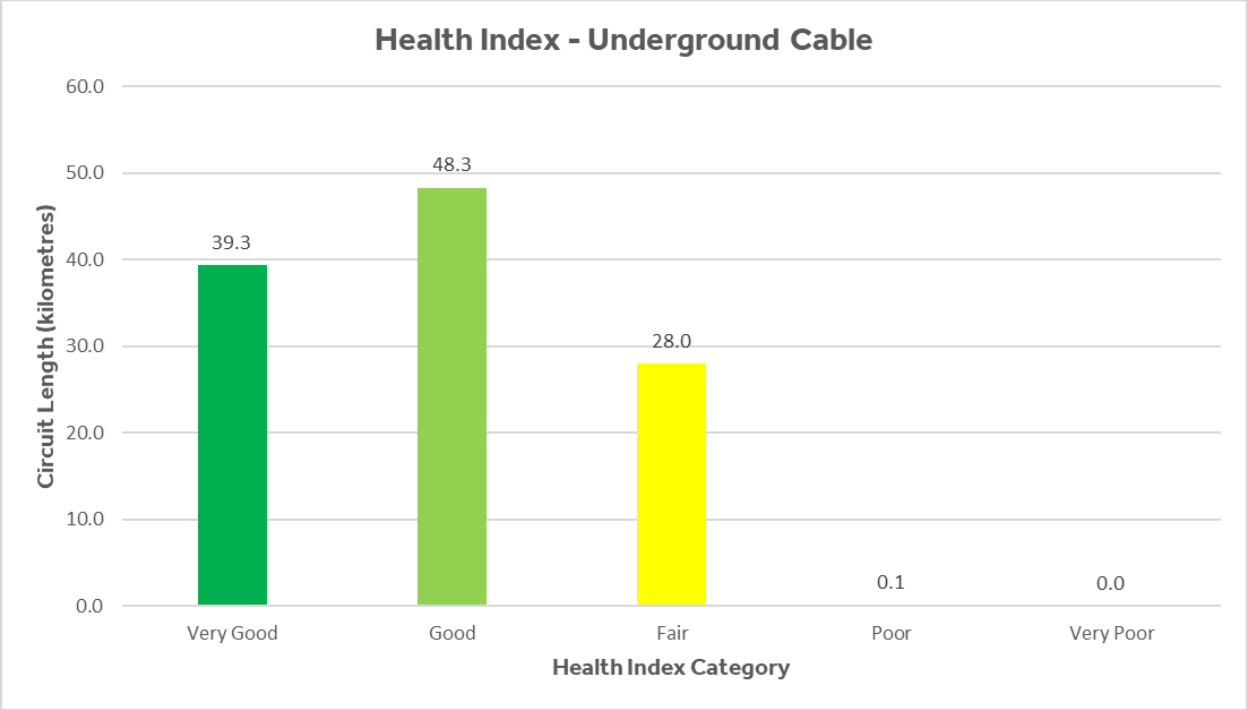
Figure 4-7: Overall Underground Primary Cable Age Demographic



	0-10	11-20	21-30	31-40	41-50	50+
1-Phase	19.4	11.4	19.0	27.6	16.7	0.0
3-Phase	5.7	3.1	5.7	4.4	2.6	0.1

NBHDL owns approximately 116 km of underground primary cable within its service territory. The installation date was unknown for approximately 2% of both 1-phase and 3-phase cables and was extrapolated by the average age of cables on the same distribution feeder to show an approximate representation of the age distribution. The figure presents the total length of underground primary cables for each age band. The applied assumption for the service age of assets was used in the Health Index calculation and was confirmed with NBHDL. Figure 4-7 presents the underground primary cable age demographic.

Figure 4-8: Underground Primary Cable Health Index Demographic



The overall Health Index for underground primary cable is illustrated in Figure 4-8. Most of the underground primary cables are in Very Good and Good condition with less than 1% being in Poor condition. The average Health Index for underground primary cables is 77%.

Table 4-7: Underground Primary Cables condition parameters data availability

Condition Parameter	% of Assets with Data
Service Age	100%*
Failure Rate	100%
Loading History	99%

**Note: Extrapolated service age included*

The average DAI across the underground primary cable asset class is nearly 100%. Table 4-7 presents the DAI of individual condition parameters used for the underground primary cable HI framework.

4.1.4 Distribution Overhead (Pole-Mount) Transformer

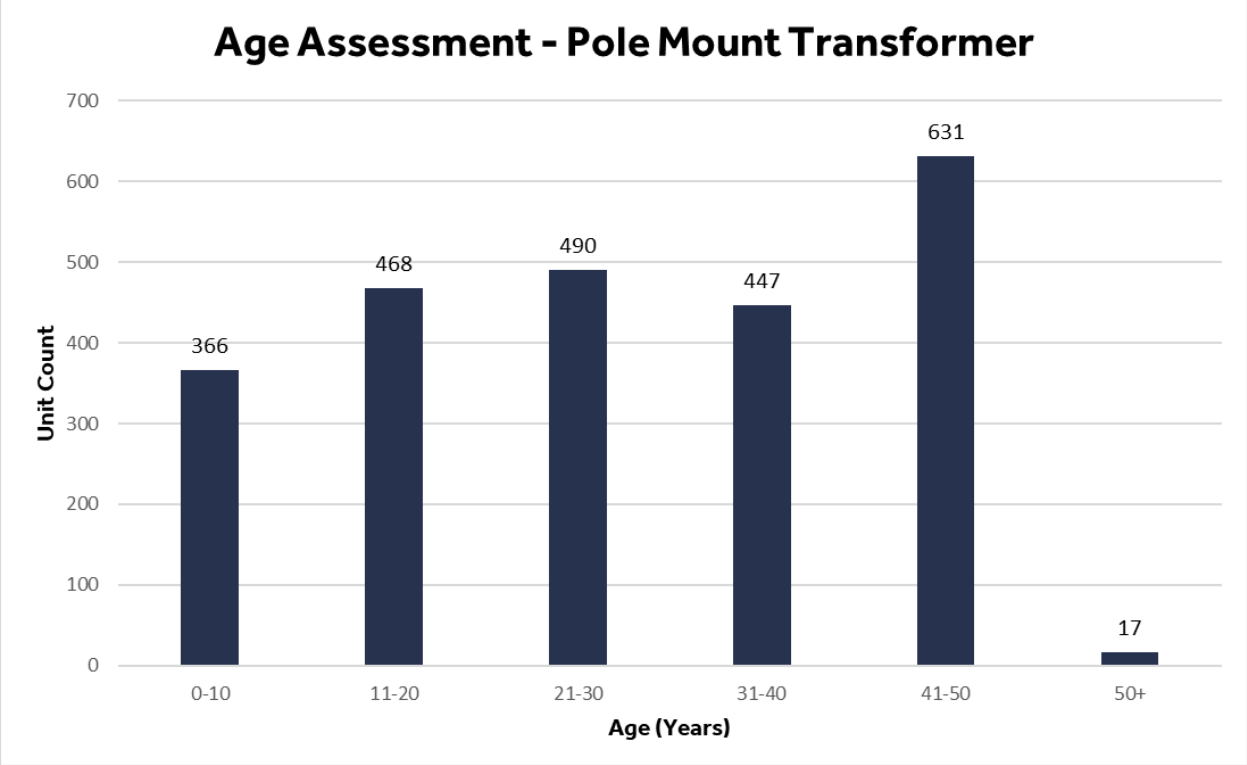
Table 4-8: Pole-Mount Transformer Health Index Algorithm

Condition Parameter	Weight	Ranking	Numerical Grade	Max Score
Service Age	3	A,B,C,D,E	4,3,2,1,0	12
Peak Loading	3	A,B,C,D,E	4,3,2,1,0	12
			Total Score	**24**

Overhead (pole-mount) transformers are installed on service poles above ground with the primary function to step down power from the medium voltage distribution system to the final voltage rating for customer use. The Health Index for pole-mount transformers is calculated by considering a combination of end-of-life criteria summarized in Table 4-8. Each condition parameter represents a factor critical in determining the asset's condition relative to a potential failure to occur. Appendix B-4 provides grading tables for each condition parameter.

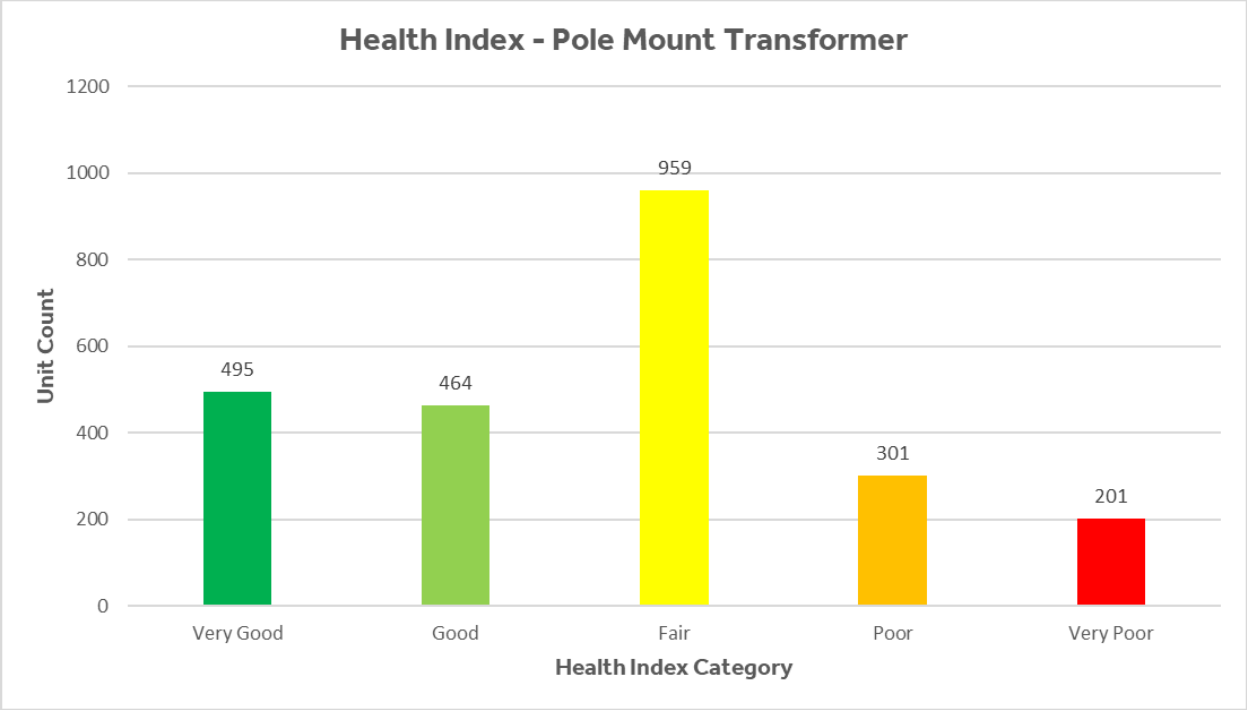
In addition to service age, another condition parameter is the peak loading experienced by the transformer. Load unbalances or peak loading reduces the useful life of a distribution transformer. In general, the useful life of a transformer is determined by its insulation condition which is largely affected by transformer loading, temperature, and presence of oxygen and moisture in the oil.

Figure 4-9: Pole-Mount Transformer Age Demographic



NBHDL owns 2,419 pole-mount transformers within its service territory. The installation date is unknown for 37% of the asset population. For unknown installation dates, the assumption made was to use the average age on the same feeder as the transformer age which resulted in 100% of assets having a known installation date. The applied assumption for the service age of assets was used in the Health Index calculation and was confirmed with NBHDL. Figure 4-9 presents the age distribution for pole-mount transformers.

Figure 4-10: Pole-Mount Transformers Health Index Demographic



NBHDL's transformer nameplate information and operating loading data were used to calculate the Health Index based on the criteria provided in Table 4-8. A valid Health Index was calculated for 96% of the pole-mount transformers, using the extrapolated age results. To complete the full analysis, the Health Index for the remaining 4% has been extrapolated based on the Health Index distribution with a valid Health Index score within each age group, at an interval of 10-years. The overall Health Index distribution is presented in Figure 4-10 for the overhead transformer. The average Health Index of the overhead distribution transformers is 61%.

Table 4-9: Pole-Mount Transformers condition parameters data availability

Condition Parameter	% of Assets with Data
Service Age	100%*
Peak Loading	96%

**Note: Extrapolated service age included*

The average DAI for the condition parameters for pole-mount transformers is 98%. Table 4-9 presents the DAI of individual condition parameters used for the overhead distribution transformer HI framework.

4.1.5 Distribution Underground Transformer

Distribution underground transformers are utilized for similar functionalities as pole-mount transformers. They step down power from the medium voltage distribution system to the final utilization voltage for the customer, however, they are located below ground or on ground level. Two types of underground distribution transformers are assessed within this report:

- Pad-Mount transformer
- Vault transformer

Table 4-10: Pad Mount Transformer Health Index Algorithm

Condition Parameter	Weight	Ranking	Numerical Grade	Max Score
Service Age	3	A,B,C,D,E	4,3,2,1,0	12
Peak loading	3	A,B,C,D,E	4,3,2,1,0	12
Visual Inspection	4	A,B,C,D,E	4,3,2,1,0	16
Condition of the Civil Structure	4	A,C,E	4,2,0	16
			Total Score	**56**

Table 4-11: Vault Transformer Health Index Algorithm

Condition Parameter	Weight	Ranking	Numerical Grade	Max Score
Service Age	3	A,B,C,D,E	4,3,2,1,0	12
Peak loading	3	A,B,C,D,E	4,3,2,1,0	12
			Total Score	**12**

The Health Index for underground distribution transformers is calculated by considering a combination of end-of-life criteria summarized in Table 4-10 and Table 4-11. Each condition parameter represents a factor critical in determining the asset's condition relative to a potential failure to occur. Appendix B-5 provides grading tables for each condition parameter.

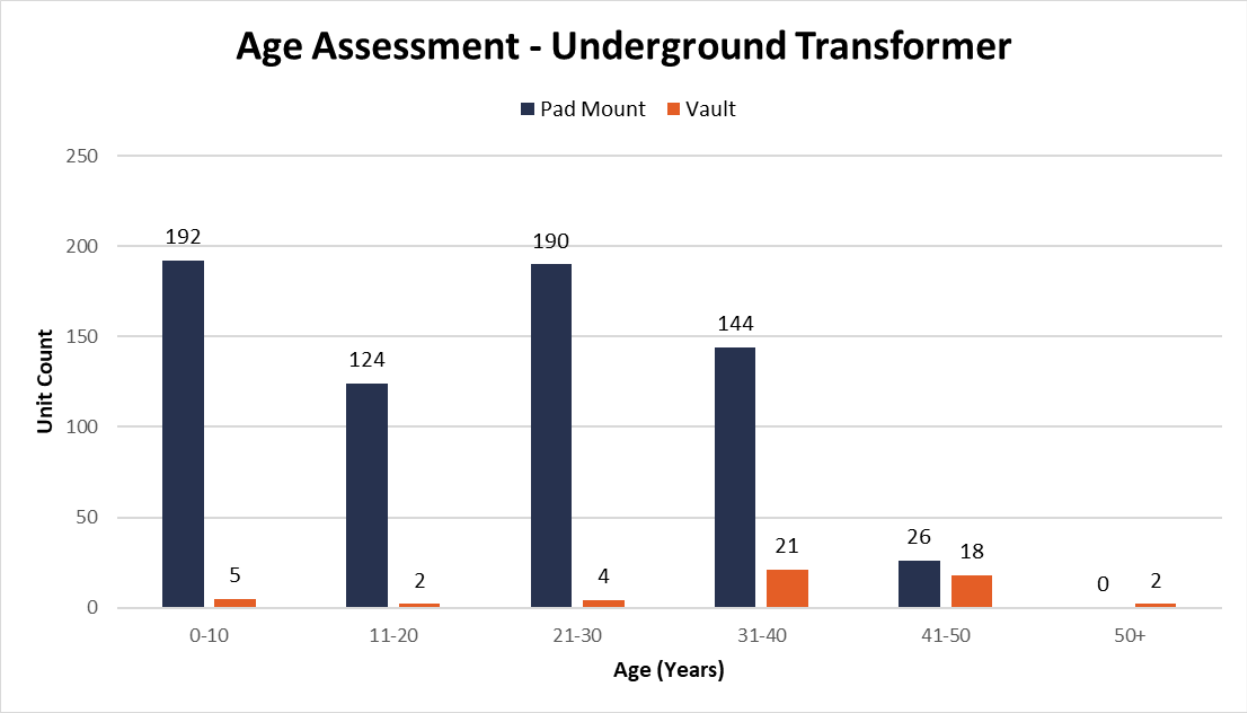
Visual inspections identify the following defects found on underground transformers:

- Presence of oil leaks
- Presence of rust on the exterior paint, lock, door, enclosure
- Presence of poor primary elbows, secondary connection, and ground connection

Visual inspections include the exterior condition of the enclosure since damage to the enclosure can expose the transformer to severe weather conditions and present serious safety concerns to humans should they come into contact with the contents inside. Hence, an enclosure that is deteriorated should be replaced to maintain safety performance.

Additionally, the peak loading experienced by the transformer is a good condition parameter to use. Load unbalances or peak loading reduces the useful life of a distribution transformer. In general, the useful life of a transformer is determined by its insulation condition which is largely affected by transformer loading, temperature, and presence of oxygen and moisture in the oil

Figure 4-11: Distribution Transformers Age Demographic



NBHDL owns 676 pad mount transformers and 52 vault transformers within its service territory. Unknown installation dates account for approximately 18% of pad-mount transformers. For unknown installation dates, the assumption made was to use the average age of installed underground cables on the same feeder which resulted in 100% of assets having a known installation date. The applied assumption for the service age of assets was used in the Health Index calculation and was confirmed with NBHDL. Figure 4-11 presents the age distribution by transformer types.

Figure 4-12: Pad-mount Transformers Health Index Demographic

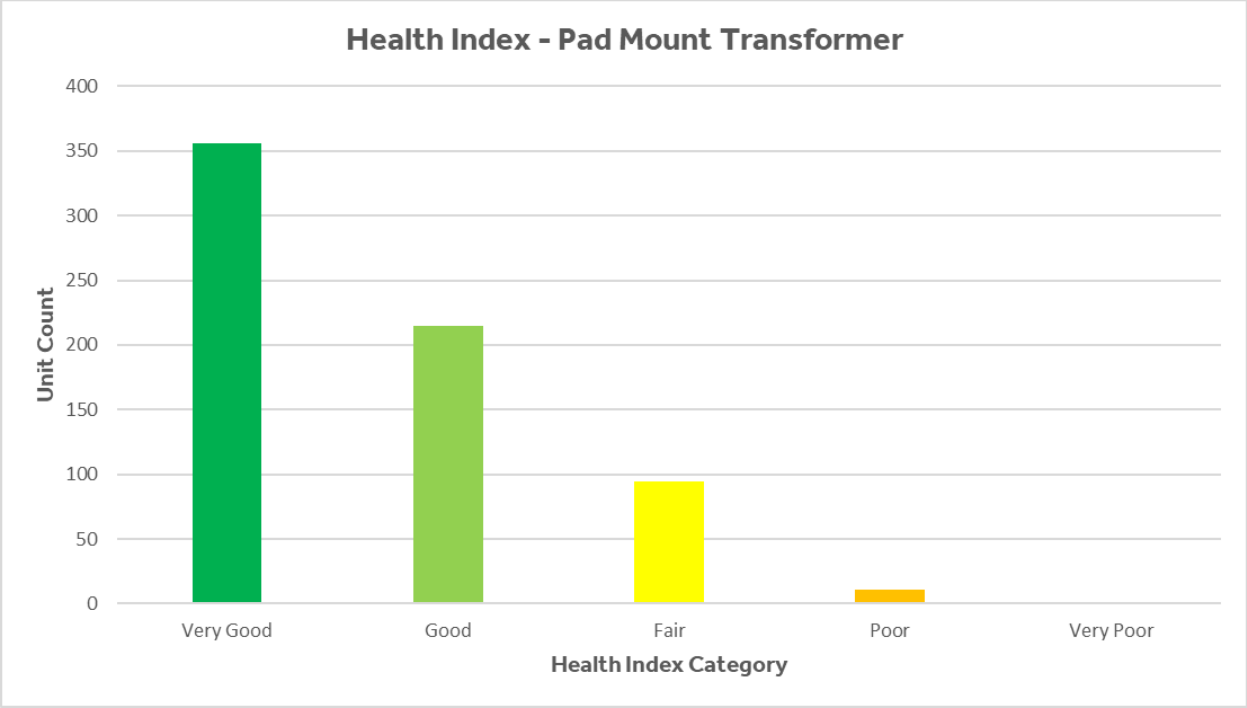
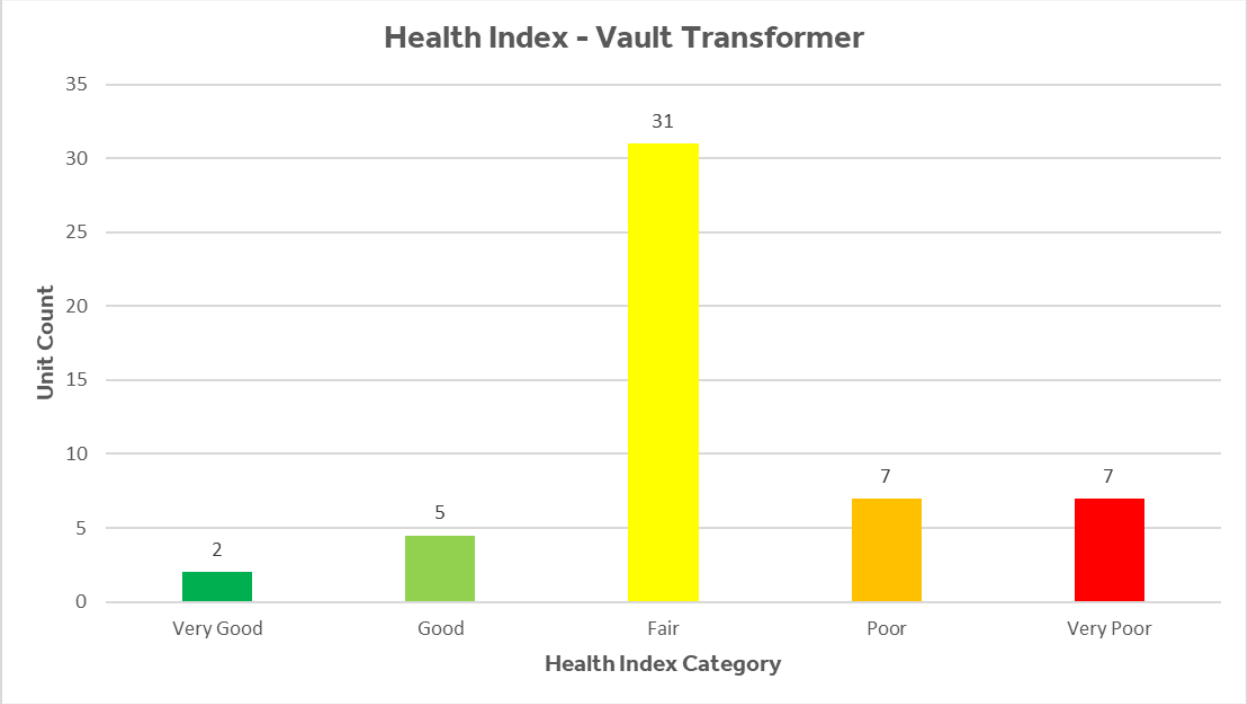


Figure 4-13: Vault Transformers Health Index Demographic



NBHDL's transformer maintenance records, nameplate information, and operating loading data were used to calculate the Health Index based on the criteria provided in Table 4-10 and

Table 4-11. Approximately 3% of the underground distribution transformers within NBHDL's service territory have peak loading percentage greater than 100% which can pose operating restrictions and impact the condition of the assets. The overall Health Index distribution is presented in Figure 4-12 to Figure 4-13 for each transformer type. A valid Health Index was calculated for 79% and 96% of pad-mount and vault transformers, respectively. To complete the full analysis, the Health Index for the remaining has been extrapolated based on the Health Index distribution with a valid Health Index score within each age group, at an interval of 10-years. Most of the pad-mount transformers are in Very Good or Good condition. The average Health Index of the pad-mount and vault transformers are 83% and 52%, respectively.

Table 4-12: Underground Transformers condition parameters data availability

Condition Parameter	% of Assets with Data	
	Pad-Mount Tx	Vault Tx
Service Age	100%*	100%
Peak Loading	94%	96%
Visual Inspection	78%	
Condition of Encloser	78%	

**Note: Extrapolated service age included*

Most of the pad-mount transformers have the visual inspection, encloser condition, age, and peak loading information. The class-average DAI for pad-mount and vault transformer data is 86% and 98% respectively. Table 4-12 presents the DAI of individual condition parameters used for the underground distribution transformers HI framework.

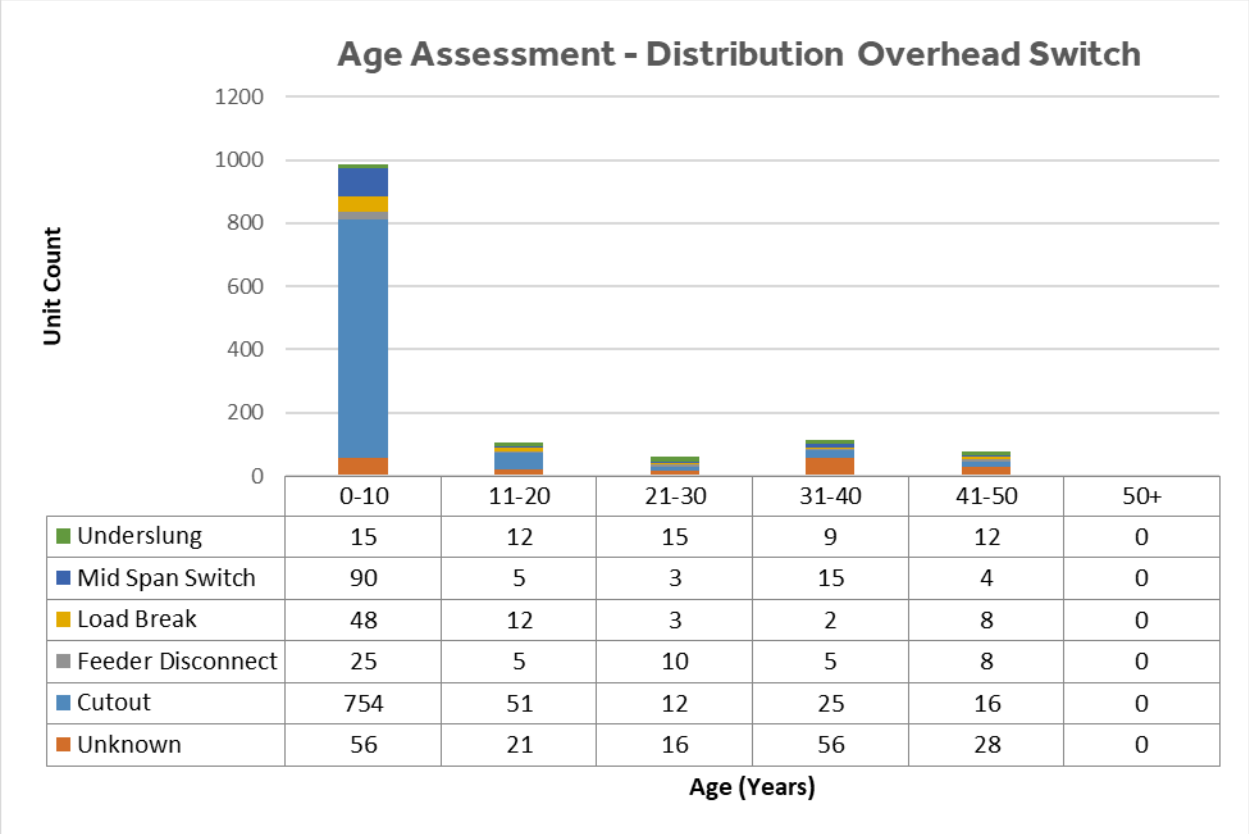
4.1.6 Distribution Overhead Switch

Table 4-13: Distribution Overhead Switch Health Index Algorithm

Condition Parameter	Weight	Ranking	Numerical Grade	Max Score
Service Age	4	A,B,C,D,E	4,3,2,1,0	16
			Total Score	**16**

NBHDL's distribution overhead switch types include fused cutout and load break and are located on its service poles. Load break switches are operated to sectionalize the circuit during a restoration procedure by breaking all three phases of load with a single operation. These switches are operated either manually or from NBHDL's control room. Fused cutout switches are a combination of a switch and a fuse and provide over-current protection during overload conditions or short circuits. The Health Index for switches is calculated by considering a combination of end-of-life criteria summarized in Table 4-13. Each condition parameter represents a factor critical in determining the asset's condition relative to a potential failure to occur. Appendix B-6 provides grading tables for each condition parameter.

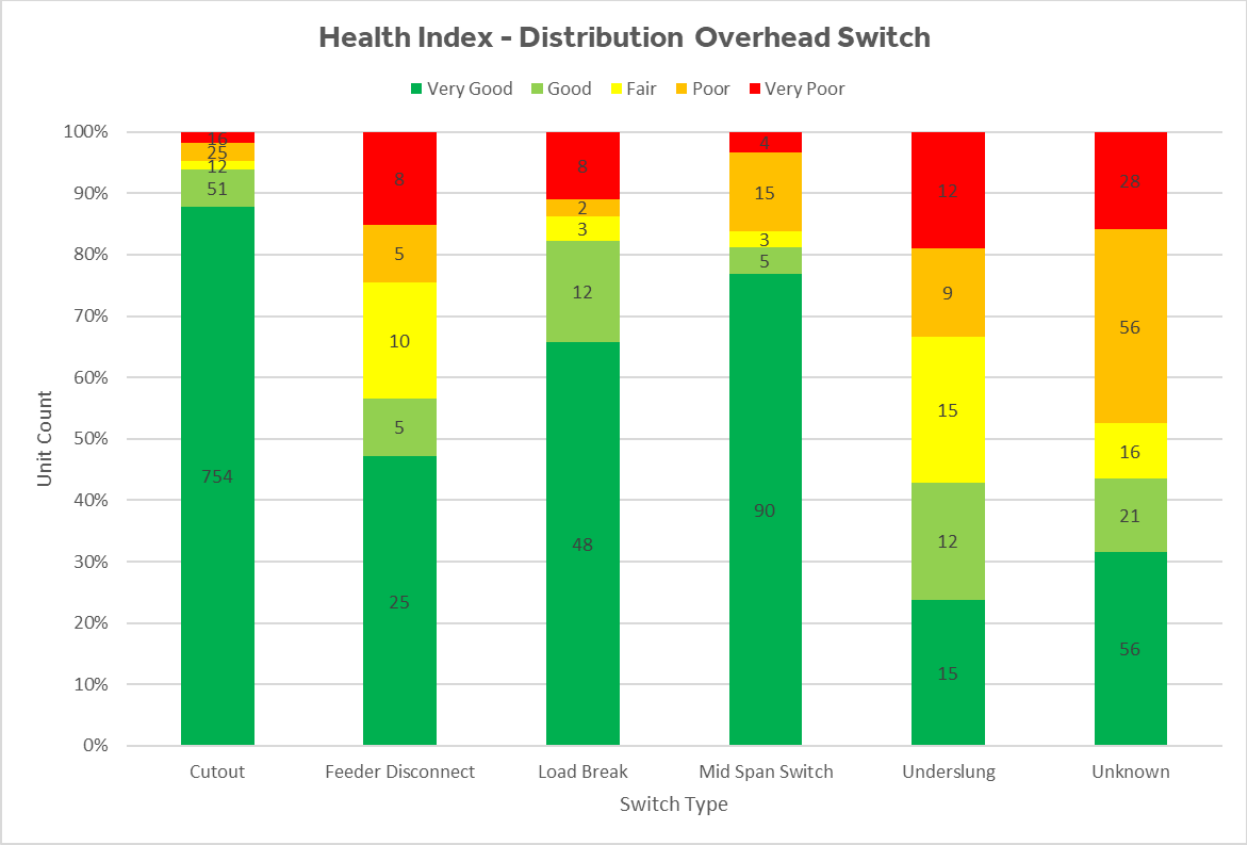
Figure 4-14: Distribution Overhead Switches Age Demographic



	0-10	11-20	21-30	31-40	41-50	50+
Underslung	15	12	15	9	12	0
Mid Span Switch	90	5	3	15	4	0
Load Break	48	12	3	2	8	0
Feeder Disconnect	25	5	10	5	8	0
Cutout	754	51	12	25	16	0
Unknown	56	21	16	56	28	0

NBHDL owns 1,341 overhead switches within its service territory. For assets with unknown installation dates, the assumption made was to use the average distribution pole age on the same feeder as a proxy. This results in 82% of switches having a known installation date. The applied assumption for the service age of assets was used in the Health Index calculation and was confirmed with NBHDL. Figure 4-14 presents the age distribution for overhead switches to show an approximate representation of the age distribution.

Figure 4-15: Overhead Switches Health Index Demographic



NBHDL's nameplate information was used to calculate the Health Index based on the criteria provided in Table 4-13. The overall Health Index distribution for the overhead switches is presented in Figure 4-15. More than 80% of the switches are in good or better conditions. The average Health Index of overhead switches is 85%.

Table 4-14: Distribution Overhead Switches condition parameters data availability

Condition Parameter	% of Assets with Data
Service Age	82%*

**Note: Extrapolated service age included*

The average DAI for overhead switch data is 82%. Table 4-14 presents the DAI of individual condition parameters used for the overhead switch HI framework.

4.2 Station Assets

4.2.1 Power Transformer

Table 4-15: Power Transformer Health Index Algorithm

Condition Parameter	Weight	Ranking	Numerical Grade	Max Score
Dissolved Gas Analysis	10	A,B,C,D,E	4,3,2,1,0	40
Load History	10	A,B,C,D,E	4,3,2,1,0	40
Insulation Power Factor	10	A,B,C,D,E	4,3,2,1,0	40
Infrared Scanning	10	A,B,C,D,E	4,3,2,1,0	40
Oil Quality	8	A,C,E	4,2,0	32
Age	6	A,B,C,D,E	4,3,2,1,0	24
Overall Condition	6	A,B,C,D,E	4,3,2,1,0	24
Bushing Condition	5	A,B,C,D,E	4,3,2,1,0	20
Main Tank Corrosion	2	A,B,C,D,E	4,3,2,1,0	8
Cooling Equipment	2	A,B,C,D,E	4,3,2,1,0	8
Oil Tank Corrosion	1	A,B,C,D,E	4,3,2,1,0	4
Foundation	1	A,B,C,D,E	4,3,2,1,0	4
Grounding	1	A,B,C,D,E	4,3,2,1,0	4
Gaskets and Seals	1	A,B,C,D,E	4,3,2,1,0	4
Connectors	1	A,B,C,D,E	4,3,2,1,0	4
Oil Leaks	1	A,B,C,D,E	4,3,2,1,0	4
Oil Level	1	A,B,C,D,E	4,3,2,1,0	4
			Total Score	**304**

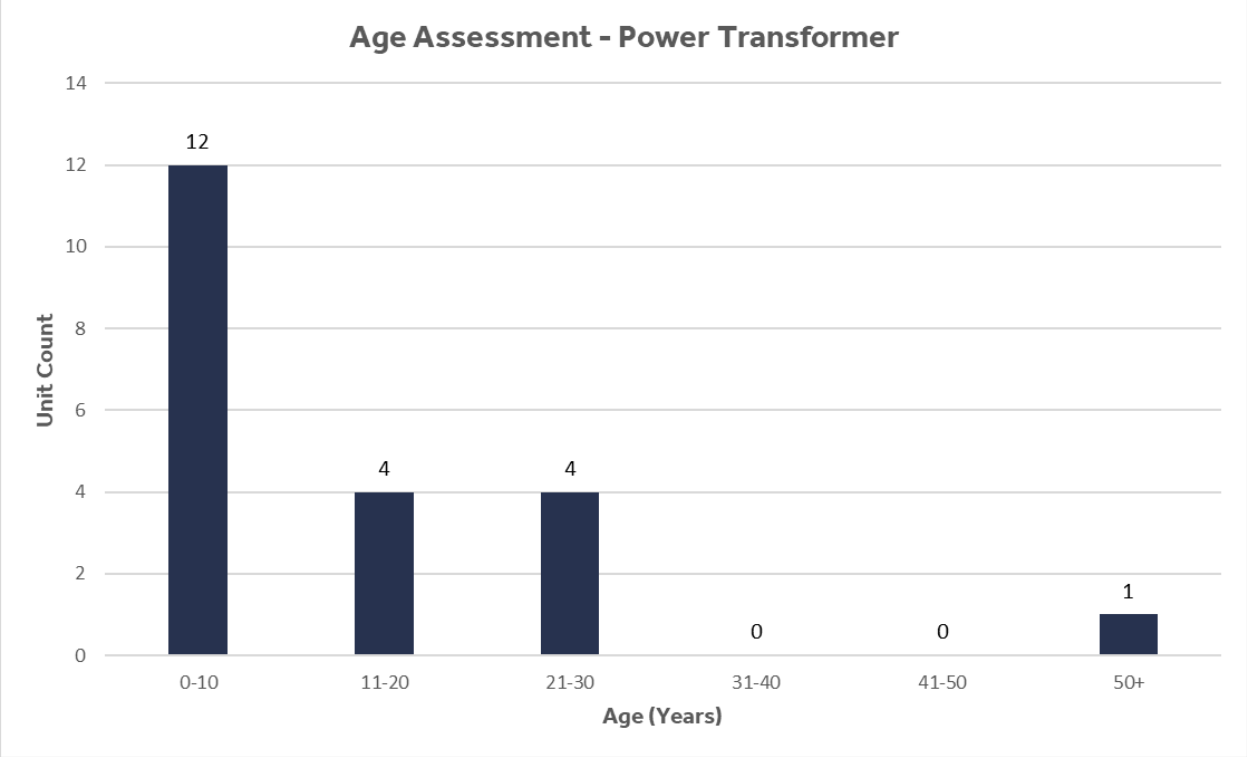
Power transformers in the distribution system are housed within municipal stations. They are used to step down the voltage within the distribution system to supply end users. Computing the Health Index of a transformer requires developing end-of-life criteria for its various components. Table 4-15 summarizes the methodology to generate the Health Index for oil type power transformers. The Health Index score for a power transformer is composed of seventeen condition parameters. Three of the seventeen parameters are determined by quantitative testing results, with each parameter carrying a weight of eight or ten. These measurements include dissolved gas analysis, insulation power factor, and oil quality. Each of these parameters represents an aspect of a power transformer with a direct impact on the operational health of the asset. Loading history and visual inspection were used to calculate the Health Index Score.

By performing the dissolved gas analysis ("DGA"), it is possible to identify the internal faults such as arcing, partial discharge, low-energy sparking, severe overloading, and overheating in the insulating medium. Insulation power factor measurements are an important source of data to monitor transformer and bushing conditions. Lower scores for one or a combination of these condition parameters strongly indicate progressed degradation of the asset, hence their larger weights.

Although load history is not a test, it holds value as an input for the Health Index algorithm. The peak loading information of January 2017 to May 2020 was used for the analysis. The rate of insulation degradation is directly related to the operating temperature which is directly related to transformer loading levels. The peak loading level of the transformers is expressed in a percentage of the nameplate rating. NBHDL collects the substation load history monthly, recording the monthly peak for each month.

Oil leaks and overall condition of components are collected by visual inspection and serve as indicators of the total health of the asset. Additionally, the degree of polymerization provides a reasonably good measure of the remaining life of the asset and is employed as a condition parameter.

Figure 4-16: Power Transformers Age Demographic



NBHDL owns 21 oil type power transformers within its service territory. Age was known for all the power transformers in the system. Figure 4-16 presents the age profile of power transformers in-service.

Figure 4-17: Power Transformers Health Index Demographic

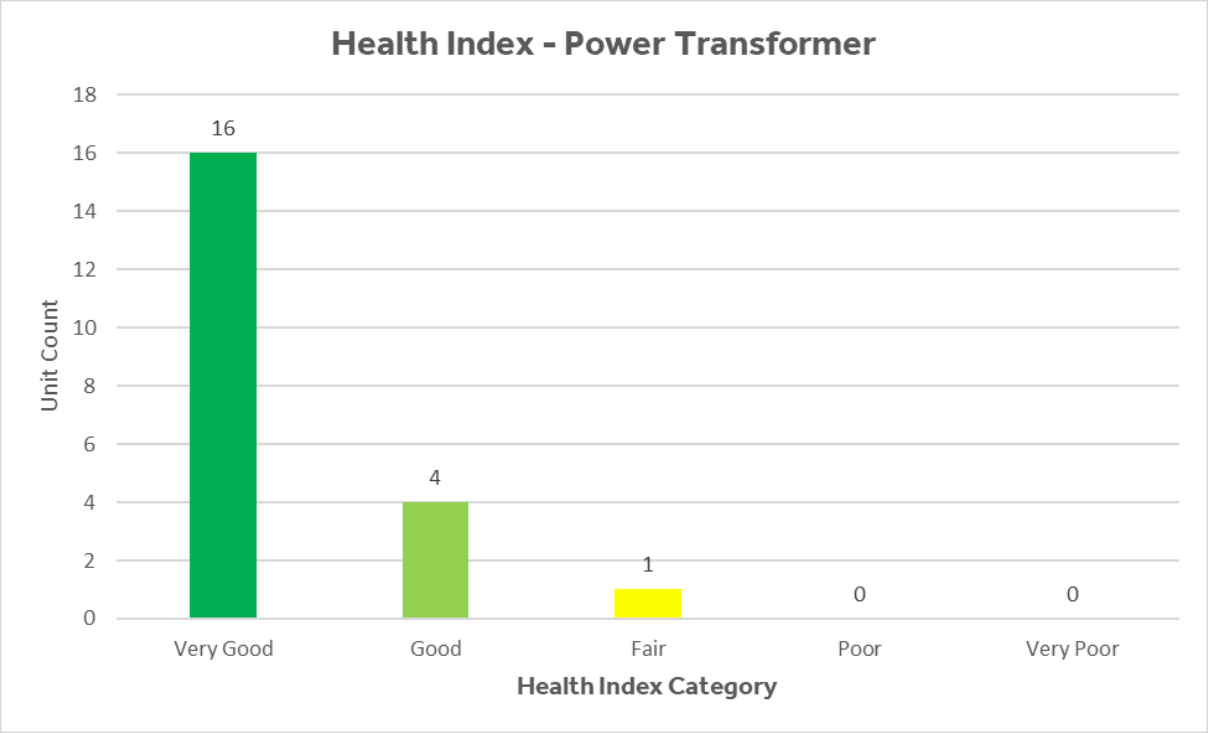
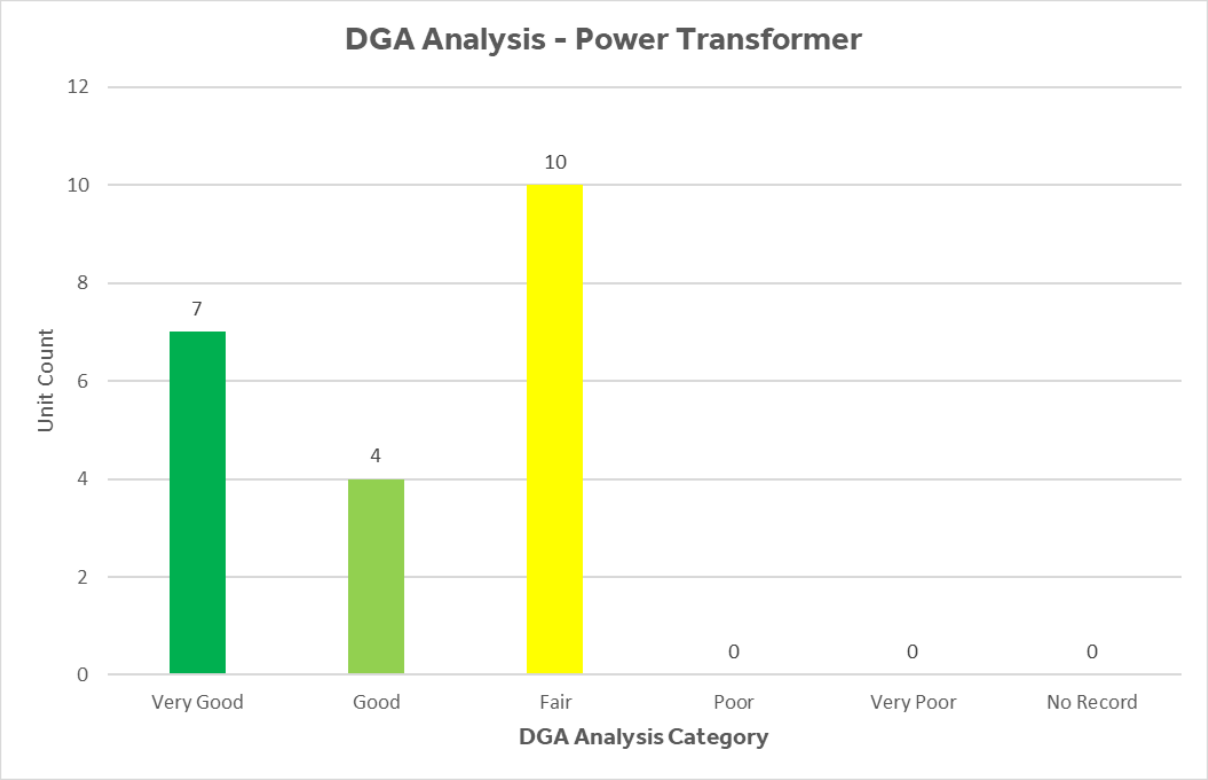


Figure 4-18: Power Transformers DGA Analysis Results



NBHDL's power transformer inspections, test results and loading history were used to calculate the Health Index based on the criteria provided in Table 4-15. The Health Index distribution for in-service power transformers leveraged from the substation assessment[3] is presented in Figure 4-17. Most of the power transformers are in Very Good or Good condition with two power transformers in Fair condition. The average Health Index for power transformer is 88%.

Figure 4-18 illustrates the DGA analysis results for the power transformers. DGA tests can be a leading indicator as to how the power transformer's internal condition is before experiencing unfavourable results. The figure is presented to show there are power transformers tested that may require intervention within a timely manner even though the overall Health Index is Very Good.

Table 4-16: Power Transformers condition parameters data availability

Condition Parameter	% of Assets with Data
DGA	100%
Load History	95%
Insulation Power Factor	100%
Infrared Scanning	95%
Oil Quality	100%
Age	100%
Overall Condition	100%
Bushing Condition	100%
Main Tank Corrosion	100%
Cooling Tank	100%
Corrosion	100%
Foundation	100%
Grounding	100%
Gaskets and Seals	100%
Connectors	100%
Oil Leaks	100%
Oil Level	100%

The average DAI for oil type power transformer data is 99%. DGA and visual inspection conditions have 100% DAI. Table 4-16 presents the DAI of individual condition parameters used for the power transformer HI framework.

[3] Costello Utility Consultants - Substation Condition Assessment of All 17 North Bay Hydro Stations

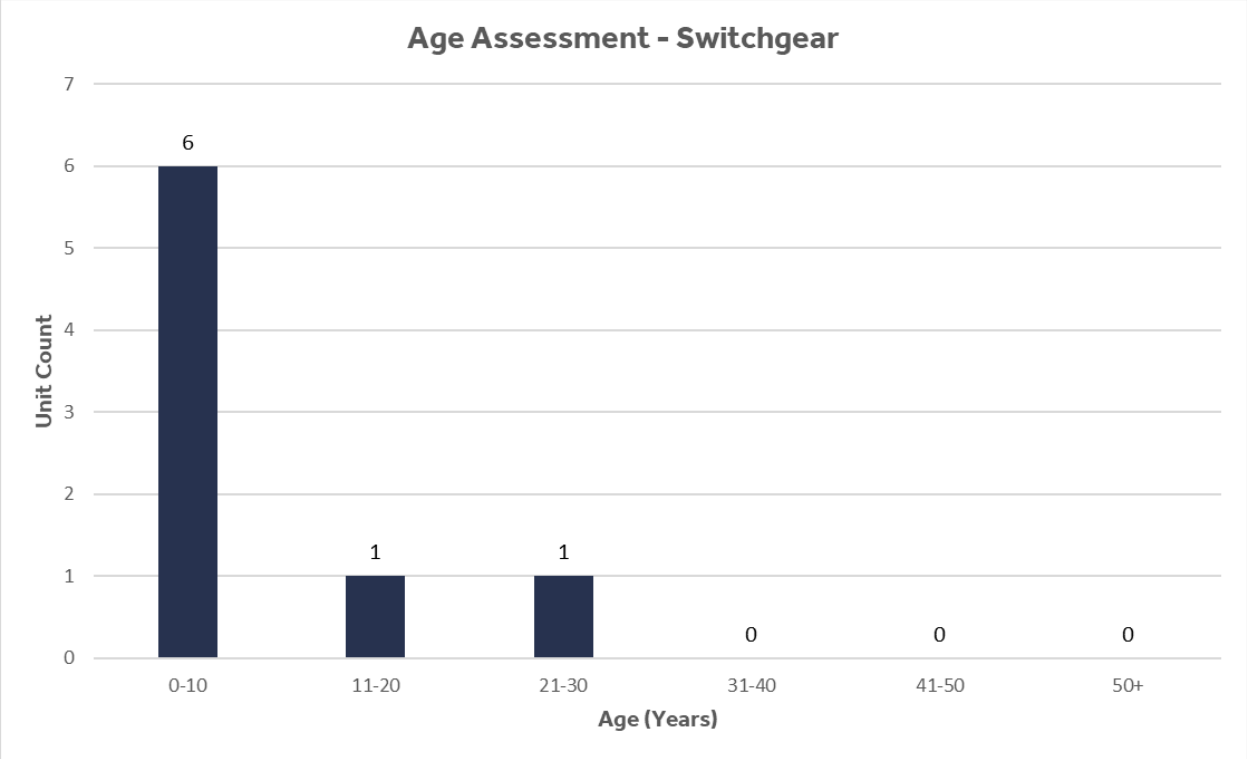
4.2.2 Switchgear

Table 4-17: Switchgears Health Index Algorithm

Condition Parameter	Weight	Ranking	Numerical Grade	Max Score
Metal Clad Cubicle and Components	3	A,B,C,D,E	4,3,2,1,0	12
Breaker Truck Condition	3	A,B,C,D,E	4,3,2,1,0	12
Control & Operating Mechanism Components	2	A,B,C,D,E	4,3,2,1,0	8
Overall CB Condition	4	A,B,C,D,E	4,3,2,1,0	16
			Total Score	**48**

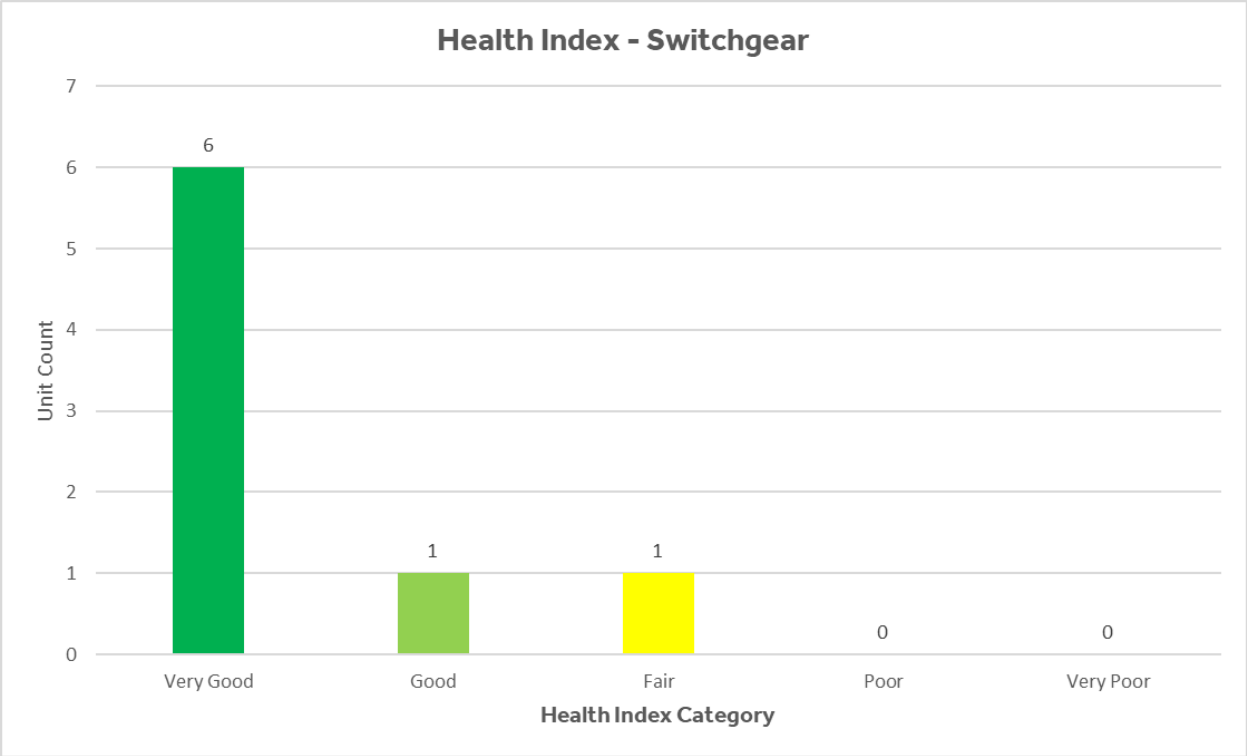
Station switchgear consists of breakers, fuses, and switches that control and regulate the current flowing through the distribution system. During a fault, the switchgear isolates and clears the faults downstream. It is also used to de-energize equipment during maintenance and testing. The Health Index for station switchgears is calculated by considering a combination of end-of-life criteria summarized in Table 4-17. Each condition parameter represents a factor critical in determining the asset's condition relative to a potential failure to occur. Appendix B-8 provides grading tables for each condition parameter. Visual inspection records of the switchgears are used as a condition parameter.

Figure 4-19: Switchgears Age Demographic



NBHDL owns 8 station switchgears within its service territory. Age was known for the total population of NBHDL's in-service station switchgears. Figure 4-19 presents the age profile of the primary switchgears.

Figure 4-20: Switchgears Health Index Demographic



NBHDL's maintenance records and nameplate information were used to calculate the Health Index based on the criteria provided in Table 4-17. The overall Health Index distribution for the station switchgears leveraged from the substation assessment[3] is presented in Figure 4-20. Most of the asset class is in Very Good or Good condition, with one of the station switchgears in Fair condition. The average Health Index for station primary switchgear is 93%.

Table 4-18: Primary Station Switchgears condition parameters data availability

Condition Parameter	% of Assets with Data
Metal Clad Cubicle and Components	100%
Breaker Truck Condition	100%
Control & Operating Mechanism Components	100%
Overall CB Condition	100%

The DAI for switchgear data is 100%. Table 4-18 presents the DAI of individual condition parameters used for the switchgear HI framework.

4.2.3 Recloser

Table 4-19: Recloser Health Index Algorithm

Condition Parameter	Type	Weight	Ranking	Numerical Grade	Max Score
Bushing/Support Insulators	All	4	A,B,C,D,E	4,3,2,1,0	16
Control & Operating Mechanism Components	All	2	A,B,C,D,E	4,3,2,1,0	8
Foundation, Support Steel, Grounding	All	3	A,B,C,D,E	4,3,2,1,0	12
Overall Condition	All	4	A,B,C,D,E	4,3,2,1,0	16
Infrared Scan (IR)	All	4	A,C,E	4,2,0	16
Tank and Mechanism Box	Oil	4	A,B,C,D,E	4,3,2,1,0	16
Oil Leaks	Oil	2	A,B,C,D,E	4,3,2,1,0	8
Vacuum Bottle Integrity	Vacuum	4	A,B,C,D,E	4,3,2,1,0	16
Enclosure	Vacuum	3	A,B,C,D,E	4,3,2,1,0	12
Total Score		**Oil**	**92**	**Vacuum**	**96**

Reclosers are installed on the distribution system to interrupt the circuit during a fault and are designed to automatically reclose to restore the normal operating conditions. Since the majority of the faults on the overhead system are self-clearing/transient, the presence of reclosers improves the reliability of the system significantly as the power is restored within seconds after a fault occurs. The Health Index for reclosers is calculated by considering a combination of end-of-life criteria summarized in Table 4-19. Each condition parameter represents a factor critical in determining the asset's condition relative to a potential failure to occur. Appendix B-9 provides grading tables for each condition parameter.

Visual inspections can detect external contamination, corrosion, evidence of overheating, misalignment, plus cracks and leaks on bushings, support insulators, tanks, enclosures, drives, linkages and fittings. Timing/travel test results provide a reasonably good measure of the functional mechanism of the asset and hence is used as a condition parameter in the Health Index framework.

NBHDL owns 31 oil type and 25 vacuum type reclosers within its service territory. Age was known for all the reclosers in the system. Figure 4-21 presents the age distribution for reclosers.

Figure 4-21: Reclosers Age Demographic

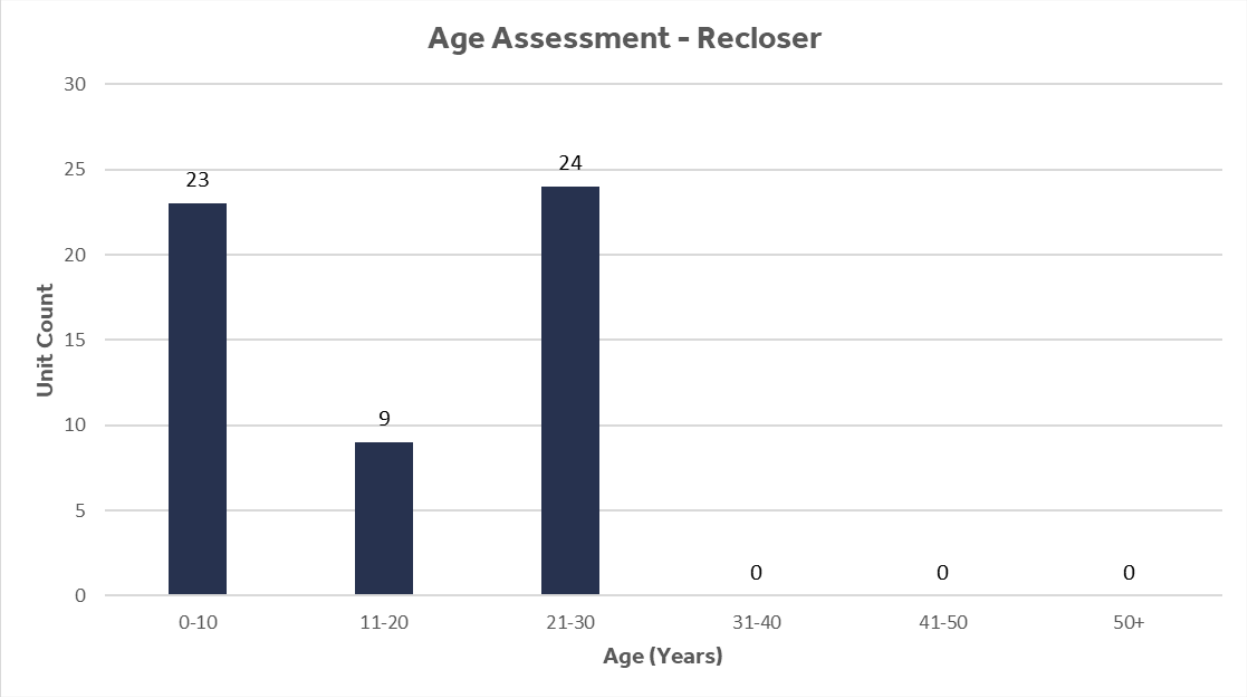
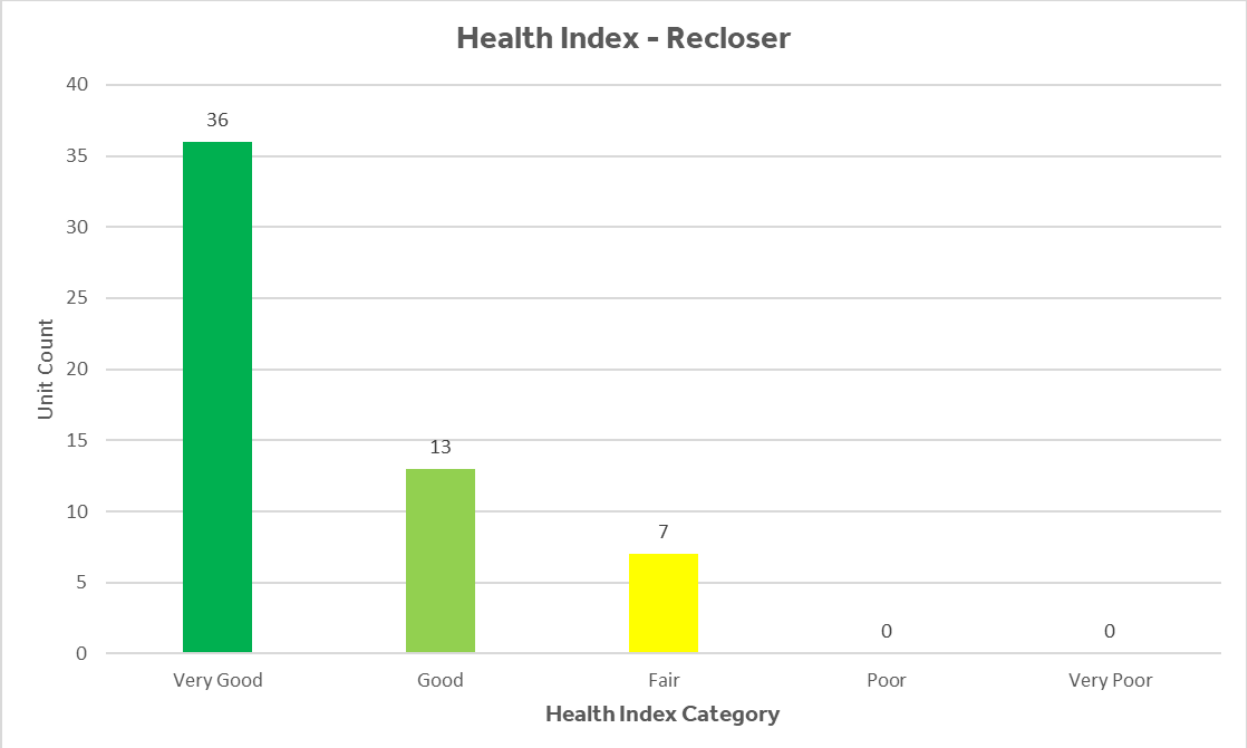


Figure 4-22: Reclosers Health Index Demographic



NBHDL maintenance records were used to calculate the Health Index based on the criteria provided in Table 4-19. The overall Health Index distribution for the reclosers leveraged from the substation assessment[3] is presented in Figure 4-22. The majority of the reclosers are in Very Good or Good condition, with ~13% in Fair condition. The average Health Index for reclosers is 91%.

Table 4-20: Reclosers condition parameters data availability

Condition Parameter	% of Assets with Data	
	Oil Type	Vacuum Type
Bushing/Support Insulators	100%	100%
Control & Operating Mechanism Components	100%	100%
Foundation, Support Steel, Grounding	100%	100%
Overall Condition	100%	100%
Infrared Scan (IR)	100%	100%
Tank and Mechanism Box	68%	
Oil Leaks	100%	
Vacuum Bottle Integrity		100%
Enclosure		100%

The average DAI for oil type and vacuum type recloser is 94% and 100%, respectively. Table 4-20 presents the DAI of individual condition parameters used for the recloser HI framework.

4.2.4 Protection Relay

Table 4-21: Protection Relay Health Index Algorithm

Condition Parameter	Weight	Ranking	Numerical Grade	Max Score
Visual Inspections	3	A,B,C,D,E	4,3,2,1,0	12
Service Age	4	A,B,C,D,E	4,3,2,1,0	16
Non-Discretionary Obsolescence	5	A,E	4,0	20
Discretionary Obsolescence	1	A,B,C,D,E	4,3,2,1,0	4
			Total Score	**52**

The function of protection relays in distribution systems is to detect abnormal operating conditions and initiate a recloser trip to isolate faulty circuits from healthy circuits. Protection relays obtain their input from instrument transformers, process the information and automatically take corrective action with adequate speed and selectivity. Table 4-21 summarizes the methodology to generate the Health Index for protection relays. The main inputs considered are service age and test results. Appendix B-10 provides grading tables for each condition parameter.

NBHDL owns 20 protection relays. Age was known for all the relays in the system. Figure 4-23 presents the age demographics of the protection relays.

Figure 4-23: Protection Relays Age Demographic

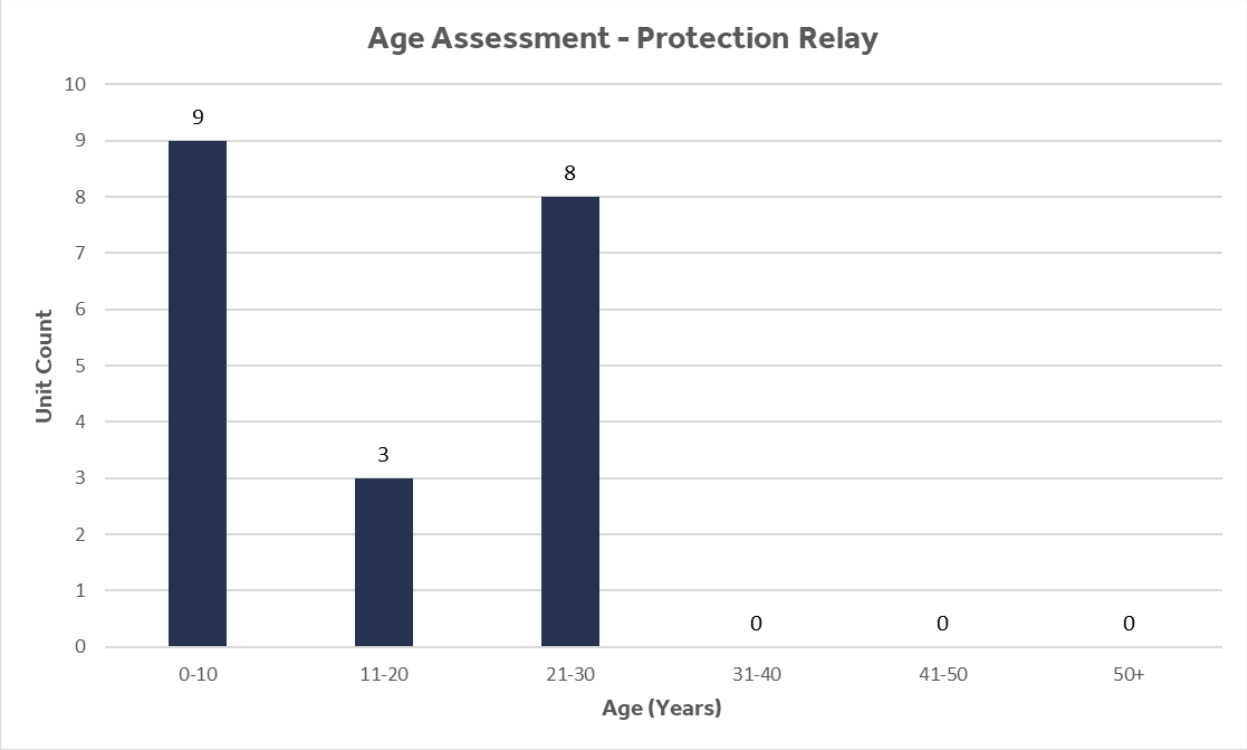
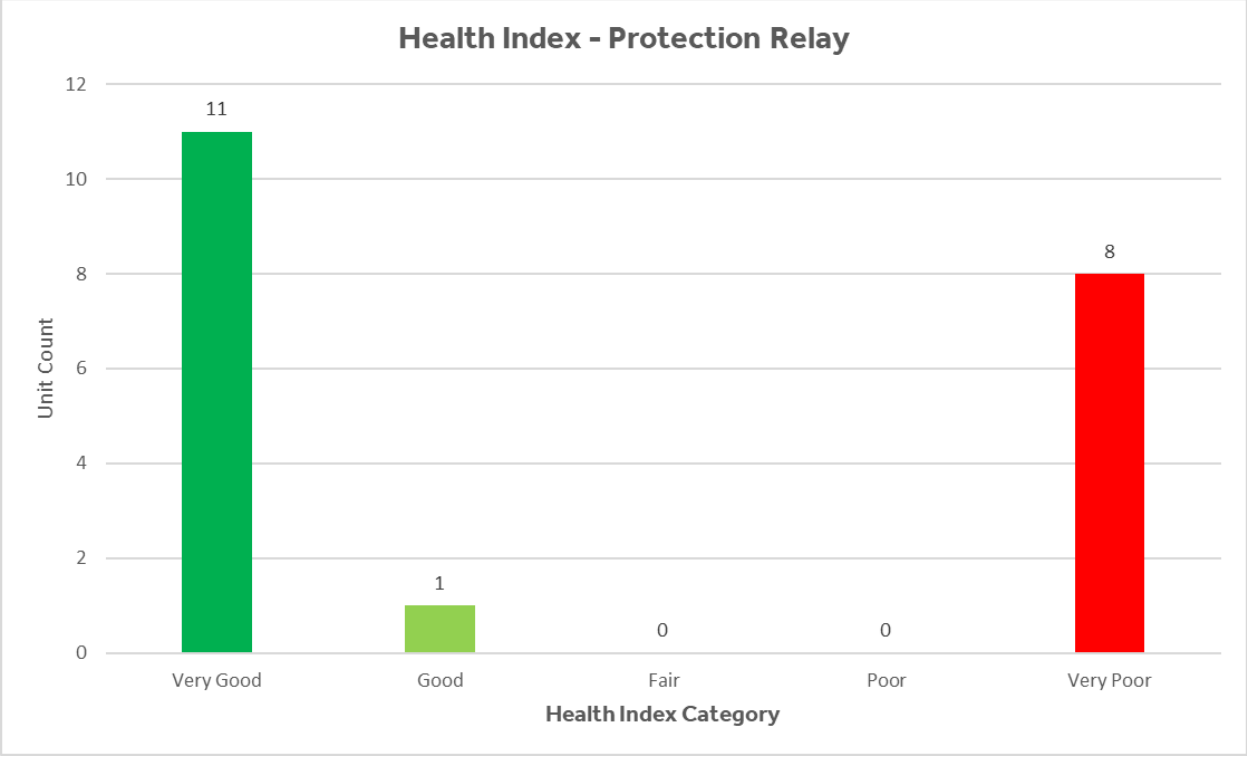


Figure 4-24: Protection Relays Health Index Demographic



NBHDL's most recent visual inspection results were used to calculate the Health Index based on the criteria provided in Table 4-21. The Health Index distribution for relays leveraged from the substation assessment[3] is presented in Figure 4-24. The population health is split with 40% of the relays in Very Poor condition. The average Health Index for protection relay is 68%.

Table 4-22: Protection relays condition parameters data availability

Condition Parameter	% of Assets with Data
Visual Inspection	100%
Service Age	100%
Non-Discretionary Obsolescence	100%
Discretionary Obsolescence	100%

The average DAI for protection relays is 100%. Table 4-22 presents the DAI of individual condition parameters used for the relays HI framework.

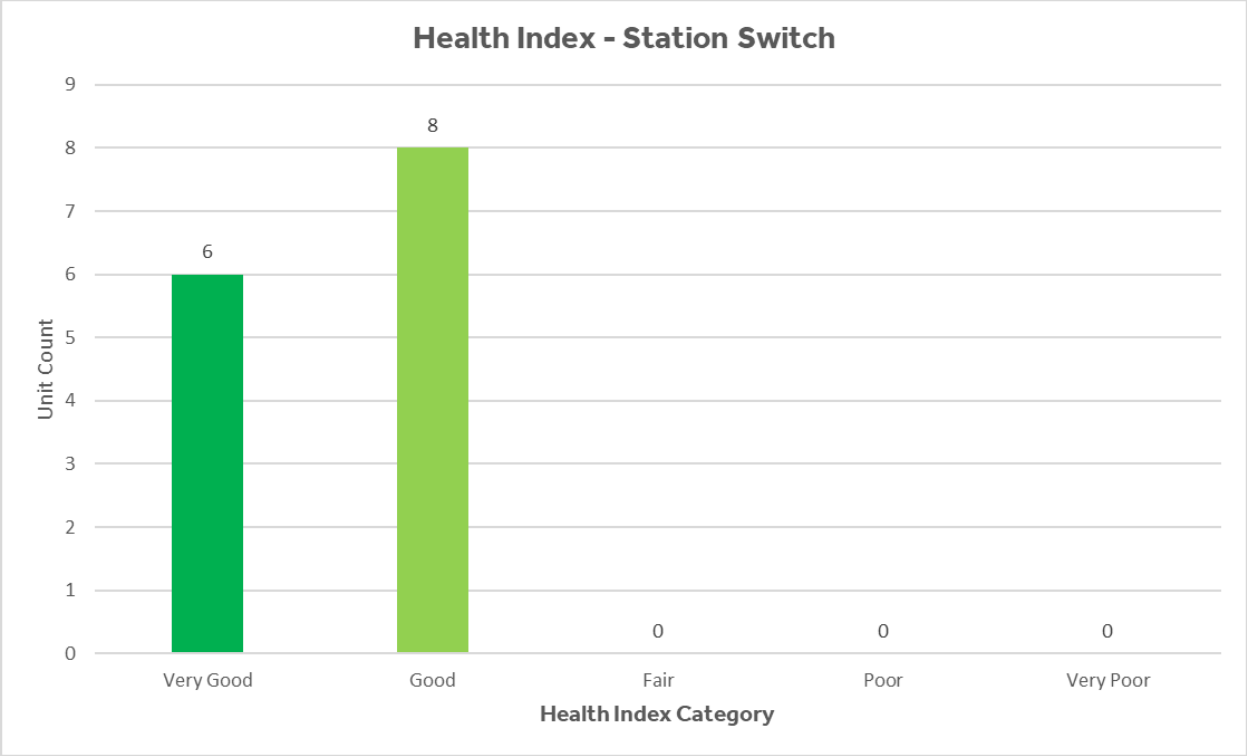
4.2.5 Station Overhead Switch

Table 4-23: Overhead Station Switch Health Index Algorithm

Condition Parameter	Weight	Ranking	Numerical Grade	Max Score
Switch or Disconnect Operator Controls	3	A,B,C,D,E	4,3,2,1,0	12
Condition of Switch/Disconnect Blades and Contacts	4	A,B,C,D,E	4,3,2,1,0	16
Power Train Drive Assembly	4	A,B,C,D,E	4,3,2,1,0	16
Connectors and Conductors	3	A,B,C,D,E	4,3,2,1,0	12
IR scans	6	A,C,E	4,2,0	24
Insulators/Porcelains	3	A,B,C,D,E	4,3,2,1,0	12
Foundation/Support Steel/Grounding	3	A,B,C,D,E	4,3,2,1,0	12
			Total Score	**104**

Station switches provide isolation between the sub-transmission feeders and the municipal station when necessary. Table 4-23 summarizes the methodology to combine these criteria into an overall Health Index. NBHDL's most recent visual inspection is the main input of the Health Index formulation. Appendix B-11 provides grading tables for each condition parameter.

Figure 4-25: Station Overhead Switch Health Index Demographic



NBHDL owns 14 station overhead switches within its service territory. The Health Index for station overhead switches leveraged from the substation assessment[3] is illustrated in Figure 4-25. The entire population is in Very Good or Good condition. The average Health Index for station overhead switches is 87%.

Table 4-24: Overhead Station Switch condition parameters data availability

Condition Parameter	% of Assets with Data
Switch or Disconnect Operator Controls	100%
Condition of Switch/Disconnect Blades and Contacts	100%
Power Train Drive Assembly	100%
Connectors and Conductors	100%
IR scans	100%
Insulators/Porcelains	100%
Foundation/Support Steel/Grounding	100%

The DAI across the station overhead switch asset class is 100%. Table 4-24 presents the DAI of individual condition parameters used for the station overhead switch HI framework.

4.2.6 Station Building

Table 4-25: Station Building Health Index Algorithm

Condition Parameter	Weight	Ranking	Numerical Grade	Max Score
Roof Condition	4	A,B,C,D,E	4,3,2,1,0	16
Wall Condition	4	A,B,C,D,E	4,3,2,1,0	16
Floors/Foundations Condition	4	A,B,C,D,E	4,3,2,1,0	16
Overall Building Condition	4	A,B,C,D,E	4,3,2,1,0	16
Lighting/Power/HVAC Condition	2	A,B,C,D,E	4,3,2,1,0	8
Doors/Windows/Louvres Condition	2	A,B,C,D,E	4,3,2,1,0	8
			Total Score	**80**

Each municipal station has a building where protection and control equipment, battery systems and indoor switchgears are located. The condition of the building is critical as they are the housing unit for storing and operating the in-service assets. Additionally, they serve a protective function for the assets from external weather patterns that may impact both the condition and performance of the housed assets. The Health Index for station buildings is calculated by considering visual inspections of several components of the buildings. Table 4-25 highlights the Health Index algorithm for buildings. Appendix B-12 provides grading tables for each condition parameter.

NBHDL owns 17 station buildings within its service territory. An assumption is made to use the construction dates of the corresponding station to show an approximate representation of the age. Using the construction date does not mean the station was in-service with all units installed. Construction date results were not used as part of the Health Index calculation. Figure 4-26 presents the age distribution for buildings.

Figure 4-26: Station Buildings Age Demographic

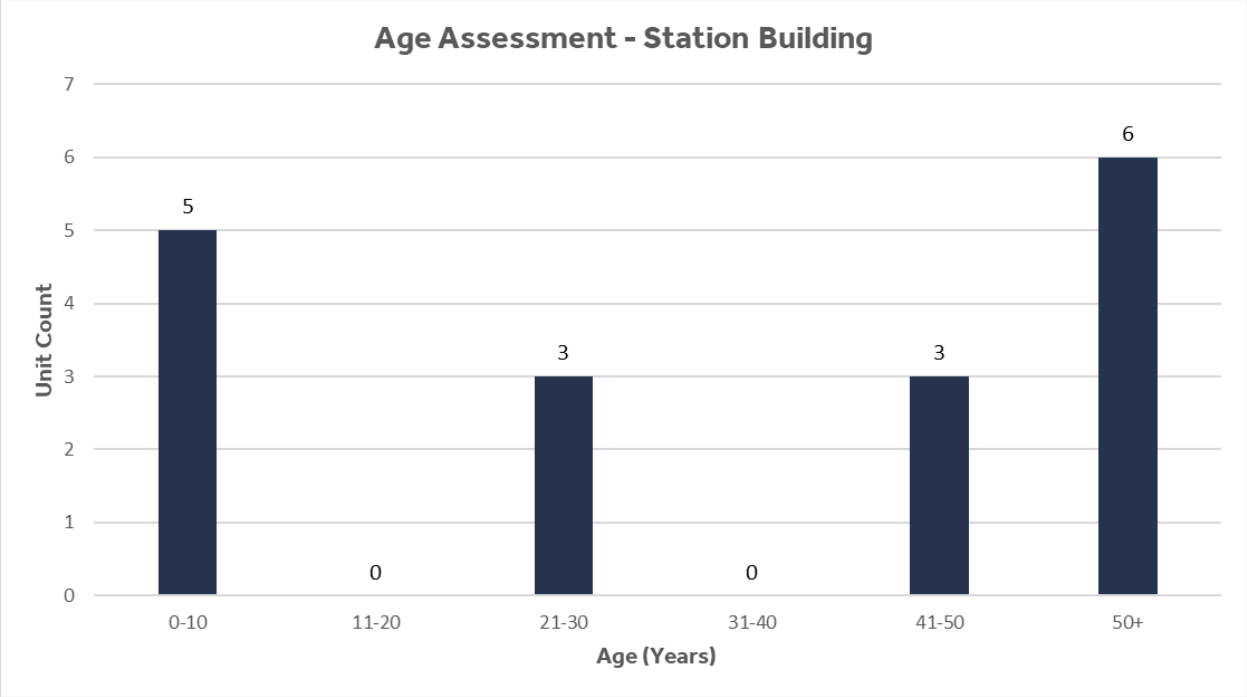
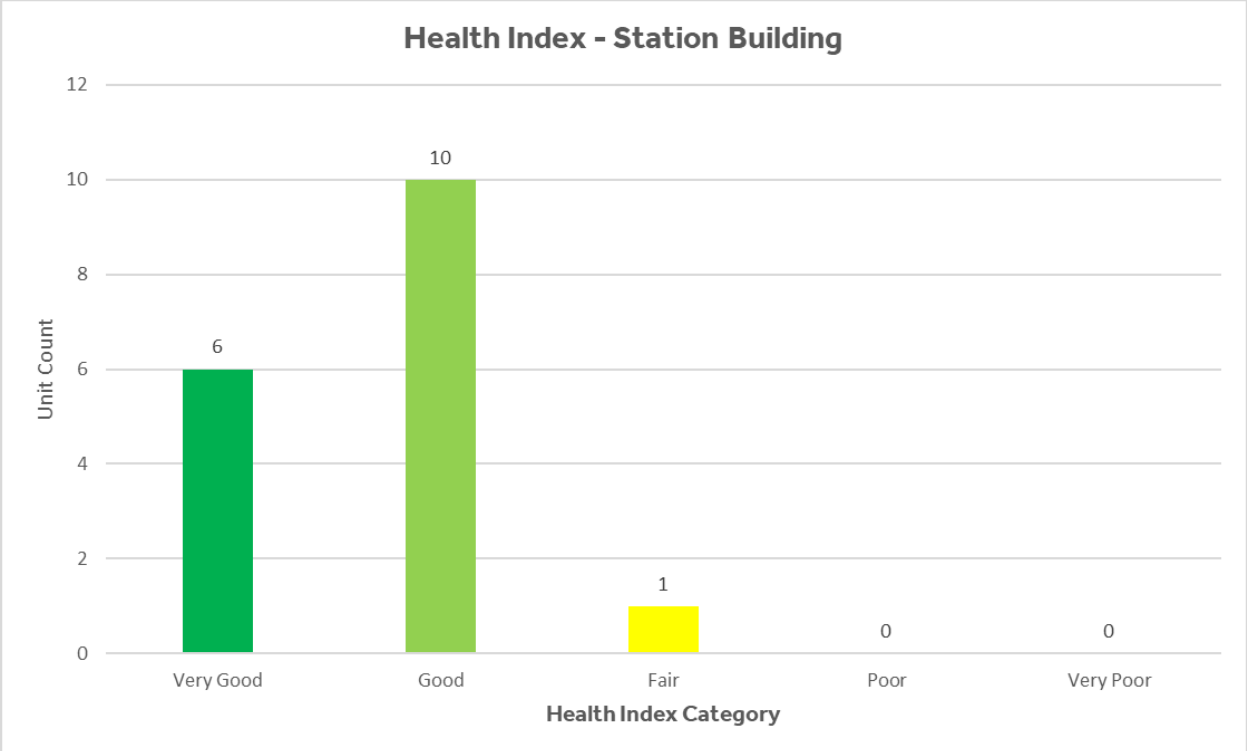


Figure 4-27: Station Building Health Index Demographic



NBHDL's most recent maintenance records were used to calculate the Health Index based on the criteria provided in Table 4-25. The Health Index values for station buildings were leveraged from the substation assessment[3] and are presented in Figure 4-27. The majority of the population is in Very Good or Good condition, whereas one unit is in Fair condition. The average Health Index for station buildings is 83%.

Table 4-26: Station building condition parameters data availability

Condition Parameter	% of Assets with Data
Roof Condition	100%
Wall Condition	100%
Floors/Foundations Condition	100%
Overall Building Condition	100%
Lighting/Power/HVAC Condition	100%
Doors/Windows/Louvres Condition	100%

The average DAI for station buildings is 100%. Table 4-26 presents the DAI of individual condition parameters used for the station buildings HI framework.

4.2.7 Ground Grid

Table 4-27: Ground Grid Health Index Algorithm

Condition Parameter	Weight	Ranking	Numerical Grade	Max Score
Ground Grid Installation	4	A,B,C,D,E	4,3,2,1,0	16
Risers/Bonds to Structures/Neutral/Overhead/ Equipment/Ground Wires/Attachment Points	3	A,B,C,D,E	4,3,2,1,0	12
Buildings, Fences, Gates	3	A,B,C,D,E	4,3,2,1,0	12
Condition of Surface Stone	3	A,B,C,D,E	4,3,2,1,0	12
			Total Score	**52**

The purpose of a substation ground grid is to provide a low resistance ground electrode for system neutral, for equipment case grounding and to maintain safe potential gradients within the station yards during abnormal operating conditions, i.e. line-to-ground faults. The Health Index for station ground grids is calculated by considering visual inspections of several components of the ground grids. Table 4-27 highlights the Health Index algorithm for buildings. Appendix B-13 provides grading tables for each condition parameter.

NBHDL owns 17 stations within its service territory. The installation date is unknown for the total in-service population. An assumption is made to use the construction dates of the corresponding station to show an approximate representation of the age distribution. The extrapolated age results were not used as part of the Health Index calculation. Figure 4-28 presents the age distribution for ground grids.

Figure 4-28: Ground Grid Age Demographic

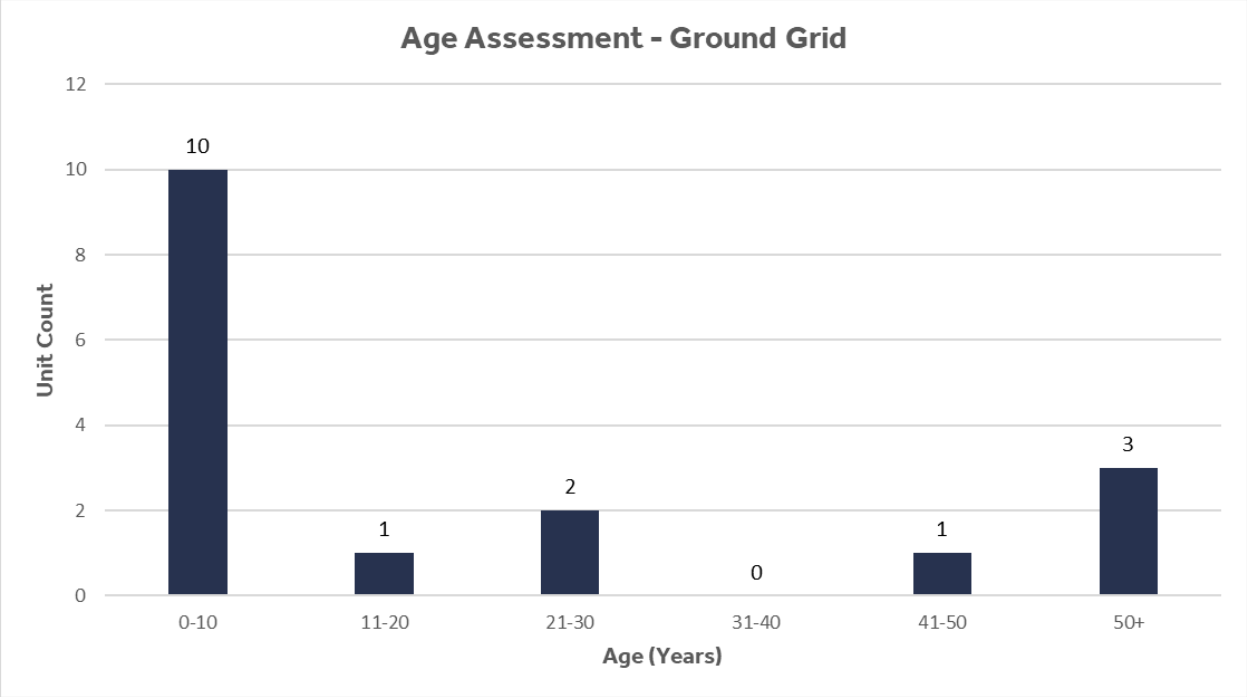
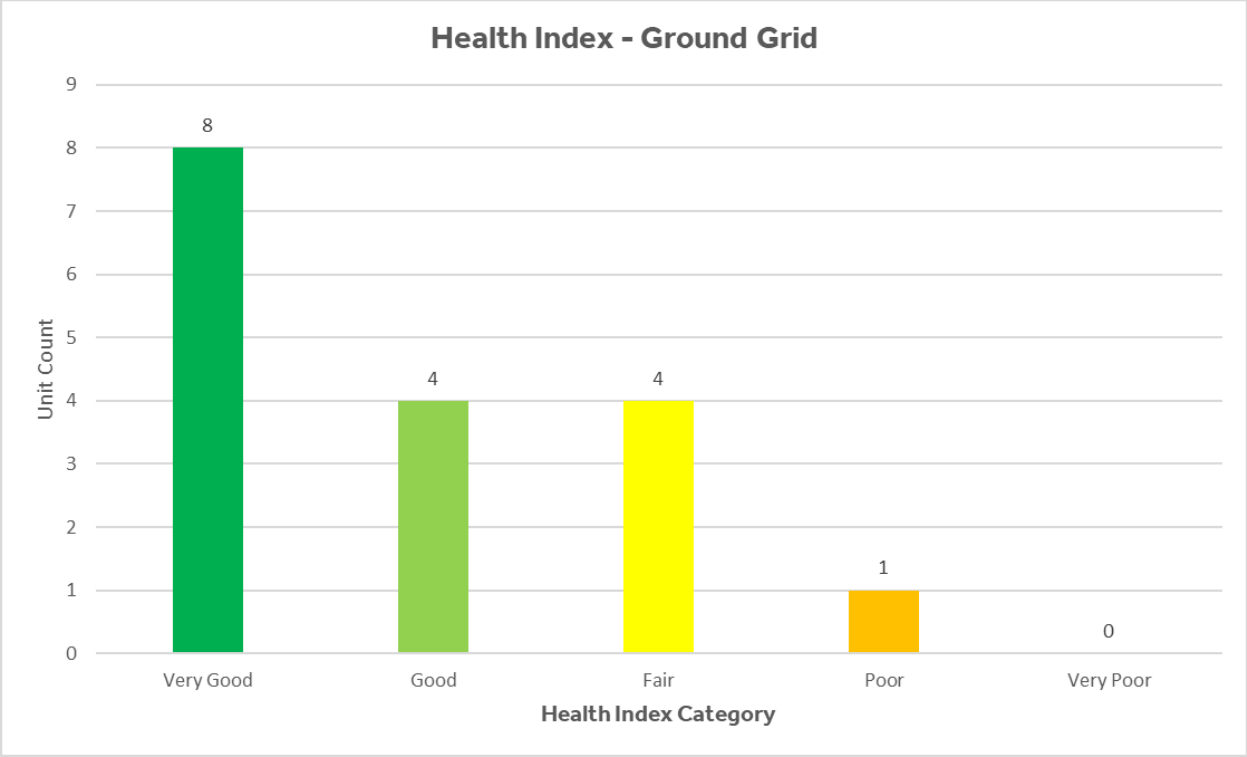


Figure 4-29: Ground Grid Health Index Demographic



NBHDL's most recent maintenance records were used to calculate the Health Index based on the criteria provided in Table 4-27. The Health Index values for ground grids were leveraged from the substation assessment[4] and are presented in Figure 4-29. The majority of the units are in Fair condition. The average Health Index for ground grids is 68%.

Table 4-28: Ground Grid condition parameters data availability

Condition Parameter	% of Assets with Data
Ground Grid Installation	100%
Risers/Bonds to Structures/Neutral/Overhead/ Equipment/Ground Wires/Attachment Points	100%
Buildings, Fences, Gates	100%
Condition of Surface Stone	100%

The average DAI for ground grids is 100%. Table 4-28 presents the DAI of individual condition parameters used for the station ground grid HI framework.

[4] CIMA+ - North Bay Hydro Asset Condition Assessment – Further Rating Review

5 Recommendations

A complete ACA framework for NBHDL represents an integral component of its broader asset management framework, enabling it to proactively manage its distribution assets and ensure that the right actions are taken for the right assets at the right time. This framework leveraged the current information captured from maintenance programs and other utility records, creating an essential linkage between the ongoing maintenance activities and the capital investment decision-making process. Leveraging the HI insights allows for NBHDL's investment decision-making to be further enhanced with the current information regarding the state of the assets. However, there are also further opportunities to introduce new data to be collected and improve data availability to continuously improve the ACA framework.

This section breaks down METSCO's recommendations into the following categories:

- Health Index improvement
- Data availability improvements

5.1 Health Index Improvement

For select asset classes, a recommended Health Index formulation was used for NBHDL's ACA framework. The following set of recommendations target additional condition parameters that can be incorporated for specific asset classes to improve the Health Index formulation and provide NBHDL with additional data to refine its asset condition calculations. The recommendations are based on the "Ideal" ACA framework for assets and should not be interpreted as suggesting that immediate action is warranted. The following tables highlight the condition parameter name, a short description of the reasoning to include the condition parameter, and a priority of importance to include it into the specific asset's class HI framework. The priority is dependent on the condition parameter's weighting in comparison to the current HI framework condition parameter's weights.

1. Underground Cable

Table 5-1: Data Collection Recommendation for Underground Primary Cable

Criteria	Reasoning	Impact
Field Tests	Like cable failure, field testing will result in an improvement in understanding the condition of the utility's asset.	**High**
Condition of Concentric Neutral	Corrosion of concentric neutrals is another mode of degradation. Insulation degradation and cable failures can be accelerated if the cable jacket is damaged allowing moisture to enter into the insulation system. Concentric neutral corrosion is a major problem particularly on unjacketed cables or when the neutrals of the cable are exposed to excessive moisture over time. The corrosion can lead to premature cable failures and/or cause touch potential risks. Time Domain Reflectometry (TDR) tests are performed to determine the degree of corrosion on concentric neutral cables.	**Medium**

2. Overhead Distribution (Pole-Mount) Transformer

Table 5-2: Data Collection Recommendation for Overhead Distribution (Pole-Mount) Transformer

Criteria	Reasoning	Impact
Visual Inspection	Identifying defects present on an asset would inform the utility of degradation and potential maintenance tasks to be completed.	**High**

3. Underground Distribution Pad-Mount Transformer

Table 5-3: Data Collection Recommendation for Underground Distribution Pad-Mount Transformer

Criteria	Reasoning	Impact
IR Scan	To identify if the transformer is operating within normal temperature ranges – excess temperature would require further investigation.	**High**

4. Underground Distribution Vault Transformer

Table 5-4: Data Collection Recommendation for Underground Distribution Vault Transformer

Criteria	Reasoning	Impact
Visual Inspection	Identifying defects present on an asset would inform the utility of degradation and potential maintenance tasks to be completed.	**High**
Condition of Civil Structure	It is likely that a failed transformer civil structure will also result in the replacement of the transformer it is supporting.	**High**
IR Scan	To identify if the transformer is operating within normal temperature ranges – excess temperature would require further investigation.	**High**

5. Distribution Overhead Switch

Table 5-5: Data Collection Recommendation for Distribution Overhead Switch

Criteria	Reasoning	Impact
IR Scan	To identify if the switch is operating within normal temperature ranges – excess temperature would require further investigation.	**High**
Visual Inspection – Condition of Insulators	The condition of the insulator helps assess the life expectancy of the switch which affects the operability of the switch. Identification of this condition parameter over time provides degradation information of an asset.	**Medium**
Visual Inspection - Condition of Blades	The condition of the blades helps assess the life expectancy of the switch which affects the operability of the switch. Identification of this condition parameter over time provides degradation information of an asset.	**Medium**
Visual Inspection - Condition of Operating Mechanism	The condition of the operating mechanism helps assess the life expectancy of the switch which affects the operability of the switch. Identification of this condition parameter over time provides degradation information of an asset.	**Medium**

6. Switchgear

Table 5-6: Data Collection Recommendation for Switchgear

Criteria	Reasoning	Impact
Contact Resistance Tests	Defective contacts lead to higher losses and may result in arcing or other incidents. Identification of this condition parameter over time provides degradation information of an asset.	**High**
Timing/Travel tests	Timing/ Travel test provides information as to whether the breaker's operating mechanism is operating properly. Identification of operation use over time provides degradation information of an asset.	**Medium**
Arc Chutes	The condition of the arc chutes helps assess the life expectancy of the switch which affects the operability of the switchgear. Identification of this condition parameter over time provides degradation information of an asset.	**Medium**

7. Recloser

Table 5-7: Data Collection Recommendation for Oil Insulated Recloser

Criteria	Reasoning	Impact
Contact Resistance Tests	Defective contacts lead to higher losses and may result in arcing or other incidents. Identification of this condition parameter over time provides degradation information of an asset.	**High**
Timing/Travel tests	Timing/ Travel test provides information as to whether the recloser's operating mechanism is operating properly. Identification of operation use over time provides degradation information of an asset.	**Medium**
Oil Analysis Tests	Defects in the insulation affect the operability of recloser. Identification of this condition parameter over time provides degradation information of an asset.	**Low**

Table 5-8: Data Collection Recommendation for Vacuum Insulated Recloser

Criteria	Reasoning	Impact
Timing/Travel tests	Timing/ Travel test provides information as to whether the recloser's operating mechanism is operating properly. Identification of operation use over time provides degradation information of an asset.	**Medium**
Contact Resistance Tests	Defective contacts lead to higher losses and may result in arcing or other incidents. Identification of this condition parameter over time provides degradation information of an asset.	**Low**

8. Protection Relay

Table 5-9: Data Collection Recommendations for Protection Relay

Criteria	Reasoning	Impact
Defect and Test Reports	Objective asset tests with output results identify asset conditions over time.	**High**
Mean Time Between Failures	Objective asset tests with output results identify asset conditions over time.	**Medium**

9. Station Overhead Switch

Table 5-10: Data Collection Recommendation for Overhead Station Switch

Criteria	Reasoning	Impact
Contact Resistance Tests	Defective contacts lead to higher losses and may result in arcing or other incidents. Identification of this condition parameter over time provides degradation information of an asset.	**Low**

10. Ground Grid

Table 5-11: Data Collection Recommendation for Ground Grid

Criteria	Reasoning	Impact
Surface Stone Resistivity	Corroded surface stone with lower resistivity can impose safety concerns or hazards. The identification of this condition parameter over time provides degradation information of the ground grid.	**Medium**
Grid and Bond Integrity	Broken conductors or connectors of the ground grid after the operability of the ground grid during a fault. The identification of this condition parameter over time provides degradation information of the ground grid.	**Medium**
Current Injection Test	The current injection test provides information as to whether the ground currents flow into the earth without creating hazardous over-voltages. Identification of operation use over time provides degradation information of an asset.	**Medium**

5.2 Data availability improvements

Data availability is critical in being able to produce prudent, accurate and justified decision-making outputs. It represents the single most important element that can influence the degree to which the AM decision-making relies on objective factors. Companies understand that it is critical to execute continuous improvement procedures through an AM data lifecycle, such that data gaps and inaccuracies can be addressed and mitigated. In the case of this ACA study, each asset class included a breakdown of data available for each condition parameter collected. For condition parameters with low data availability METSCO recommends that NBHDL continue collecting the information related to these data points. An example of this is seen for vault transformers; the condition parameter "Visual Inspection" is collected but is only available for 2% of the asset population.

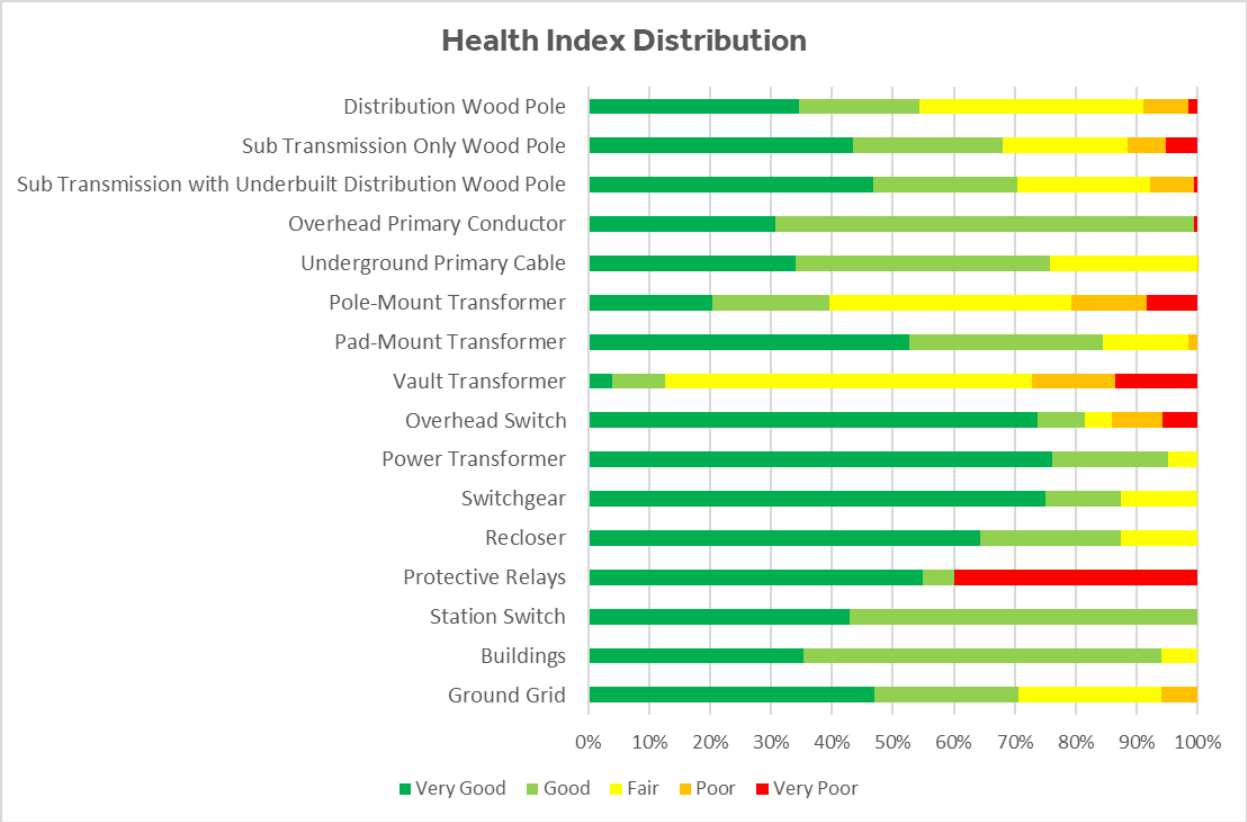
Additionally, for an asset to have a valid Health Index, it must meet a minimum of 70% available data across the condition parameters used in the HI formulation. As part of future improvement opportunities, it is recommended that NBHDL continue capturing asset data for condition parameters that are currently available for a small proportion of the asset population, such that valid Health Indices can be produced across the population. It is expected that with every passing year, the inspection record database will continue to grow, allowing for Health Indices to be calculated for the remaining population.

Lastly, METSCO noticed that some condition parameters recorded by NBHDL vary in the detail with respect to the grading scheme. Some parameters will have a pass-fail grade (e.g. Ok and Not-Okay), such as inspection for underground transformers. Others may have a three-tier grade (e.g., Good, Fair, and Poor), such as inspection for poles. METSCO recommends for NBHDL to evaluate options of changing some condition parameters recorded to a five-level grade, as doing so can provide more defined segregation between assets that need immediate attention and those that can still be in-service without intervention in the short-term.

6 Conclusion

As Figure 6-1 indicates, most assets across NBHDL asset classes analyzed are in Fair condition or better. This can indicate NBHDL has taken steps in the past to manage their asset health and performance for the benefit of its customers. As with every system, however, there are areas that require NBHDL's attention in the coming years where asset populations contain material portions of equipment in or approaching poor condition or worse.

Figure 6-1: Health Index Results



METSCO recommends that NBHDL continue to work on mitigating the existing data gaps, such that more degradation parameters can be assigned actual grades, thus expanding the sample size of valid HI and capturing all possible degradation of the evaluated assets. NBHDL's testing, inspection, and maintenance programs are positioned to continue to capture this information using processes and technologies in place at their facility.

This concludes METSCO's report on the condition assessment performed for NBHDL. We wish the utility's staff all the best as they continue their system planning work and preparation for their upcoming rate filing.

7 Appendix A – METSCO Company Profile

METSCO Energy Solutions Inc. is a Canadian corporation which started its operations on the market in 2006. METSCO is engaged in the business of providing consulting and project management services to electricity generating, transmission, and distribution companies, major industrial and commercial users of electricity, as well as municipalities and constructors on lighting services, asset management, and construction audits. Our head office is located in Toronto, ON and our western office is located in Calgary, AB. Through our network of associates, we provide consulting services to power sector clients around the world. A small subset of our major clients is shown in the figure below.

Figure 7-1: METSCO Clients



METSCO has been leading the industry in Asset Condition Assessment and Asset Management practices for over 10 years. Our founders are the pioneers of the first-ever Health Index methodology for power equipment in North America as well as the most robust high voltage risk-based analytics on the market today. METSCO has since completed hundreds of asset condition assessments, asset management plans, and asset management framework implementations. Our collective record of experience in these

areas is the largest in the world, with ours being the only practice with widespread acceptance across regulatory jurisdictions. METSCO has worked with over 100 different utilities through its tenure, and as such, has been exposed and introduced to practices and unique challenges from a variety of entities, environments, and geographies. When a client chooses METSCO to work on improving Asset Management practices, it is choosing the industry-leading standard, rigorously tested, and refined on a continued basis. Our experts have developed, supported, managed, led, and sat on stand defending their own DSPs as utility staff giving METSCO the qualified experts to provide its service to NBHDL.

In addition to our work in the area of asset health assessments and lifecycle enhancement, our services span a broad common utility issue area, including planning and asset management, design, construction supervision, project management, commissioning, troubleshooting operating problems, investigating asset failures and providing training and technology transfer.

Our founders and leaders are pioneers in their respective fields. The fundamental electrical utility-grade engineering services we provide include:

- Power sector process engineering and improvement
- Fixed Asset Investment Planning – development of economic investment plans
- Regulatory Proceeding Support
- Power System Planning and Studies – identifying system constraints
- Smart Grid Development – from planning to implementation of leading technologies
- Asset Performance and Asset Management
- Distribution and Transmission System Design
- Mentoring, Training, and Technical Resource Development
- Health Index Validation and Development
- Business Case Development
- Owners Engineering Services
- Risk Modeling – Asset Lifecycle and Risk Assessment

8 Appendix B – Condition Parameters Grading Tables

1. Wood Pole

Table 8-1: Criteria for Woodpecker Holes

Condition Rating	Corresponding Condition
A	No Visible Holes
C	Minor to moderate number of small holes
E	A significant number of small holes; large hole; holes located in compromising location (such as near a mounting bolt for equipment)

Table 8-2: Criteria for Pole Top Condition

Condition Rating	Corresponding Condition
A	Pole top is flat with little to no wear on edges; no cracking/splintering – pole top appears to be solid; no holes or other visible issues
C	Pole top is mostly flat with some wear on edges; moderate (typical) amount of cracking / splintering – pole top appears to be mostly solid; minor holes or other visible issues
E	Pole top is rounded with significant wear on edges; significant cracking/splintering – pole top no longer solid – not suitable to mount any new equipment without changing pole; major holes or other visible issues

Table 8-3: Criteria for Pole Shell Condition

Condition Rating	Corresponding Condition
A	Pole shell is not weathered with no visible signs of decay; pole shell has a minimal amount of scaling; pole shell appears to be solid
C	Pole shell has some signs of decay or weathering (knots are protruding); Pole shell has a moderate amount of scaling; Pole shell has a small number of soft/weakened spots
E	Pole shell has significant signs of decay or weathering (knots are heavily protruding); pole shell has a significant amount of scaling; pole shell is overall soft and weakened – dents easily, pieces can be pulled off.

Table 8-4: Criteria for Hammer Test

Condition Rating	Corresponding Condition
A	Pass the hammer test
E	Fail the hammer test

Table 8-5: Criteria for Defects / Other Damages

Condition Rating	Corresponding Condition
A	No signs of any defects on the wood pole due to cracking, insect infestation, vandalism, vehicular accidents, electrical burns, lightning, soil erosion.
B	Moderate signs of defects on the wood pole due to cracking, insect infestation, vandalism, vehicular accidents, electrical burns, lightning, soil erosion
C	Significant signs of defects on the wood pole due to cracking, insect infestation, vandalism, vehicular accidents, electrical burns, lightning, soil erosion

Table 8-6: Criteria for Service Age

Condition Rating	Corresponding Condition
A	0 to 10 years
B	11 to 30 years
C	31 to 40 years
D	41 to 55 years
E	Over 55 years

Table 8-7: Criteria for Remaining Strength

Condition Rating	Corresponding Condition
A	91% to 100%
B	81% to 90%
C	71% to 80%
D	61% to 70%
E	Less than 60%

Table 8-8: Criteria for Displacement of Footing / Wash Out / Grading Change

Condition Rating	Corresponding Condition
A	There is no displacement of footings from the original installed condition, and there is no disorientation, the pole is perfectly straight
C	There is significant displacement of footings and/or there is significant disorientation, requiring planned corrective action
E	Serious displacement of footings and disorientation of the pole in present requiring immediate emergency repairs

2. Overhead Primary Conductor

Table 8-9: Criteria for Service Age

Condition Rating	Corresponding Condition
A	0 to 10 years
B	11 to 30 years
C	31 to 50 years
D	51 to 70 years
E	Over 70 years

Table 8-10: Criteria for Small Risk Conductor

Condition Rating	Corresponding Condition
A	Absence of small-sized conductors
E	Presence of small-sized conductors (#4 to #6 copper)

3. Underground Primary Cable

Table 8-11: Criteria for Service Age

Condition Rating	Corresponding Condition
A	0 to 15 years
B	16 to 25 years
C	26 to 35 years
D	36 to 45 years
E	Over 45 years

Table 8-12 Criteria for Failure Rates

Condition Rating	Corresponding Condition
A	Corresponding condition
B	Less than 0.5 Failure per 10 km per year
C	More than 0.5 and up to 1.0 failure per 10 km per year
D	More than 1.0 and up to 2.0 failures per 10 km per year, the cable is deteriorating
E	More than 2.0 and up to 4.0 failures per 10 km per year, the cable is close to end-of-life, plan replacement

Table 8-13 Criteria for Loading History

Condition Rating	Corresponding Condition
A	Typical Peak load of less than 50% of its rating
B	Typical Peak load of 50% to 75% of its rating
C	Typical Peak load of 75% to 100% of its rating
D	Typical Peak load of 100% to 125% of its rating
E	Typical Peak load greater than 125% of its rating

4. Overhead/pole mount transformer

Table 8-14: Criteria for Service Age

Condition Rating	Corresponding Condition
A	0 to 10 years
B	11 to 20 years
C	21 to 30 years
D	31 to 40 years
E	Over 40 years

Table 8-15: Criteria for Peak Loading

Condition Rating	Component Condition
A	Peak load of less than 50% of its rating
B	Peak load of 50% to 75% of its rating
C	Peak load of 75% to 100% of its rating
D	Peak load of 100% to 125% of its rating
E	Peak load of greater than 125% of its rating

5. Underground Transformer

Table 8-16: Criteria for Service Age

Condition Rating	Corresponding Condition
A	0 to 10 years
B	11 to 20 years
C	21 to 30 years
D	31 to 40 years
E	Over 40 years

Table 8-17: Criteria for Peak Loading

Condition Rating	Component Condition
A	Peak load of less than 50% of its rating
B	Peak load of 50% to 75% of its rating
C	Peak load of 75% to 100% of its rating
D	Peak load of 100% to 125% of its rating
E	Peak load of greater than 125% of its rating

Table 8-18: Criteria for Visual Inspection

Condition Rating	Component Condition
A	No rust on tank/enclosure, no damage to bushings, no sign of oil leaks, padlocks in good condition on pad-mounted transformers
B	Only one of the following defects: Minor rust, or minor cracks in bushings or minor oil leak
C	Two or more of the above-indicated defects present but do not impact the safe operation
D	Tank/radiator badly rusted or major damage to bushing or major oil leak
E	Two or more of the above-indicated defects

Table 8-19: Criteria for Condition of the Civil Structure

Condition Rating	Component Condition
A	Good condition as new
B	Poor condition, remedial action required
C	Immediate replacement required

6. Distribution Overhead Switch

Table 8-20: Criteria for Service Age

Condition Rating	Corresponding Condition
A	0 to 10 years
B	11 to 20 years
C	21 to 30 years
D	31 to 40 years
E	Over 40 years

7. Power Transformer

Table 8-21: Criteria for DGA Results

Gas Condition	Gas Generation Rate		
	Low	Low to High	High
Condition 1	A	A	B
Condition 2	B	B	C
Condition 3	C	C	D
Condition 4	D	D	E

Table 8-22: Criteria for Load History

Condition Rating	Corresponding Condition
A	LS ≥ 3.5
B	2.5 ≤ LS < 3.5
C	1.5 ≤ LS < 2.5
D	0.5 ≤ LS < 1.5
E	LS < 0.5

Table 8-23: Criteria for Insulation Power Factor

Condition Rating	Corresponding Condition
A	$PF_{MAX} < 0.5$
B	$0.5 \leq PF_{MAX} < 1$
C	$1 \leq PF_{MAX} < 1.5$
D	$1.5 \leq PF_{MAX} < 2$
E	$PF_{MAX} \geq 2$

Table 8-24: Criteria for Oil Quality Tests

Test	Station Transformer Voltage Class U ≤ 69 kV	Grade
Acid Number	≤0.05	A
	0.05-0.20	C
	≥0.20	E
IFT [mN/m]	≥30	A
	25-30	C
	≤25	E
Dielectric Strength [kV]	>23 (1mm gap) >40 (2 mm gap)	A
	≤40	E
Water Content [ppm]	<35	A
	≥35	E

Table 8-25: Criteria for Service Age

Condition Rating	Corresponding Condition
A	Less than 20 years
B	20 to 40 years
C	40 to 60 years
D	More than 60 years
E	-

Table 8-26: Criteria for Visual Inspection field

Condition Rating	Corresponding Condition
A	Excellent condition / No defect / No leaks
B	Good condition with minor defect/ leaks
C	One of the above characteristics is unacceptable
D	Two or more of the characteristics are unacceptable
E	Unacceptable condition, requires immediate replacement

8. Switchgear

Table 8-27: Criteria for Metal Clad Cubicle and Components

Condition Rating	Component Condition
A	Bus insulation, MegaOhm readings are well within limits. Cubicle doors, hinges, and latches are free from damage and operated properly. Bus shutters and interlocks work properly. Installation protected from dust, high humidity, and high temperatures
B	Normal wear
C	One condition unacceptable
D	Two or more conditions unacceptable
E	Any of the above conditions are damaged/degraded beyond repair

Table 8-28: Criteria for Breaker Truck Condition

Condition Rating	Component Condition
A	The floor is level, Support steel and anchor bolts tight and free from corrosion. Ground connections free of damage and corrosion. Breaker truck moves freely without obstructions.
B	Normal wear
C	One condition unacceptable
D	Two or more conditions unacceptable
E	Any of the above conditions are damaged/degraded beyond repair

Table 8-29: Criteria for Control & Operating Mechanism Components

Condition Rating	Component Condition
A	Wiring, terminal blocks, relays, contactors, and switches all in good condition. Trip and close coils, relays, auxiliary switches, motors, springs are all in good condition. Linkages, shafts, rods, trip latches are clean, free from cracks, distortion, abrasion, or obstruction. No visible evidence of poor mechanism settings, looseness, loss of adjustment, excess bearing wear, or other out of tolerance operation. No sign of overheating or deterioration.
B	Normal wear
C	One condition unacceptable
D	Two or more conditions unacceptable
E	Any of the above conditions are damaged/degraded beyond repair

Table 8-30: Criteria for Overall CB Condition

Condition Rating	Component Condition
A	Breaker is externally clean, corrosion-free. All primary and secondary connections are in good condition. No external evidence of overheating or restriking. The number of breaker operations on the counter is in the below-average range for the age of breaker. Appears to be well maintained with service records readily available.
B	Normal wear
C	One condition unacceptable
D	Two or more conditions unacceptable
E	Any of the above conditions are damaged/degraded beyond repair

9. Recloser

Table 8-31: Criteria for Bushing/Support Insulators

Condition Rating	Corresponding Condition
A	No rust or corrosion on tank and cabinets. Door sealing very effective – no evidence of moisture or insect ingress or condensation. Bushings/support insulators are not damaged. Cementing and fasteners are secure.
B	Minor rust or corrosion on tank and cabinets. No evidence of moisture ingress or condensation in the mechanism box. Bushings/support insulators have minor chips and cracks. Cementing and fasteners are secure.
C	Some rust and corrosion on tank, cabinets and mechanism box and/or evidence of minor moisture leak or condensation. Requires corrective maintenance within the next several months. Bushings/support insulators have major chips and cracks but can still work. Cementing and fasteners are secure.
D	Significant corrosion on tank, cabinets and mechanism box. Defective sealing leading to water ingress and insects/rodent damage. Bushings/support insulators are broken or damaged. Requires immediate corrective action.
E	Corrosion, water, insect, or rodent damage or degradation beyond repair. Bushings/support insulators, cementing, or fasteners are damaged beyond repair.

Table 8-32: Criteria for Control & Operating Mechanism Components

Condition Rating	Component Condition
A	Control wiring, terminal blocks, relays, contactors, and switches all in good condition. Operating mechanism, trip and close coils, motors, compressors, and springs all in good condition. No sign of overheating or deterioration. Linkages, drive rods, and trip latches are clean, lubricated, free from corrosion or racks, distortion, abrasion, and obstruction. The mechanical integrity of dampers/dashpots and oil levels is acceptable. No visible evidence of poor mechanism settings, looseness, loss of adjustment, excess bearing wear, or other out of tolerance operation.
B	Normal signs of wear with respect to the above characteristics.
C	One or two of the above-indicated characteristics are unacceptable.
D	More than two of the above-indicated characteristics are unacceptable.
E	Control and mechanism components are damaged or degraded beyond repair.

Table 8-33: Criteria for Foundation, Support Steel, Grounding

Condition Rating	Component Condition
A	Concrete foundation is level, free from cracks with no evidence of concrete spalling. Support steel and/or anchor bolts are tight and free from corrosion. Ground grid connections to the tank are secure; cabinet supports are free of corrosion.
B	Normal signs of wear with respect to the above characteristics.
C	One of the above characteristics is unacceptable.
D	Two or more of the above characteristics are unacceptable.
E	The foundation, steel supports, or grounding are damaged/degraded beyond repair.

Table 8-34: Criteria for Overall Condition

Condition Rating	Component Condition
A	Breaker/Recloser is externally clean and corrosion-free. All connections are in good condition. No external evidence of overheating. Counter readings for the number of breaker operations and run timer readings on auxiliary motors are in the below-average range for the age of the breaker. Appears to be well maintained with service records readily available.
B	Normal signs of wear with respect to the above characteristics.
C	One or two of the above-indicated characteristics are unacceptable.
D	More than two of the above-indicated characteristics are unacceptable.
E	The circuit breaker is damaged or degraded beyond repair.

Table 8-35: Criteria for Infrared Scan (IR)

Condition Rating	Component Condition
A	No Hotspots detected
C	Minor Hotspots detected; maintenance required during next planned outage
E	Major Hotspots detected; emergency repairs/replacement required

Table 8-36: Criteria for Tank and Mechanism Box

Condition Rating	Component Condition
A	No rust or corrosion on the main tank. No external or internal rust on cabinets. No rust, corrosion or paint peeling on tanks or cabinets. Door sealing very effective – no evidence of moisture or insect ingress or condensation.
B	Minor rust or corrosion on the main tank. No evidence of moisture ingress or condensation in the mechanism box.
C	Some rust and corrosion on both tank and mechanism box and/or evidence of minor moisture leak or condensation. Requires corrective maintenance within the next several months.
D	Significant corrosion on the main tank and on mechanism box. Defective sealing leading to water ingress and insects/rodent damage. Requires immediate corrective action.
E	Corrosion, water, insect, or rodent damage or degradation beyond repair.

Table 8-37: Criteria for Oil Leaks

Condition Rating	Component Condition
A	No evidence of oil leakage at any of the bushing-metal interfaces, flanges, manholes, covers, breathers, pipes, or gauges. Oil levels are acceptable.
B	Minor oil leaks exist, but no moisture ingress likely.
C	Clear evidence of oil leaks, but the rate of loss is not likely to cause any operational or environmental impacts.
D	Significant oil leakage and probable moisture ingress indicate an immediate need for a major reconditioning or replacement.
E	Major oil leakage and moisture ingress resulting in damage/degradation beyond repair.

Table 8-38: Criteria for Vacuum Bottle Integrity

Condition Rating	Component Condition
A	Vacuum bottle areas free of contamination, chips, cracks, flashover burns, or indications of overheating or PD traces. All cemented elements are secure.
B	Normal signs of wear with respect to the above characteristics.
C	One or two of the above characteristics are unacceptable.
D	More than two of the above characteristics are unacceptable.
E	The vacuum bottle is damaged/degraded beyond repair.

Table 8-39: Criteria for Enclosure

Condition Rating	Component Condition
A	The floor is level. Support steel and/or anchor bolts are tight and free from corrosion. Ground connections are free of damage and corrosion and are made directly to enclosure, cabinets; supports without any intervening paint or corrosion.
B	Normal signs of wear with respect to the above characteristics.
C	One of the above characteristics is unacceptable.
D	Two or more of the above characteristics are unacceptable.
E	Enclosure/truck/grounding is damaged/degraded beyond repair.

10. Protective Relay

Table 8-40: Criteria for Visual Inspections

Condition Rating	Corresponding Condition
A	All components are clean; corrosion and leak-free and are in good condition. No external evidence of overheating, deterioration or abnormality or damage. No wear and tear noticeable.
B	Normal signs of wear with respect to the above characteristics.
C	One or two of the above characteristics are unacceptable.
D	More than two of the above characteristics are unacceptable.
E	More than two of the above characteristics are unacceptable and cannot be brought into an acceptable condition.

Table 8-41: Criteria for Service Age

Condition Rating	Corresponding Condition
A	In-service life to design life ratio of 0% to 20%
B	In-service life to design life ratio of 20% to 40%
C	In-service life to design life ratio of 40% to 80%
D	In-service life to design life ratio of 80% to 100%
E	In-service life to design life ratio of 100% or more

Table 8-42: Criteria for Non-Discretionary Obsolescence

Condition Rating	Corresponding Condition
A	The device has available spare parts and meets present system design needs
E	The device does not have available spare parts or does not meet present system design needs

Table 8-43: Criteria for Discretionary Obsolescence

Condition Rating	Corresponding Condition
A	This device can fulfil its role in the present operational environment
B	This device is not of the most current installation type for its present operational environment
C	This device may become obsolete in its present operational environment within the next 5 years
D	This device may become obsolete in its present operational environment within the next 3 years
E	This device is considered obsolete in its present operational environment

11.Station Overhead Switch

Table 8-44: Criteria for Switch or Disconnect Operator Controls

Condition Rating	Component Condition
A	Wiring, terminal blocks, relays, contactors and switches all in good condition. Operating motor, coils, relays, shunt trip (if applicable), auxiliary switches, position indicators, and counters all in good condition. No sign of overheating or deterioration. No evidence of moisture or condensation or insect ingress into a control cabinet.
B	Normal signs of wear present on control components based on the above-listed characteristics.
C	Significant wear of control components based on the above-listed characteristics, but it does not affect the safe operation of the switch or disconnect.
D	Unacceptable level of degradation of control components based on the above-listed characteristics, requiring component replacement/repairs during the next scheduled outage.
E	Switch or disconnect operator controls defective, damaged, or degraded, requiring immediate replacement.

Table 8-45: Criteria for Condition of Switch/Disconnect Blades and Contacts

Condition Rating	Component Condition
A	Switch or Disconnect blades are aligned with no excessive corrosion, or erosion especially at the fault closing (jaw) end. Contact engagement is within tolerance.
B	Minor signs of wear of the switch or isolating disconnect blades, based on the above-listed characteristics.
C	Significant degradation of the switch or disconnect blades, but it does not impact the safe operation of the switch or disconnect.
D	Major degradation of the blades or contacts requiring repairs or replacement during the next scheduled outage.
E	Disconnect blades or contacts damaged/degraded to the point where they require immediate replacement.

Table 8-46: Criteria for Power Train Drive Assembly

Condition Rating	Component Condition
A	Linkages, levers, shafts, pipes, couplers, gearboxes, and stops are clean and free from cracks, corrosion, distortion, abrasion or obstruction. All fasteners are tight. No visible evidence of poor settings, stops/toggle, looseness, loss of adjustment, excess bearing wear or other out of tolerance operation.
B	Minor signs of wear with respect to the above-listed deficiencies.
C	Significant signs of wear with respect to the above-listed deficiencies, but the deficiencies are not critical to the safe operation of the switch or disconnect.
D	Power train assembly components performance degraded requiring replacement during the next scheduled outage.
E	Power train assembly components damaged or degraded beyond repair, requiring immediate replacement.

Table 8-47: Criteria for Connectors and Conductors

Condition Rating	Component Condition
A	All connectors are tight, free from corrosion and show no sign of overheating. Line conductors are adequately supported and impose no excessive loading on switch or disconnect during operating duty.
B	Minor signs of wear with respect to the above characteristics.
C	Significant signs of degradation with respect to the above characteristics, but they do not impact the safe operation of the switch or disconnect.
D	Major deficiencies with respect to the above-listed characteristics requiring repairs during the next scheduled outage.
E	Major deficiencies with respect to the above-listed characteristics requiring immediate repairs or replacement.

Table 8-48: Criteria for IR scans

Condition Rating	Component Condition
A	No Hotspots detected
C	Minor Hotspots/Hotspots on connections detected
E	Major Hotspots detected

Table 8-49: Criteria for Insulators/Porcelains

Condition Rating	Component Condition
A	Insulators are free of damage, chips, cracks, flashover burns, copper splash and copper wash. Cementing and fasteners are secure
B	Minor surface chips and cracks on insulators. No evidence of flashover burns, copper splash or copper wash. Cementing and fasteners are secure
C	Major chips and cracks are present. Some evidence of flashover burns, copper splash or copper wash. Cementing and fasteners are secure
D	Insulators are broken or damaged to a degree that they require replacement during next scheduled outage
E	Insulator cementing or fasteners are broken or damaged, requiring immediate replacement through emergency repairs

Table 8-50: Criteria for Foundation/Support Steel/Grounding

Condition Rating	Component Condition
A	Concrete foundation is level, free from cracks with no evidence of concrete spalling. Support steel and/or anchor bolts are tight and free from corrosion. Ground grid connections to the tank are secure; cabinet supports are free of corrosion.
B	Normal signs of wear with respect to the above characteristics.
C	One of the above characteristics is unacceptable.
D	Two or more of the above characteristics are unacceptable.
E	Foundation, steel supports, or grounding are damaged/degraded beyond repair.

12.Buildings

Table 8-51: Criteria for Roof Condition

Condition Rating	Corresponding Condition
A	Clean and free from signs of deterioration. Roof elements straight and level. Gutters and Spouts in good condition. No leaks are noticeable. Appears 'as new' or to have been well maintained.
B	Normal signs of wear with respect to the above characteristics.
C	One or two of the above characteristics are unacceptable. Minor maintenance suggested.
D	More than two of the above characteristics are unacceptable. Significant maintenance or repair is required.
E	More than two of the above characteristics are unacceptable and cannot be brought into an acceptable condition.

Table 8-52: Criteria for Wall Condition

Condition Rating	Corresponding Condition
A	Clean and free from signs of deterioration. Wall elements straight and level. Paint on surfaces clean and free from cracking, discoloration or flaking/peeling. Caulking, flashings and other seals in good condition. No wall cracks or other damage. Appears 'as new' or to have been well maintained.
B	Normal signs of wear with respect to the above characteristics.
C	One or two of the above characteristics are unacceptable. Minor maintenance suggested.
D	More than two of the above characteristics are unacceptable. Significant maintenance or repair is required.
E	More than two of the above characteristics are unacceptable and cannot be brought into an acceptable condition.

Table 8-53: Criteria for Doors/Windows/Louvres

Condition Rating	Corresponding Condition
A	Clean and free from signs of deterioration. No leaks are noticeable. Paint on surfaces clean and free from cracking, discoloration or flaking/peeling. Locks and mechanisms in good working condition. Appears 'as new' or to have been well maintained.
B	Normal signs of wear with respect to the above characteristics.
C	One or two of the above characteristics are unacceptable. Minor maintenance suggested.
D	More than two of the above characteristics are unacceptable. Significant maintenance or repair is required.
E	More than two of the above characteristics are unacceptable and cannot be brought into an acceptable condition.

Table 8-54: Criteria for Floors/Foundations

Condition Rating	Corresponding Condition
A	Clean and free from signs of deterioration. Floors are straight and level. Foundation is level and free from cracks and spalling. Caulking, flashings and other seals in good condition. No floor cracks or other damage. Appears 'as new' or to have been well maintained.
B	Normal signs of wear with respect to the above characteristics.
C	One or two of the above characteristics are unacceptable. Minor maintenance suggested.
D	More than two of the above characteristics are unacceptable. Significant maintenance or repair is required.
E	More than two of the above characteristics are unacceptable and cannot be brought into an acceptable condition.

Table 8-55: Criteria for Lighting/Power/HVAC

Condition Rating	Corresponding Condition
A	Clean and free from signs of deterioration. Lighting adequate and in good working condition. Electrical wiring and tables, AC and DC in good condition. HVAC in good working condition. Appears 'as new' or to have been well maintained.
B	Normal signs of wear with respect to the above characteristics.
C	One or two of the above characteristics are unacceptable. Minor maintenance suggested.
D	More than two of the above characteristics are unacceptable. Significant maintenance or repair is required.
E	More than two of the above characteristics are unacceptable and cannot be brought into an acceptable condition.

Table 8-56: Criteria for Overall Building

Condition Rating	Corresponding Condition
A	Clean and free from signs of deterioration. Structural elements are straight and level. Paint on surfaces clean and free from cracking, discoloration or flaking/peeling. Caulking, flashings and other seals in good condition. Appears 'as new' or to have been well maintained.
B	Normal signs of wear with respect to the above characteristics.
C	One or two of the above characteristics are unacceptable. Minor maintenance suggested.
D	More than two of the above characteristics are unacceptable. Significant maintenance or repair is required.
E	Buildings or structures damaged/degraded beyond repair.

13.Ground Grid

Table 8-57: Criteria for Ground Grid Installation

Condition Rating	Corresponding Condition
A	Individual yards show considerable conductor redundancy (meshing), adjacent yards interconnected with multiple paths, conductors at a specified depth, sized for fault duty, with an adequate number of ground rods for winter conditions.
B	The installation has minor variations from originally specified or variation is only at isolated locations (1 or 2)
C	The installation has significant variation from original specifications or variation is noted at multiple locations
D	Installation major deviations from original spec or has been significantly damaged
E	Installation is damaged or degraded beyond repair.

Table 8-58: Criteria for Risers/Bonds to Structures/Neutral/Overhead/ Equipment/Ground Wires/Attachment Points

Condition Rating	Corresponding Condition
A	Risers/bonds are in good condition (without any intervening paint or corrosion), mechanically supported, paralleled for redundancy, sized for fault duty, terminated with rated connectors. Check risers on wood poles within the yard.
B	Normal signs of wear with respect to the above characteristics.
C	One of the above characteristics is unacceptable.
D	Two or more of the above characteristics are unacceptable.
E	Two or more of the above characteristics are unacceptable and cannot be brought into acceptable condition.

Table 8-59: Criteria for Buildings, Fences, Gates

Condition Rating	Corresponding Condition
A	Robust conductors are located around the interior perimeter; all panels and equipment are bonded with redundancy, while metallic objects on the roof have lightning protection. Frequent riser conductors thread through fence fabric and are bonded to barbed wire, gates bonded with gradient control grids under swing area.
B	Normal signs of wear with respect to the above characteristics.
C	One of the above characteristics is unacceptable.
D	Two or more of the above characteristics are unacceptable.
E	Two or more of the above characteristics are unacceptable and cannot be brought into acceptable condition.

Table 8-60: Criteria for Condition of Surface Stone

Condition Rating	Corresponding Condition
A	Stone has specified size range and thickness, is free of weeds and contamination by fines, and has proper grading to prevent ponding of water.
B	Minor deficiencies in ground/soil/gravel conditions.
C	Significant variations in the above, corrective maintenance recommended
D	Major variations - corrective maintenance/repair essential
E	Surface stone is damaged or degraded beyond repair.

9 Appendix C – Asset Replacement Plan

Asset Replacement Plan

Disclaimer

This report was prepared by METSCO Energy Solutions Inc. ("METSCO") for the sole benefit of North Bay Hydro Distribution Limited ("NBHDL" or the Client), in accordance with the terms of the METSCO proposal and the Client Agreement.

Some of the information and statements contained in the Asset Replacement Plan ("ARP") are comprised of or are based on, assumptions, estimates, forecasts and predictions and projections made by METSCO and NBHDL. In addition, some of the information and statements in the ARP are based on actions that NBHDL currently intends it will take in the future. As circumstances change, assumptions and estimates may prove to be obsolete, events may not occur as forecasted, predicted or projected, and NBHDL may at a later date decide to take different actions to those it currently intends to take.

Except for any statutory liability which cannot be excluded, METSCO and NBHDL will not be liable, whether in contract, tort (including negligence), equity or otherwise, to compensate or indemnify any person for any loss, injury or damage arising directly or indirectly from any person using, or relying on any content of the ARP.

When considering any content of the ARP, persons should take appropriate expert advice in relation to their own circumstances and must rely solely on their own judgement and expert advice obtained.

Purpose

This plan provides an estimation of asset units that would likely require replacement for the upcoming short-term planning period based on the completed condition assessment.

Approach

The ACA report documents the Health Index distribution for each asset class. For each condition of an asset, a condition-based intervention approach can be applied to assess when assets should be replaced to manage the number of expected failures (Table 1). This is a very general approach to assess a preliminary investment plan which can vary between asset classes. With continuous monitoring and testing of assets, NBHDL will be able to assess the current state condition of the asset population prior to every planning year. The current asset replacement plan prioritizes those assets to be found largely in Poor and Very Poor condition with consideration of assets that are past the reported typical useful life based on the Kinectrics' Asset Depreciation Study for the Ontario Energy Board.

Table 1 - Health Index definition and intervention approach

Health Index (%)	Condition	Intervention Approach
85 - 100	Very good	None
70 - 85	Good	None
50 - 70	Fair	Replace within 3-10 years
30 - 50	Poor	Replace within 1-3 years
0 - 30	Very poor	Replace immediately

Asset renewal can occur from other trigger drivers such as safety factors, meeting standards and working with third parties such as the city, developers, and customer connections. However, these factors are not directly considered within the ARP. Hence, NBHDL's final asset renewal plan may differ slightly as the utility needs to consider all planning aspects and scenarios when putting their plan together.

Additionally, some asset classes may be operated on a run to failure approach. Assets that are operated on a run to failure approach are only replaced once the asset has experienced a failure and can no longer perform its intended function. Typical asset classes found to be on this approach include overhead transformers and overhead switches. Once an overhead transformer is observed to be leaking oil or the switch is severely rusted and cannot perform its function, utilities commonly classify the assets as failed and plan to replace them. This approach lowers the overall renewal budget and maintains the system at current performance and operation levels.

Lastly, overhead conductors are not considered within the asset replacement plan for two reasons. The first reason being the asset class itself is low risk of failure from material degradation. Often overhead conductors fail from external environments such as weather, tree contacts or human interference as well as the failure of surrounding assets such as poles falling and brining the overhead conductors down. The second reason being the economics to optimize the asset intervention does not support to replace individually but rather as part of a larger circuit renewal that considers poles and transformers being replaced as well. Additionally, overhead conductors typically outlive the poles which support them and are replaced when the poles are replaced.

Healthy Asset Classes

Few asset classes are healthy when measured with the current Health Index framework. A healthy asset class can be understood as no unit in the asset class was evaluated to be in Poor or Very Poor condition. However, these assets require continuous inspections to monitor and note any health degradation observed. Asset materials are prone to experiencing degrading conditions and can quickly change from a Good condition grade to a Poor condition within a year. However, this is not commonly observed. Although this plan does not identify an immediate need to replace any units of the above-mentioned asset

classes, it is advised to NBHDL to be diligent in observing changing trends and planning accordingly.

Wood Poles

Table 2 presents the range of wood poles recommended for replacement each year for 2020 to 2025. The identified replacement units can assist with managing the health of the asset population at acceptable levels (i.e. mitigating further deterioration of the population than the current state). The replacement plan leverages the condition of the assets that were calculated with the current Health Index framework and the recent maintenance records. The recommended plan prioritizes those assets that are rated as Poor and Very Poor. Furthermore, it is expected that a small portion of the Fair condition assets can deteriorate to Poor condition or worse by the final year of this program.

Table 2: Estimated replacement units and dollar value for wood poles

Quantity of Assets Recommended for Replacement						
Year	2020	2021	2022	2023	2024	2025
Distribution Poles	95	95	95	95	95	95
Sub Transmission Poles	20	32	32	32	40	40
Estimated Dollar Replacement ($)	$642,000	$782,000	$782,000	$782,000	$875,000	$875,000

Underground Primary Cable

A total of 100 m of underground primary cable is assessed to be in Poor condition. In addition to the health of the cables, NBHDL has underground cables that are beyond their typical useful life and may require intervention if the performance of the cables begins to deteriorate. Specifically, there is approximately 17.2 km in conduit underground cable at or past 40 years of age, which is the reported typical useful life from the Kinectrics' *Asset Depreciation Study for the Ontario Energy Board*. Furthermore, there is approximately 1.79 km direct buried underground cable that will reach 30 years of age within 3 years.

Table 3 presents the range of underground primary cable recommended for replacement each year for 2020 to 2025. The identified replacement units can assist with managing the health of the asset population at acceptable levels (i.e. mitigating further deterioration of the population than the current state). The replacement plan leverages the condition of the assets that were calculated with the current Health Index framework and the recent failure records. The recommended plan prioritizes those assets that are rated as Poor and considers the potential failure of those cables that have passed their typical useful life. Furthermore, it is expected that a small portion of the Fair condition assets can deteriorate to Poor condition or worse by the final year of this program. The estimated replacement units shown in the table below are in alignment with historical and current cable replacement targets and costs.

Table 3: Estimated replacement units and dollar value for underground primary cable

Quantity of Assets Recommended for Replacement						
Year	2020	2021	2022	2023	2024	2025
Units (m)	500	500	500	500	500	500
Estimated Dollar Replacement ($)	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000

Distribution Transformers

Table 4 presents the range of distribution transformers recommended for replacement each year for 2020 to 2025. However, NBHDL adopts a run to failure approach for its distribution transformers which may influence the decision for NBHDL to proactively replace these units. Furthermore, transformers are often combined with pole renewal projects and are replaced if deteriorated significantly. Therefore, the identified replacement units can assist with NBHDL in developing a forecast expenditure needed to support the procurement of the assets. The replacement plan leverages the condition of the assets that were calculated with the current Health Index framework and the recent maintenance records. The recommended plan prioritizes those assets that are rated as Poor and Very Poor.

Table 4: Estimated replacement units and dollar value for distribution transformers

Quantity of Assets Recommended for Replacement						
Year	2020	2021	2022	2023	2024	2025
Units (#)	55	55	55	55	55	55
Estimated Dollar Replacement ($)	$230,000	$230,000	$230,000	$230,000	$230,000	$230,000

Overhead Switches/Conductors/Misc.

Table 5 highlights the estimated investment required on auxiliary assets such as overhead switches, conductors, guys and anchors. These assets are replaced either due to significant deterioration or because NBHDL has planned to replace other assets such as transformers or wood poles and from an efficiency and safety perspective, these assets are replaced simultaneously. The cost estimates are derived based on historical ratios and values experienced at NBHDL for replacing these supporting units to continue the performance of the system.

Table 5: Estimated replacement units and dollar value for auxiliary overhead assets

Quantity of Assets Recommended for Replacement						
Year	2020	2021	2022	2023	2024	2025
Estimated Dollar Replacement ($)	$978,000	$1,028,000	$1,028,000	$1,028,000	$1,061,000	$1,061,000



Appendix D – Renewable Energy Generation Plan

Renewable Energy Generation Investments Plan

Prepared for the

Independent Electricity System Operator

To accompany

North Bay Hydro Distribution Limited's
2020 Cost of Service Application

30 March 2020

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1 INTRODUCTION

North Bay Hydro Distribution Limited ("**NBHDL**") is preparing to file a Cost of Service ("**COS**") Application for the prospective rate year of 2020. In accordance with the Ontario Energy Board ("**OEB**") *Filing Requirements for Electricity Transmission and Distribution Applications*, NBHDL has prepared this Renewable Energy Generation ("**REG**") Investments Plan to accompany its Distribution System Plan ("**DSP**") and COS Application.

This REG Investments Plan provides information on NBHDL's ability to accommodate new REG connections to its distribution system. The purpose of this REG Investments Plan is to inform the Independent Electricity System Operator ("**IESO**") of any REG investments over the DSP period (2020-2025) and to request the IESO to provide a letter commenting on this information.

Section 2 of this REG Investments Plan provides background information regarding NBHDL's distribution system. Section 3 lists the existing and proposed REG connections. Section 4 contains the system assessment to identify constraints. Finally, Section 5 summarizes the proposed investments to facilitate new REG connections.

2 NORTH BAY HYDRO'S DISTRIBUTION GRID

NBHDL is the local distribution company, responsible for electricity distribution in the City of North Bay. NBHDL's distribution network serves a population approximately 54,000 and approximately 24,172 customers. The service area served by NBHDL covers approximately 330 square kilometers, of which 279 square kilometers is rural.

NBHDL receives power form Hydro One at the following Hydro One owned Transformer Stations ("**TS**"):

- 115/44 kV North Bay TS
- 230 kV Trout Lake TS

There are eight sub-transmission feeders operating at 44 kV that supply a total of 17 Municipal Distribution Stations ("**MS**"), where power is stepped down to 4.16 kV or 12.47 kV. Figure 1 indicates the MS locations within the NBHDL service territory and as shown, these MS locations provide good coverage within the entire service territory for renewable energy generation plant connections. Table 1 shows the rated capacities and the peak load served from each MS during the past five years.

Figure 1 – NBHDL MS locations

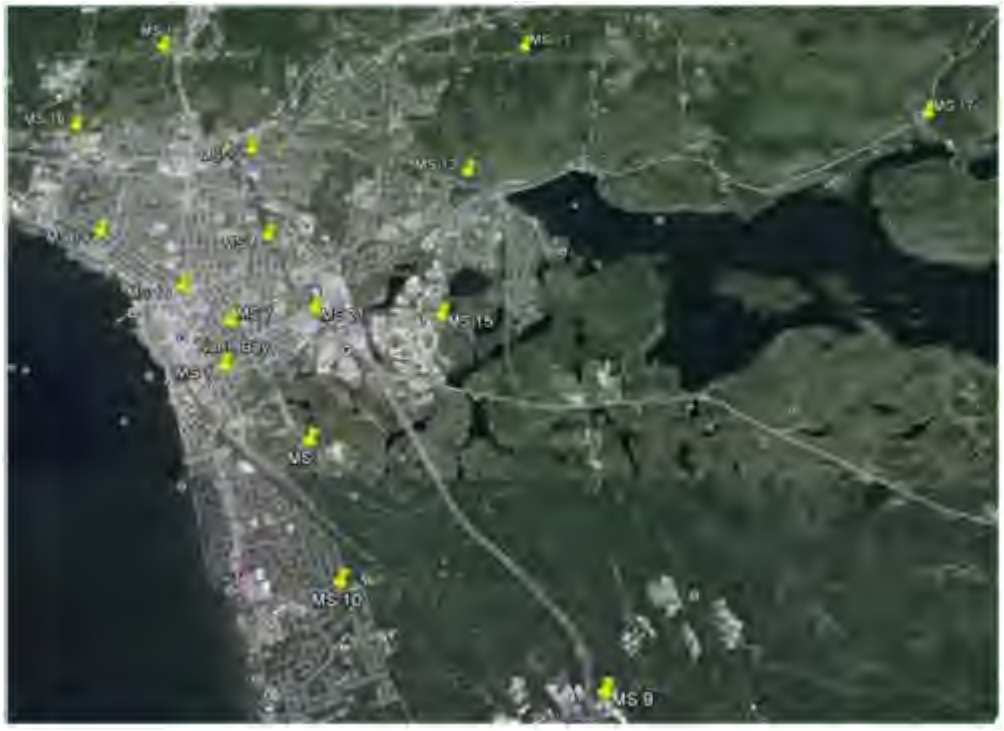


Table 1 – Municipal Distribution Station Capacities and Loads

Distribution Station (12.47 kV)	MVA Rating		Peak Load During Last Five Years
	ONAN	ONAF	
MS1	7.5	10	2.28
MS4	7.5	10	7.24
MS8	7.5	10	5.32
MS10 (T1)	7.5	10	5.36
MS10 (T2)	7.5	10	4.59
MS11	7.5	10	7.76
MS13 (T1)	7.5	10	4.41
MS13 (T2)	7.5	10	5.30
MS14	7.5	10	8.36
MS15	7.5	10	7.86
MS16	7.5	10	6.10
MS17	7.5	10	5.75
MS18 (T1)	7.5	10	7.95
MS19	7.5	10	7.88
MS20	7.5	10	8.59
MS21	7.5	10	7.93
MS22 (T1)	7.5	10	3.12
MS22 (T2)	7.5	10	5.51
MS23	2.5	No fan	0.74
Distribution Station (4.16 kV)	**MVA Rating**		**Peak Load During Last Five Years**
	ONAN	**ONAF**	
MS7	5	6	5.01
MS18 (T2)	7.5	10	4.72

3 EXISTING AND PROPOSED CONNECTIONS

There are a total of 57 renewable energy generation installations presently connected to NBHDL's distribution system under the province's Feed-in-Tariff ("**FIT**") and micro FIT programs, as summarized below and detailed in Table 2 and Table 3, respectively. In summary, the breakdown of these connections are:

- Three FIT installations with generating capacity of 1.88 MW, listed in Table 2
- 49 micro FIT installations with 439.74 kW installed capacity, as shown in Table 3
- One RESOP installation with 10 kW installed capacity
- Five solar net-metering installations with 28.15 kW installed capacity.

In addition to the above, there are 21 micro-Fit installations that are currently registered with IESO but have not yet proceeded to the development stage. There are currently no applications in queue, under the FIT program waiting for connections.

NBHDL provides the last five-year statistics of net-metering services connected to the distribution system in Table 4. Approximately one to two new net-metering services have been installed each year. Hence, NBHDL projects to connect one new net-metering service a year over the 2021-2025 forecast period.

Table 2 – FIT Generation Facilities

S. No.	Fuel Source	kW Rating
1	Solar Power	30
2	Landfill Site	1600
3	Solar Power	250

Table 3 – MicroFIT Generation Facilities

Micro-FIT Reference #	Meter Install Date	Rating (kW)
M398BVN	2010-01-18	10
MHT2DVF	2010-05-13	8
MRTCG3X	2010-06-25	10
MXTD9JV	2010-08-13	10
M3ERPKX	2010-10-28	2.7
MB8I8C2	2010-11-18	10
MP422N8	2010-12-03	4.14
MBEZI3Q	2011-02-10	4.14
MU6YEEB	2011-06-13	8.46
MJT2MR2	2011-09-09	10
MJDDAKJ	2011-12-13	10
M31YDMU	2012-01-09	10
M3NMX47	2012-01-12	10
M2EB668	2012-02-28	10
MPZMKKT	2012-03-20	10

M9M6FT9	2012-03-20	2.6
MQCN8YN	2012-04-27	10
MQF4F2F	2012-07-04	10
MM39FQM	2012-07-05	10
MJIWG4D	2012-10-30	10
MXTPJQI	2012-11-27	8.3
MB8JUWN	2013-01-23	10
MYU6YJC	2013-02-27	10
M2ZPA6G	2013-05-29	10
M3MKIDY	2013-06-12	10
M84JXDZ	2013-06-28	10
MBMFAQN	2013-09-13	10
MJ8V8CI	2013-09-20	5
MXA97NF	2013-10-25	6
MKD2AV8	2013-11-01	5
MDTPJ2C	2013-12-11	5.5
M9BZEBD	2014-11-10	10
MK7W297	2014-12-03	10
MFRWAXY	2015-01-06	10
MGWQH3D	2015-05-20	10
M3XJGZH	2015-06-15	10
MB2IBJF	2015-06-15	10
M9NMV3A	2015-06-15	10
MZ2MVIU	2015-07-29	10
M7UEZB4	2015-08-07	10
MY3DD9Z	2015-08-07	10
M4I6RJR	2015-08-19	10
MAWVK9Q	2015-11-16	10
M9XGXEY	2016-04-22	10
M8HXKPF	2016-04-26	10
M7PP977	2016-07-07	10
MDNW29J	2017-07-07	10
MR3F9AF	2017-10-13	9.9
M9M8UAZ	2018-07-09	10
	Total:	439.74

Table 4 – New Connections for Services over the Historical Period (2015-2019)

Service	2015	2016	2017	2018	2019	
	Count (#)	Count (#)	Count (#)	Count (#)	Count (#)	Installed Capacity (kW)
MicroFIT	43	46	48	48	49	439.74
FIT	3	3	3	3	3	1880.00
RESOP	1	1	1	1	1	10.00
Net Metering - Solar	1	1	4	5	5	28.15

4 SYSTEM ASSESSMENT TO IDENTIFY CONSTRAINTS

Under conservative assumptions of the maximum permissible generation capacity at a distribution station being equal to 60% of the power transformer nameplate rating plus the minimum station load (equal to 15% of station rating) and 90% power factor, the approximate available capacities for connecting renewable energy generation to various municipal stations is indicated in Table 5 and Table 6.

The 12.47 kV and 44 kV feeders employ 336 kcmil and 556 kcmil conductors, respectively, on the main trunk line and these conductors have sufficient thermal rating to permit the connection of the largest Green Energy Generation plant up to 10 MW, allowed under the FIT contracts.

As shown, based on the application currently in hand or anticipated to be received during the next five years, no system constraints exist, preventing the connection of green energy generation developments, within NBHDL's service territory. Therefore, no capital investments are needed for capacity upgrades to facilitate the connection of renewable energy generation plant. However, funds have been budgeted to connect one or two services per year to the distribution grid.

Table 5 – 12.47 kV Stations Distributed Generation Connection Capacity

Distribution Station	MVA rating		Approximate Available Capacity (MW) for Generation Connections	System Constraints for Connection of Generation
	ONAN	ONAF		
MS1	7.5	10	3.38	No Constraints
MS4	7.5	10	6.75	No Constraints
MS8	7.5	10	6.75	No Constraints
MS10 (T1)	7.5	10	6.75	No Constraints
MS10 (T2)	7.5	10	6.75	No Constraints
MS11	7.5	10	6.75	No Constraints
MS13 (T1)	7.5	10	6.75	No Constraints
MS13 (T2)	7.5	10	6.75	No Constraints
MS14	7.5	10	5.55	No Constraints
MS15	7.5	10	6.75	No Constraints
MS16	7.5	10	5.06	No Constraints
MS17	7.5	10	6.75	No Constraints
MS18 (T1)	7.5	10	6.75	No Constraints

MS19	7.5	10	6.75	No Constraints
MS20	7.5	10	6.75	No Constraints
MS21	7.5	10	6.75	No Constraints
MS22	7.5	10	6.75	No Constraints
MS23	2.5	N/A	N/A	N/A

Table 6 – 4.16 kV Stations Distributed Generation Connection Capacity

Distribution Station	MVA rating		Approximate Available Capacity (MW) for Generation Connections	System Constraints for Connection of Generation
	ONAN	ONAF		
MS7	5	6	4.05	No Constraints
MS18 (T2)	7.5	10	6.75	

5 PROPOSED INVESTMENTS TO FACILITATE NEW CONNECTIONS

NBHDL's historical distribution automation and smart grid development initiative required all municipal distribution stations to be equipped with supervisory control and automated data acquisition (SCADA) system by 2015. SCADA technology promoted reliability improvements as well as improved control and monitoring of distribution feeders to which green energy generation plant is connected.

Based on the evaluation of the distribution system to accept green energy generation connections, no constraints have been identified in the system, preventing the connection of renewable energy generation installations. Therefore, NBHDL is not proposing any capital investments for capacity upgrades on the distribution system to accommodate the applications for the connection of renewable energy generation plant, over the next five years from 2020 to 2025. NBHDL projects to connect one new net-metering service a year over the 2021-2025 forecast period.

Appendix E - Fleet Assessment

John Saunders Utility Services

8280 Sideroad 30
R.R. 3, Rockwood, On

Dec. 5, 2013

Background

I have been in the utility industry since 1969, spending 34 years at Guelph Hydro. My position when I retired was Line Superintendent. For the last 20 years there I was responsible for fleet, specifications and budgeting. During this time I sat on the EDA's vehicle advisory committee and became very familiar with utility fleet practices.

Since I retired in 2009, I have assisted Waterloo North Hydro, Haldimand County Hydro and Guelph Hydro with their vehicle specifications and research for fleet replacements.

Industry Practices

Most utilities have adopted the practice of replacing small vehicles between 5 and 7 years and large vehicles between 10 and 14 years. Differences in service territory, hours of use and class of equipment will dictate the differences.

For a medium size utility like yourselves, with your service territory , the fact that most line construction is done in house and after discussions with Paul Ridley, I would recommend that you adopt a 7 year replacement program for most of your small vehicles (less than 8600 lbs.). The large trucks should be on a 12 year replacement , with the exception of your RBD's and large elevator bucket that could be placed on a 15 year replacement because they are not on the same duty cycle as the smaller aerial devices.

Although you have only asked for a five year projection schedule, you cannot get a proper picture of the impacts of deferring vehicle replacement unless you project out at least 12 years. The accuracy on a 12 year projection is still limited to the first 3 to 5 years.

Depending on maintenance cost and condition of the vehicles, they can be adjusted ahead or extended on the replacement cycle if required. Another influence on vehicle replacement would be if you bought a piece of equipment that was too light for the job, or that your construction methods have changed, creating a need for a larger or heavier duty piece of equipment.

While everyone likes to make equipment last as long as possible you want to replace it before any major repairs are required, such as diesel engine, Allison transmission failures or major overhaul of aerials.

The longer you intend to keep your vehicles increases the importance of annual Krown rust proofing programs to limit body and frame corrosion issues. Vehicles on 6 year replacement do not require annual rust proofing but large vehicles on a 12 or 14 year replacement schedule is money well spent, approximately $2,400 over the life of the truck.\

So far, we have only talked about power units and have not touched on trailers or other equipment. Industry wide they are the most neglected pieces of equipment and are often overlooked, until something goes wrong or the MTO writes you up. This is why trailers, stringers and forklifts should be included in any vehicle replacement schedule and placed on a 20 year replacement schedule. Depending on their condition, they can always be extended, and this forces you to evaluate their condition when their time is up and has allocated budget dollars if required. A good example, of how fast the years go by, is you presently have two 1976 trailers in your fleet making them 38 years old.

In summarizing, I have put your vehicles with a GVW weight less than 8600 lbs. on a 7 year replacement schedule with the exception of a couple of lower usage that have been scheduled at 8 years. Large vehicles, over 8600 lb GVW have been put on either 12 or 15 year replacement and trailers on a 20 year schedule.

The accuracy of the projections depends on pricing of the various classes of vehicle being updated annually as well as new vehicle classes being added or deleted. The spreadsheet should be modified at the end of the year to drop the present year off and insert a new column at the end to maintain 12 years of projections.

John Saunders
John Saunders Utility Services

North Bay Hydro Fleet Replacement Projections

Truck #	Year	Make	Model	Description	Department	Life Expectancy	Original YR ('22-'25)		Assumption	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
1	2016	Dodge	Ram	Crew Cab 4x4	ENG. Supervisor	8-12 years	N/A		10	Pickup_L										Pickup_L									
2	2016	Chevrolet	Silverado	4 Door 4x4	Engineering	8-12 years	N/A		9	Pickup_L									Pickup_L									Pickup_L	
3	2016	Chevrolet	Silverado	Crew Cab 4x4	Operations	7-12 years	N/A		8	Pickup_H								Pickup_H								Pickup_H			
4	2008	Ford	F150	4 Door 4x4	Engineering	8-12 years	2024		not to be replaced	spare																			
6	2016	Chevrolet	Silverado	Crew Cab 4x4	Substations	7-12 years	2023		9	Pickup_H									Pickup_H									Pickup_H	
10	2018	Chevrolet	Silverado	4 Door 4x4	Operations	7-12 years	2022	DUTY	7yrs			Pickup_L							Pickup_L							Pickup_L			
11	2019	Chevrolet	Silverado	Crew Cab 4x4	Operations	7-12 years	2025		7				Pickup_H							Pickup_H							Pickup_H		
14	2016	Chevrolet	Silverado	4 Door 4x4	Engineering	8-12 years	2023		10	Pickup_L										Pickup_L									
17	2016	Chevrolet	Silverado	4 Door 4x4	Customer Service	7-12 years	N/A	LOCATES	9	Pickup_L									Pickup_L									Pickup_L	
18	2016	Chevrolet	Silverado	4 Door 4x4	Engineering	8-12 years	2023		8	Pickup_L								Pickup_L								Pickup_L			
20	2016	Chevrolet	Silverado	4 Door 4x4	Metering	7-12 years	2023		7	Pickup_L							Pickup_L							Pickup_L					
21	2019	Chevrolet	Silverado	Crew Cab 4x4	Operations	7-12 years	2025		9				Pickup_H									Pickup_H							
24	2018	Chevrolet	Silverado	4 Door 4x4	Operations	7-12 years	2026	LOCATES	9yrs			Pickup_L									Pickup_L								
25	2012	Chevrolet	Volt	Electric Car	Services	10-12 years	2025		12ys									E_Car											
26	2013	Ford	F150	Ext. Cab 4x4	Metering	7-12 years	N/A		8					Pickup_L								Pickup_L							
27	2014	GMC	Sierra	Ext. Cab 4x4	Operations	7-12 years	N/A		8							Pickup_L								Pickup_L					
28	2015	Chevrolet	Silverado	Ext. Cab 4x4	Operations	7-12 years	N/A		8								Pickup_L								Pickup_L				
29	2015	Chevrolet	Silverado	Ext. Cab 4x4	Engineering	8-12 years	N/A		9									Pickup_L									Pickup_L		
5	2020	Chevrolet	silverado			7-12 years	N/A	NEW SS	9					Pickup_L									Pickup_L						
31	2009	Freightliner	M2 106	Posi Plus 400-46A	Operations	12 Years	2022										S_Bkt_40_												S_Bkt_40_
33	2017	Freightliner	FM2	Telelect 5052 RBD	Operations	15 Years	N/A				H_Dig															H_Dig			
34	2008	Freightliner	M2 106	Posi Plus 500-55	Operations	12 Years	N/A								D_Bkt_68_												D_Bkt_68_		
35	2019	Freightliner	FM2	Telelect 4047 RBD	Operations	15 Years	N/A						M_Dig															M_Dig	
38	2009	Freightliner	M2 106	Posi Plus 400-50A	Operations	12 Years	2021											S_Bkt_50_											
43	2012	Freightliner	M2	Altec TA-40	Operations	12 Years	2025							S_Bkt_40_												S_Bkt_40_			
44	2012	Freightliner	M2	Altec TA-40	Operations	12 Years	2026									S_Bkt_40_												S_Bkt_40_	
45	2015	Freightliner	M2 112	Posi - 83'	Operations	15 Years	N/A														D_Bkt_83_								
Fork Lift					Operations	20 years						Fork_Lift																	
				Trailers																									
T1	2006	Timberland	DPT30-B	Stringer	Operations	18 Years	stagger							Stringer															
T2	2008	Timberland	DPT30-B	Stringer	Operations	18 Years	stagger							Stringer															
T3	1976	King	30TH-108	Reel Trailer	Operations	25 Years	not to be replaced																						
T4	2011	CZENG30KP		Pole Trailer	Operations	20 Years																			Pole Trailer				
T5	2011	Brooks		Double Reel Trailer	Operations	20 Years																			Double Reel Trailr				
T6	2011	American Falcon		Closed In Trailer	Operations	20 Years																			Closed In Trailer				
T7	2015	Dura Trail	16'	Material Trailer	Operations	20 Years																						Material Trailer	
T8	2015	Dura Trail	4x8	Material Trailer	Operations	20 Years																						Material Trailer	
Estimated Year Total Vehicle Cost ($):										$342,188	$400,000	$174,396	$367,000	$523,987	$464,143	$381,420	$441,068	$643,107	$224,605	$173,893	$738,875	$123,484	$58,583	$119,509	$193,940	$1,201,499	$724,982	$1,202,996	$427,433

Appendix F – Building Assessment + Table

Induspec
engineering profitability

Bertrand Wheeler architecture inc.

Building Condition Assessment

Head Office - North Bay Hydro

74 Commerce Crescent
North Bay, Ontario



Submitted to:
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1 Introduction

Purpose

The contents of a Building Condition Assessment (BCA) are commonly produced to provide relevant building condition information along with financial information regarding short and long term operation and maintenance costs of a building. The ultimate goal of a BCA is to facilitate the normalization of annual expenditures by estimating budgetary costs and predicting the optimal timing of anticipated maintenance works. In conjunction with expert knowledge, this approach is intended to ensure that serviceability functions and required safety standards of the building are met.

The findings and recommendations of the BCA are summarized in a Building Condition Report (BCR) to be used as an information resource and reference for the client.

Description of Property

The subject property includes a commercial office space, equipment storage, and vehicle maintenance facility located at 74 Commerce Crescent in North Bay, Ontario. The original construction of the facility was in the late 1970's and became the head office for North Bay Hydro in 2002. The original prefabricated steel building now consists of a garage area and stores (12,100 ft^2), as well as two storeys of office space (4,000 ft^2 each floor). A building addition was constructed on the south side of the building, reportedly in the mid 1980's (2,200 ft^2) and generally consists of washrooms, rest areas/locker room and a lunch room. Another building addition was constructed on the east side of the original building in 2009 (1,100) known as the meter shop. The front area of the property includes approximately 50,000 ft^2 of paved surface, and the rear consists of a storage area of approximately 110,000 ft^2 enclosed by a chain-link fence with a paved apron adjacent to the building of approximately 14,000 ft^2.

Considerations & Limitations

In order to prepare this BCR for the property the following work was performed:

- Site visits on October 8th, October 16th, October 18th, October 30th and November 13th, 2019 to inspect and record information regarding representative building elements (units, common spaces, storage spaces, electrical rooms and mechanical rooms), including interior and exterior features.
- Interview with facility maintenance staff, Jeff Smith on October 8, 2019.
- Thermographic imaging of the building exterior, roofs and electrical switchgear.
- Reviewed available technical drawings.
- Prepare an inventory of relevant building features and components.
- Procured or provided budgetary cost estimates for anticipated maintenance works.

- Prepare summary spreadsheet identifying the timing for execution of work, resolved into 0-5, 6-10 and 11-20 year timelines; based on architectural and engineering experience, thermographic imaging and the information available at the time the BCA was performed.

The conclusions of this report are partly based on extensive, albeit non exhaustive, evaluations of building features and components performed during walkthroughs and thermal imaging surveys. Exact timing of future maintenance works should be corroborated with additional inspections by competent persons immediately prior to their undertaking. Omission of features and components within the inventory of this report shall not be interpreted as; confirmation of irrelevance, satisfaction of mandated safety requirements, or good physical condition.

Induspec provides this BCR in accordance with the recommendations stipulated under ASTM E2018 - Property Condition Assessments: Baseline Property Condition Assessment Process.

This report also includes the results of thermographic inspection of electrical panels throughout the subject property, building roofs and building exterior. These inspections were performed to complement the building condition assessment. For the electrical panels it identifies circuits which may be overloaded and/or loose circuits within electrical panels. For the building roofs it helps verify roof condition by identifying areas of significant heat loss and potentially damp insulation. For the building exterior it identifies areas of significant heat loss and assists with confirmation of the condition of the building envelope, windows and doors. The observations and recommended actions regarding potentially problematic areas are identified in the physical assessment section of this report. The detailed thermographic inspection reports are provided as appendices to this report.

Use of Report

This report shall not be used for purposes other than to provide guidance as part of a long-term financial strategy regarding building operation and maintenance. The estimated replacement costs and anticipated replacement timings are based on information which is subject to varying margins of errors and uncertainty. The contents of this report should be considered in their entirety; limited or partial consultation of the information provided may lead to inaccurate conclusions or unfavourable results.

Induspec shall not be responsible or considered liable for any interpretation of the contents of this report in any way.

Signatures

The following staff at Induspec were involved in the preparation of this report.

Field observations performed by:
BWA
- Brian Bertrand, B.E.D.S., B. Arch., O.A.A., FRAIC
- Kaemon Dubeau

Induspec
- Dave Smits, P.Eng.
- Thorsten Brost, P.Eng., CMVP, CEM
- Réaume Brazeau-Gauvreau, B.Eng.

Property condition assessment report prepared by:
- Brian Bertrand
- Dave Smits
- Réaume Brazeau-Gauvreau

Property condition assessment report approved by:
- Brian Bertrand
- Dave Smits

2 Methodology & Approach

Introduction

This Building Condition Assessment (BCA) is intended to document the current condition of assets of the property in order to anticipate the timing and magnitude of future capital repairs and replacements. These costs do not include what should be considered routine on-going maintenance. The timing of the repairs and replacements are based on the current condition of each asset while considering their attributed priority from a property serviceability and life-safety standpoint.

Life Expectancy / Repair Cycle

Each asset is attributed an expected lifespan or repair cycle. The life expectancy of an asset applies for those assets whose lifecycle is expected to be less than the lifespan of the facility. These assets are presumed to require a complete replacement or major repair at the end of their service life. Alternatively, for those assets which are expected to last at least as long as the facility, a repair cycle is presumed. The repairs for these latter assets are generally cyclical in nature.

Both types of assets are generally attributed with an estimated lump-sum or recurring cost for the replacement/major repair, or for the repair cycle. These life expectancies and repair cycles are based on industry standards and professional experience, and may be adjusted based on the observed condition of the asset during the BCA walkthrough.

Cost Estimates

The cost estimates provided in this Building Condition report are based on the original cost of the asset or the anticipated in-kind replacement at the time that this report was prepared. The anticipated costs for the target periods of 0-5 years, 6-10 years and 11-20 years are the expected future costs based on current costs factored by an annual inflation rate of 2%. These costs may be included to cover replacement, repair, or a periodical allowance for as-needed repairs.

Asset Condition

In order to categorize the condition of the assets of a property, the following standard labels are used in this BCR:

Good:
The asset appears to be in new, refurbished or recently-repaired condition. There are no significant observe deficiencies, and no imminent repairs are anticipated to be necessary. However, assets in ‘good’ condition may still require capital expenditures by the end of the study period of the BCA (20 years).

Fair:
The asset appears to be in a condition which is consistent with its age. Some deficiencies may be apparent, but they are not severe nor do they impair the function of the system in any major way.

Poor:
The asset appears to be defective or deficient for its intended purpose. Major repairs or replacement is expected to be required in the immediate term or in the near future.

It should be noted that the condition of an asset does not necessarily reflect the chronology or priority in which it should be replaced or repaired. This evaluation is considered in the 'priority' of the asset.

Priority

The priority evaluation of an asset is provided to justify or complement the justification for the urgency maintaining an asset in working condition. A single asset may be attributed more than one priority label. The priority categories are as follows, from most to least urgent:

Class A - Life Safety:
The asset must be maintained in working condition to prevent loss of life. Any replacement or repairs which are required should be considered paramount in importance and urgency.

Class B - Structural Integrity:
The asset is a component of the building structure and its failure could pose a significant risk to the safety of occupants. Any replacement or repairs which are required should be addressed immediately.

Class C - Legislative Requirements:
The asset is in need of modifications or upgrades to ensure that it meets the current applicable codes and standards.

Class D - Building Functionality:
The asset provides an integral function for the intended purpose of the building. The deterioration of the asset is not expected to expose the occupants to safety risks, although the serviceability of the building may be affected and productivity may decline as a result.

Class E - Cost-Effective Upgrades:
The asset is not essential to the safety of occupants or the function of the building. Any repairs or upgrades could be considered to be merely aesthetic.

3 Physical Assessment

General

This section of the report summarizes the observations recorded during the Building Condition Assessment walkthrough, as well as any relevant information that was obtained from asset documents and specifications where available. It should be noted that asset defects or deficiencies which can be addressed via normal routine maintenance are generally not included in the observations of this report.

Description of Property

The subject property includes a commercial office space, equipment storage, and vehicle maintenance facility located at 74 Commerce Crescent in North Bay, Ontario. The original construction of the facility was in the late 1970's and became the head office for North Bay Hydro in 2002. The original prefabricated steel building now consists of a garage area and stores (12,100 ft^2), as well as two storeys of office space (4,000 ft^2 each floor). A building addition was constructed on the south side of the building, reportedly in the mid 1980's (2,200 ft^2) and generally consists of washrooms, rest areas/locker room and a lunch room. Another building addition was constructed on the east side of the original building in 2009 (1,100) known as the meter shop. The front area of the property includes approximately 50,000 ft^2 of paved surface, and the rear consists of a storage area of approximately 110,000 ft^2 enclosed by a chain-link fence with a paved apron adjacent to the building of approximately 14,000 ft^2. The rear yard also contains two uninsulated wood frame/metal clad buildings both of which are in reasonable condition for their intended service.



Existing Building and the Ontario Building Code

(Section 3.8 Accessibility)

As with all existing buildings in the province of Ontario, existing buildings are considered "grandfathered in" when considering existing conditions. Typically an owner cannot be forced to upgrade items to meet current standards for bona fide work completed under a previous building permit.

With this perspective it must be noted that several areas do not meet current accessibility standards within Section 3.8 of the Ontario Building Code. Kaemon Dubeau (BWA) performed an on-site review with his observations offered below. This is not intended to be an exhaustive list as the building is technically compliant. These are being offered for NBH's reference and as a starting point should an in-depth study be undertaken.

1. Accessible Entrance: Path of travel obstructed to barrier free entrance by structural column and metal gates. Barrier free door only 845mm (Code states 860mm door). Old power door operator style buttons.
2. Vestibule Entrance Corridor: Obstructed path of travel reduces path to 880mm (Code states 1100mm is required).
3. Office Area Stair #1 – Does not meet required accessible code due to: lack of tactile strips, tactile indicators, or contrasting colours. Handrail only on one side. Door swings into area at top of stair landing.
4. Office Area Stair #2 – Does not meet required accessible code due to: lack of tactile strips, tactile indicators, or contrasting colours. Handrail only on one side.
5. Kitchen: Sink area does not meet accessible space required by code, turning radius not provided, adequate path of travel is not provided.
6. Universal Barrier Free Washroom: Does not meet several accessible requirements. Door 760mm (860mm required), obstructed path of travel. Door hardware knob (latch is required). Sink does not meet required accessible space for turning.
7. Barrier Free Washroom (Women's): Existing shower does not meet accessible code. Sink does not meet accessible code.
8. Coat storage does not meet code. Path of travel only 720mm, (900-1100mm required).
9. All door hardware is knob type, to be latch handle.
10. Low lighting levels in some offices and corridors.
11. No elevator for second level.
12. Photocopy room path of travel restricted to less than 860mm (900-1100 preferred) with proper accessible space.

1.0 Site (BWA/Induspec)

Topography/Storm Water Drainage/Ingress & Egress

1. Comments

The property is located on relatively flat grade. Storm water drainage is provided by trenches along the eastern and southern edges of the property and no standing water was observed. Vehicle access to the property is provided by two paved entrances on the southeastern and southwestern boundaries of the property. No catch basins were observed and slopes appear to be minimal with regards to drainage.



Paving - Front Parking Lot

1. Comments

The front of the property consist of a paved surface which includes approximately 65 parking spaces. The vast majority of the paved surface is used for vehicular circulation (~75%), while the remainder is used for parking. The pavement appears to have been replaced recently and no significant deficiencies were observed. The asphalt surface abuts the building at the base flashing line. The proximity has caused deterioration problems on the building facade.

2. Recommendations

Consider implementing 2'0" french gravel drain around perimeter of building complete with curbs to keep traffic, snow/salt away from building. Install bollards as required for metal corner protection. This french drain could also be used to redirect the eaves trough downspout that is serving the Addition on the Southside.

Landscaping & Paving - Enclosed Outdoor Storage Area

1. Comments

The rear of the property consists of a large enclosed outdoor storage area which is accessed via a powered sliding gate on the western side, or through the garage area of the main building. The majority of the enclosed area is unfinished natural surface or gravel, while a smaller area of asphalt pavement is located immediately adjacent to the building (14,000 ft^2). The asphalt apron (north side of building) is in poor condition and exhibits areas of deterioration. Concrete patio stones in front of meter shop were also observed as cracked and deteriorated. Vegetation/moss is growing along connection of asphalt to building.



2. Recommendations

The asphalt apron and broken patio stones should be repaired or replaced.

Chain-link Fence - Enclosed Outdoor Storage Area

1.0 Comments

The rear storage area is completely enclosed by a secure, galvanized steel, 8-foot chain-link fence. The fence is approximately 1,200 ft in total length and is in generally good condition.

A cost is included for the ongoing maintenance of the fence.



Signage - Site Identification

1.0 Comments

There is a site identification sign at the southwestern edge of the property that is in generally good condition.



Bollards - Main Entrance

1.0 Comments

There are fixed steel bollards installed on the western side of the building in the parking lot near the main entrance. The base of the bollards appears to be somewhat corroded and the paint is showing signs of wear.

2.0 Recommendations

These deficiencies should be addressed as part of routine maintenance.



Outdoor Storage Shed (Cold Storage)

1 Comments

There is a separate small building which is used to store equipment and materials while shielding them from the elements. The building is not temperature-controlled and is of timber frame construction. It can be accessed via conventional doors or multiple overhead doors. No significant deficiencies were observed although the light fixtures appear to be outdated (T-12s) and could be replaced with more energy efficient models.



2 Recommendations

A cost is included for the repair/ replacement of the personnel door and garage doors in years 6-10. Recommend that the lighting be changed to a more efficient type the next times the bulbs/ballasts needs to be replaced.

Telecommunications Antenna

1.0 Comments

There is a large galvanized steel-truss antenna installed at the read of the main building. The structural frame of the antenna appears to be in fair condition. A cost has been included for the eventual replacement of the antenna.



2.0 Structure (BWA/Induspec)

Steel Structure - Original Building

1.0 Comments

The original building superstructure is of the prefabricated steel building type. The columns and major roof beams appear to be moment-connected plate girders. The structure was observed to only be visible from inside the vehicle storage area. No structural deficiencies were apparent.



Concrete Masonry - Original Building

1.0 Comments

A concrete masonry wall separates the eastern garage area from the western office space. No structural deficiencies were apparent. The 2013 BCR identified a crack in this wall but it was not observed during this inspection so it has either been repaired or is very minor in nature.



Concrete Slab - Vehicle Storage

1.0 Comments

The concrete foundation is used as an unfinished floor for the vehicle storage area. Water runoff drains appear to have been integrated into the concrete slab as part of the original construction. No structural deficiencies were apparent.



Concrete Slab - Stores

1.0 Comments

The concrete foundation is used as a floor surface in the stores. The floor seems to have been re-levelled in the past and painted. The joints between the old and new cement were observed to have cracked and has even spalled in a few locations. Some cracked locations may be considered a tripping hazard.



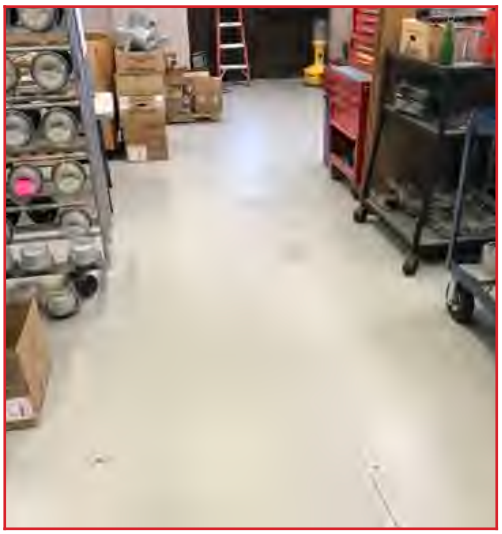
2.0 Recommendations

A cost is included to repair the floor surface in the stores.

Concrete Slab - Meter Shop

1.0 Comments

The concrete foundation is used as a floor surface in the meter shop. The floor appears to be in good condition.



Foundation Flashing - Addition on Southside

1.0 Comments

It appears that a base flashing has been applied over top of the protruding foundation wall in front of the split face block. While the intent of sill flashing is to shed water away from a wall the flashing has been applied in such a manner that it is horizontal from the wall. In some instances it slopes backwards to the wall. In addition the flashing has been damaged by vehicular wear and tear over time.



2.0 Recommendations

Repair base flashing. 45° slope over cant strip away from building.

Steel Columns & Footings - Visitor's Entrance

1.0 Comments

The small canopy above the visitor's entrance on the western side of the building is at least partially supported on two steel columns bearing on concrete footings. The bottom of the steel posts have begun to corrode noticeably. The top surface of the concrete footings were observed to have spalled along the edges.



2.0 Recommendations

A cost is included to refurbish the posts and install flashing to protect the footings.

Steel Structure - Rear Lean-to

1.0 Comments

There is a partially enclosed structure which is used to house the emergency generator, as well as store miscellaneous equipment on the north side of the building, which is attached to the original building. The structure appears to be of the prefabricated steel building type. Access to the interior of the space is restricted via locked chain-link fence gates. The steel frame appears unfinished and slightly corroded.



2.0 Recommendations

A cost is included for further inspection the Lean-To and replacement of its roof.

Concrete Footing - Telecoms. Antenna

1.0 Comments

There is a small concrete footing used to anchor the telecommunications antenna at the rear of the building. The concrete appeared to be slightly deteriorated.



2.0 Recommendations

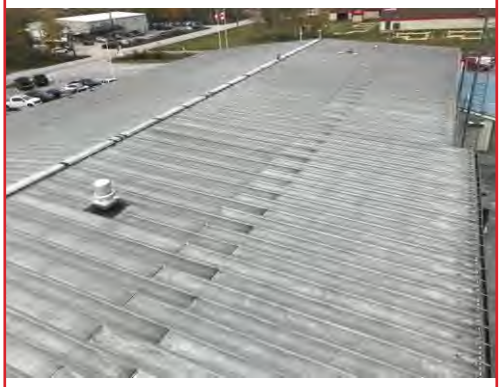
A cost is included to repair the concrete footing.

3.0 Building Envelope (BWA/Induspec)

Main Building Roof - Exterior

1.0 Comments

The main building roof (~ 18,000 ft^2) is constructed of a 24 gauge (0.022" thick) metal roof which appears to be galvanized steel. The roof appears to be original to the building and is in generally good condition with a potential remaining life of 15 - 20 years. Fasteners and peak flashings have been sealed with caulking and this caulking is failing.



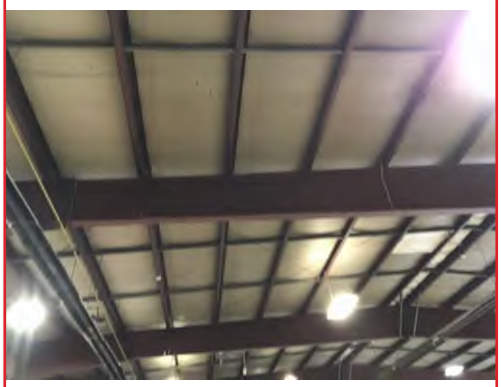
2.0 Recommendations

Fasteners under caulking have dried out or missing washers and should be replaced. Eavestroughs along the north and south sides appear to be in good condition although there are signs of rust on the underside of the eaves. A maintenance cost for this roof is included.

Main Building Roof - Interior Insulation

1.0 Comments

The interior of the main building roof appears to be original to the building. Anecdotally, there does not appear to be an ongoing issue with routine roof leaking. Some evidence of water infiltration into roof insulation was noticed. See the attached roof thermography report for further information. Insulation appears to be 4" ± bag insulation with an estimated insulation value of <R8.



2.0 Recommendations

A maintenance cost for the interior portion of this roof is included.

Meter Shop Roof

1.0 Comments

The meter shop roof (~ 1,600 ft²) is constructed of what appears to be 26 gauge (0.018" thick) steel with an anodized finish and is in generally good condition. Some evidence of previous roof modifications or repairs exists. Neoprene washers are dried out or missing.



2.0 Recommendations

Fasteners should be replaced. An eave flashing appears to have slipped leaving an unprotected opening and this issue should be corrected forthwith.

Addition on Southside - Roof

1.0 Comments

The south office roof (~ 2,400 ft²) appears to be constructed of a non-typical modified bitumen material with a subsequent coating addition. The roof appears to have had relatively extensive patching and thermography indicates that there is water infiltration into the roofing system.



2.0 Recommendations

The south office roof should be replaced within the next five (5) years and a replacement cost is included. Further information can be found in the roof thermography report presented within appendices.

Addition on Southside - Eaves Trough, Downspout and Soffit/Fascia

1.0 Comments

The eaves trough on the south-side of the building is damaged and the down spout discharges next to the split masonry wall causing erosion.



2.0 Recommendations

Repair eaves trough and review options to redirect downspout. Install snow retention chevrons to reduce risk of ongoing damage to eaves trough.



Main Building - Metal Siding





1.0 Comments

The majority of the existing building including the additions is generally metal siding. The siding has somewhat faded in colour over time but is still intact. It appears in fair condition except for the condition at the base of the wall panels. The base drip flashing is directly at grade where asphalt abuts the building. Best practices usually dictates grade is 8 to 10" below base drip line. The as-built condition has led to major rusting and corrosion of the bottom of the metal panels. This condition exists over at least 45% to 50% of the exterior wall. As corrosion continues it will impact the integrity of the entire wall panel which rests on the foundation. As well, it will allow moisture to migrate through the wall at the base. Painting the walls will bring back colour but not arrest corrosion. More invasive work will be required. In several instances these panels have random holes which have been abandoned and left open. They require attention and patching. Unprotected corners at metal siding have also been damaged from vehicular or heavy object movement. In some instances damage is just visual, in others it has penetrated siding. At the main entrance, asphalt has been graded to ramp to door sill. In turn, it covers base sill metal flashing.

2.0 Recommendations

Repairs or replacement are required to ensure more severe long term damage does not continue. Asphalt perimeter parking lot could be altered to assist in protecting metal siding. (See 1.2 regarding French drain).

Windows & Personnel Doors

1.0 Comments

In general, the windows and personnel doors throughout the facility appear to be of original construction relative to the section of the building they are installed in. A thermographic inspection was completed of the exterior of the building and this can be found as an appendices to this report. This report identifies a variety of deficiencies that need to be addressed. The caulking around windows and doors and other building penetrations was found to be failing in a number of locations.



2.0 Recommendations

Consider replacement of windows based on their age and results of the thermographic inspection. Also ensure that the sealing elements on windows and doors receive routine maintenance. Review flashing on windows to ensure that it is sloped appropriately to shed water. Review and repair damaged caulking associated with all windows, doors and other wall penetrations.



Garage Doors

1.0 Comments

In 2014, two garage doors were replaced. The last Architectural Building Condition Assessment (2013) recommended all be replaced. The lifespan of the new overhead garage door with moderate usage is anticipated to be 20 years.

Refer to Thermographic Inspection report for more information.



2.0 Recommendations

Replace doors as condition warrants. Service seals to improve energy performance.

4.0 Interior Elements (BWA)

Millwork

1.0 Comments

Millwork remains in generally reasonable condition having been replaced 10 to 11 years before. Original millwork with heavy usage would probably have a life span of another 4-5 years, light usage could extend life span. The millwork in the washroom areas including washroom accessories have been upgraded. These items are at the beginning of their life cycle and have another 15-18 years.

Maintain as required.



Interior Doors - All Sections

1.0 Comments

Interior doors are mostly hollow metal construction on the ground floor and are in good shape. With proper care and maintenance, life expectancy is unlimited. The 2nd floor office area consists of hollow metal frames with hollow core wood doors, which have been recently installed and painted and should last beyond the replacement program.

Maintain as required.



Flooring - All Sections

1.0 Comments



The type of flooring product through the facility varies depending on location. The entire garage area and east addition are concrete floors which will last the life of the building.

The other areas of the building have the following flooring finishes:
1. Office Area 1st Floor - Carpet tile, select areas of vinyl tile and ceramic tile within the main entrance area.
2. Office area Upstairs – Carpet tile with select areas of vinyl tile.
3. Front Addition (South) – Vinyl tile with area of original ceramic tile.
4. The flooring in the change rooms and washroom areas have not been changed and upgraded. The existing tile flooring appears in reasonable condition.

Proper maintenance will prolong lifespan of all of the flooring products.

Ceilings - Main Building (1st and 2nd Floor)

1.0 Comments



Within the offices there are minor areas of ceilings which are surfaced with gypsum board, including some bulkheads, vestibule ceilings and main entrance areas. The remainder of the office area is T-bar type ceiling. T-bar ceiling with proper building conditions will last indefinitely; the only reason for replacement would be damage from some event or aesthetic replacement.

It was observed level 100 T-bar ceiling is in good condition. The T-bar ceiling on level 200 exhibits some damage and water staining.

1.0 Recommendations

Damaged and stained tiles on level 200 should be removed and replaced.

Ceilings - Addition on South Side

1.0 Comments

The south addition (change area) has original drywall ceilings throughout most of the area with a stipple surface. The washrooms which were upgraded recently have experienced drywall repairs or replacements, (could not be determined) and have a flat painted finish. The drywall in all areas within this portion of the building is in good condition and will last for years to come with some maintenance and painting.

Acoustical Sound Isolation

1.0 Comments

Walls between offices (level 200) are not acoustically separated. Walls extend to joist above the suspended ceiling tiles. The ceiling space is utilized as a return air plenum.

Substantial rework with wall construction / isolation acoustic batts, ductwork insulation and specialty acoustic design would be required to remedy the situation.

2.0 Recommendations

If this is a significant issue a specific study should be undertaken to determine the best way to address this.

5.0 Mechanical (Induspec)

5.1 Plumbing System

5.1.1 Water Supply Piping & Meter - Domestic Water

1.0 Comments

The domestic water for the building is supplied by underground piping whose condition is not known. No issues were reported and failure is generally unpredictable.

An allowance is provided to repair the buried water supply piping.

Sanitary Drainage Piping

1.0 Comments

The type and condition of the sanitary drainage piping is not known. No issues were reported.

An allowance is provided to repair the buried sanitary drainage piping.

Piping - Domestic Water System

1.0 Comments

Based on the visible piping in the mechanical room, as well as those entering or exiting hot water heating tanks, the piping is typically of copper material. Hot water pipe typically requires more frequent maintenance than cold water pipes. Neither the cold or hot water piping appears to be insulated, and it is expected that the majority of the piping is of the same age as the building.

An allowance is included to perform repairs/replace a portion of the domestic water piping in the next five years.



Hot Water Tank - 1st Floor (Change Area)

1.0 Comments

There is a 74 gal_{US} electric-powered hot water tank that serves the men's and women's washrooms in the change area addition. Model 172E-3F7M-CC, serial# A 9189195, 4500 W, 18.75 A, 240 VAC, 1-PH, 60 Hz. The tank appears to be in good condition and was installed in February 2019.

A cost is included to replace the hot water tank.



Hot Water Tank - 1st Floor (Offices)

1.0 Comments

There is a 12 gal_{US} electric-powered hot water tank that serves the office area washroom sinks. Model SS12SEB15, serial#1407J007170, 1500 W, 120 VAC. The tank appears to be in good condition and is roughly 5 years old.

A cost is included to replace the hot water tank.



Hot Water Tank - 2nd Floor (Offices)

1.0 Comments

There is a 12 gal_{US} electric-powered hot water tank that serves the office area washroom sinks. Model SS-12SEB-15, serial#1834111642542, 1500 W, 120 VAC. The tank appears to be in good condition and is only approximately a year old.

A cost is included to replace the hot water tank.



Hot Water Tank - Stores

1.0 Comments

There is a 6 gal_{US} electric-powered hot water tank that serves the stores area. Model SS06SEB015, serial#1544J007269, 1500 W, 120 VAC. The tank appears to be in good condition and is approximately four years old.

A cost is included to replace the hot water tank.



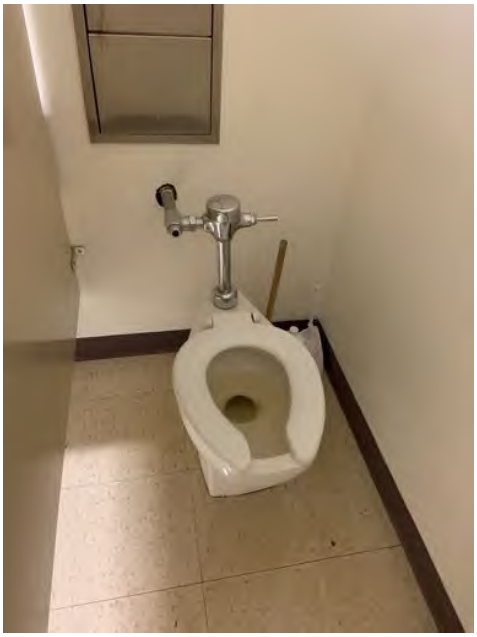
5.1.2 Plumbing Fixtures

1.0 Comments

Fixtures throughout the facility are of various ages but generally in good condition. Many of the fixtures have standard flow faucets/flush valves. Low flow fixtures should be considered when renovations are completed in the future as per the washrooms in the Addition on Southside.







5.1.3 HVAC Equipment

Air Handling Unit - #1

1.0 Comments

The second floor ‘interior’ area of the main building is climate controlled via a Lennox air handling unit, model LGH048S4TH2Y, serial# 5613L07130, gas-fired heating capacity 120 MBH at 80% efficiency, 49 MBH cooling capacity, SEER: 15, EER: 12.5. The unit is 6 years old and appears to be in good condition. The air intake screens were observed to be obstructed by dust and debris as well as slightly damaged and should be cleaned and repaired as part of routine maintenance.

A cost is included for the replacement of the AHU at the appropriate time in the future.



Air Handling Unit - #2

1.0 Comments

The second floor ‘exterior’ area of the main building is climate controlled via a Lennox air handling unit, model LGH036S4TU2Y, serial# 5613L07128, gas-fired heating capacity 84 MBH at 80% efficiency, 34.8 MBH cooling capacity, SEER: 15, EER: 11.6. The unit is 6 years old and appears to be in good condition. The air intake screens were observed to be obstructed by dust and debris as well as slightly damaged and should be cleaned and repaired as part of routine maintenance.

A cost is included for the replacement of the AHU at the appropriate time in the future.



Air Handling Unit - #3

1.0 Comments

The first floor 'interior' area of the main building is climate controlled via a Lennox air handling unit, model LGH060S4TH2Y, serial# 5613L07127, gas-fired heating capacity 120 MBH at 80% efficiency, 60 MBH cooling capacity, SEER: 15.5, EER: 12.5. The unit is 6 years old and appears to be in good condition. The CO2 levels in the area served by AHU#3 were observed to be in excess of 1000 ppm in a number of areas. The recommended maximum for C02 is 800 ppm. The level had dropped to less than 600 ppm when the area was resurveyed a short time later.



2.0 Recommendations

Investigate system operation to confirm cause of elevated C02 levels. A cost is included for the replacement of the AHU at the appropriate time.

Air Handling Unit - #4

1.0 Comments

The first floor 'exterior' area of the main building is climate controlled via a Lennox air handling unit, model LGH072H4BH2Y, serial# 5613L07129, gas-fired heating capacity 120 MBH at 80% efficiency, 60 MBH cooling capacity, EER: 12. The unit is 6 years old and appears to be in good condition. The air intake screens were observed to be obstructed by dust and debris as well as slightly damaged and should be cleaned and repaired as part of routine maintenance.

A cost is included for the replacement of the AHU at the appropriate time.



HVAC Control Panels - Mechanical Room (AHU #3 & #4)

1.0 Comments

Control modules for AHU #3 and #4 are installed on the first floor in the mechanical room of the main building. Similar units for AHU #1 and AHU#2 are installed on the second floor. These units are 6 years old and appear to be in good condition.

A cost has been included for the replacement of the controls at the appropriate time.



Ducting - Main Building Exterior

1.0 Comments

Air handlers #1 through #4 are connected to the building using insulated rectangular galvanized steel ducting supported by pre-fabricated galvanized steel component frames. The exterior ducting assembly appears to be in generally good condition. Water was observed leaking from the duct work enclosure well after the last rain event so it appears the duct work is leaking and retaining water.



2.0 Recommendations

Investigate duct work to identify source of water ingress.



Ducting - Main Building Interior

1.0 Comments

Air handlers#1 through #4 are ducted through the building using rectangular galvanized steel ducting through the ceiling space. The visible portion of the ducting appears to have been replaced 6 years ago at the same time that the AHUs were replaced in 2013. Duct work through major parts of the building was modified during the retrofit in 2013 so we are assuming any problem areas were rectified so the duct work is assumed to be in good condition.



Baseboard Heaters

1.0 Comments

Baseboard heaters are utilized in a number of areas throughout the building for supplementary heaters. A number of these are located below exterior windows in the offices and are coupled with the forced-air climate control system to avoid overlap between heating and cooling modes. The heaters appear to be generally in fair condition and the same age as the part of the building they are in.

A cost is included for the replacement of the baseboard heaters.



Fan-Forced Heaters

1.0 Comments

There are fan-forced cabinet electric heater units at a couple of the entrances of the building. The heaters appears to be the same age as the section of the building they are in and are in fair condition.

A cost is included for the replacement of the heaters at the appropriate point in time.



Split AC Condenser - Server Room

1.0 Comments

The cooling system condenser for the server room in the main building is located on the northwestern side of the building, near the bank of larger air handling units. It is a Mitsubishi Electric model Mr. Slim MSYD36NA designed to operate at low ambient temperature to allow cooling of the server room during the winter. The unit is 6 years old and in good condition.

A cost is included for the replacement of the condenser unit at the appropriate time.



Split AC Evaporator - Server Room

1.0 Comments

The evaporator for the server room in the main building is a Mitsubishi Electric model Mr. Slim MSYD36NA and is mounted on the wall of the server room. The unit is 6 years old and in good condition.

A cost is included for the replacement of the condenser unit at the appropriate time.



Split AC Condenser - Main Building (Offices)

1.0 Comments

There is a split AC condenser unit installed in the vehicle storage area which serves the 2nd floor telephone room of the main building. It is a Mitsubishi Electric model Mr. Slim MSYA24NA. The unit is 6 years old and in good condition.

A cost is included for the replacement of the condenser unit at the appropriate time.



Split AC Evaporator - Main Building (Offices)

1.0 Comments

The evaporator for the server room in the main building is a Mitsubishi Electric model Mr. Slim MSYA24NA and is mounted on the wall of the server room. The unit is 6 years old and in good condition.

A cost is included for the replacement of the condenser unit at the appropriate time.



Heating & Cooling - Meter Shop

1.0 Comments

Climate control in the metering area is partially provided by a combined heat pump/air conditioning unit located on the north side of the metering addition. Model 25HCCA/FX4C, 1000 CFM, 2-stage 10 kW electric heater, 2.5 ton cooling coil. The system is 10 years old and in fair condition.

A cost is included for the replacement of the condenser unit at the appropriate time.



Unit Heater - Meter Shop

1.0 Comments

Additional heat is provided to the garage space in the metering area by a gas-fired unit heat. Model: HD30, Modine, 30 MBH output. The asset is 10 years old and in good condition.

A cost is included for the replacement of the unit at the appropriate time.



Gas-fired Radiant Heaters - Main Building (Vehicle Storage)

1.0 Comments

The vehicle storage area is heated by a combination of overhead gas-fired radiant tube heaters which are exhausted to the north side of the building. The age of the system is unknown, but is estimated to be greater than 20 years. The system appears to be in fair condition.

A cost is included for the replacement of the system at the appropriate time.

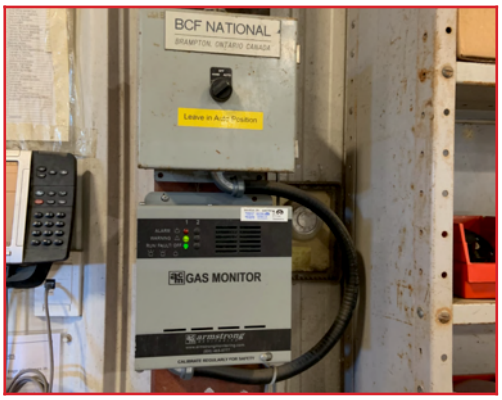


Exhaust Fans - Main Building (Vehicle Storage)

1.0 Comments

Ventilation in the vehicle storage area is provided by two roof-mounted exhaust fans which communicate with a CO_2/NO detector. The exhaust fans appear to be in fair condition. The Gas Monitor has been replaced in the last 5 years.

A cost is included for the replacement of the various components of the system at the appropriate time.

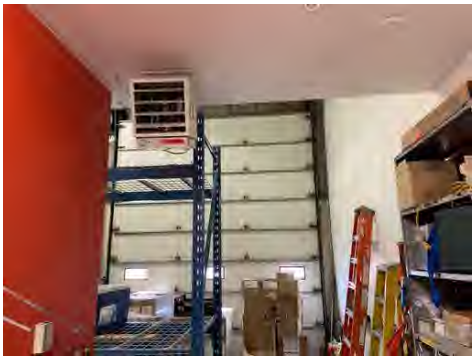


Unit Heaters - Main Building (Stores)

1.0 Comments

Heat is provided to the main area in Stores by two 5 kW electric unit heaters Model #EUH05B21T. The asset is estimated to be 17 years old and in fair condition. It was reported that this area is cold in the winter indicating that the heaters cannot keep up with the heat loss in this area.

A cost is included for the replacement of the unit but the size of the required unit should be reviewed as part of the overall energy analysis for the building.



PTAC Unit - Main Building (Stores)

1.0 Comments

Heat is provided to the office area in Stores by a Carrier unit. The asset is estimated to be 17 years old and in fair condition. It was reported that this area is cold in the winter indicating that the heaters cannot keep up with the heat loss in this area.

A cost is included for the replacement of the unit but the size of the required unit should be reviewed as part of the overall energy analysis for the building.



Split AC Condenser - Addition on Southside (Locker Room)

1.0 Comments

The condenser for the locker room is installed on the east wall of the addition. It is a Mitsubishi Electric model Mr. Slim MSYD36NA. The unit is 6 years old and in good condition.

A cost is included for the replacement of the condenser unit at the appropriate time.



Split AC Evaporator - Addition on Southside (Locker Room)

1.0 Comments

The evaporator for the locker room is installed on the south wall of the addition. It is a Mitsubishi Electric model Mr. Slim MSYD36NA. The unit is 6 years old and in good condition.

A cost is included for the replacement of the condenser unit at the appropriate time.



PTAC Units - Addition Southside (Office and Lunch Room)

1.0 Comments

Heating and cooling in the change area addition is partially provided by three (3) packaged terminal air-conditioning (PTAC) units; two in the lunch room and one in the office. All three units are the same type and size. Applied Comfort, 14 MBH cooling capacity, 17.5 MBH heating capacity. The units are 6 years old and are all considered to be in good condition.

A cost is included for the replacement of the PTAC units at the appropriate time.



Heat Recovery Ventilators - Addition Southside

1.0 Comments

Fresh tempered air is provided to the locker room and the lunch room in the Addition Southside, with a thermostat in each room, by two heat recovery ventilators which are installed in the vehicle storage area. The unit serving the lunchroom is a Venmar AVS and assumed to be the same age as the addition itself and considered to be in fair condition. The unit serving the locker room is a Venmar 1.8HE installed 6 years ago and it is considered to be in good condition. There is a third HRV in place that no one knows what if anything it does at this point.

A cost is included for the replacement the HRVs at the appropriate time.



Fan-forced Heater - Southside Addition (Men's washroom)

1.0 Comments

A fan-forced cabinet air heater is installed in the men's washroom room to assist in drying clothes and uniforms. It is assumed be the same age as the Southside Addition and is in fair condition.

A cost is included for the replacement of the heater.



Electric Heater - Southside Addition (Woman's washroom)

1.0 Comments

Supplementary heat is provided in the women's washroom of the change area by a small wall-mounted fan-forced electric heater. It is assumed be the same age as the Southside Addition and is in fair condition.

A cost is included for the replacement of the heater.

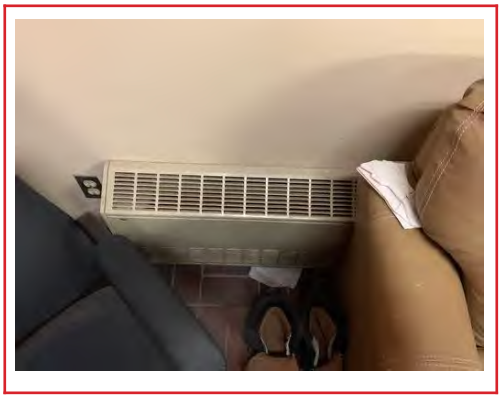


Baseboard Heaters - Linemen Room

1.0 Comments

Heat in the linemen room is provided by electric baseboard heaters. The units appear to be in fair condition.

A cost is included to replace the baseboard heaters.



6.0 Electrical (Induspec)

6.1 Distribution

Electrical Power Supply

1.0 Comments

Electrical power is supplied via an underground feed from three 25 kVA pole-mounted transformers on Commerce Crescent. The electrical service is 400 A, 120/208 V, 3-phase and is accessible from the vehicle storage area.

The main service electrical panel is equipped with a 400 A, 3-phase main disconnect. The main panel is the age of the building and appears to be in poor condition.

To assist with the assessment of the condition of the various electrical panels and disconnects throughout the building thermography was taken of each and the results are summarized here and presented fully in the Appendices to this report.

2.0 Recommendation

We recommend that all electrical equipment receive general maintenance in accordance with NFPA 70B (Recommended Practice for Electrical Equipment Maintenance - 2019 Edition). Also, all existing electrical panels should be complete with type written panel schedules and be labelled to ease any maintenance or electrical upgrades in the future.

Electrical Wiring

1.0 Comments

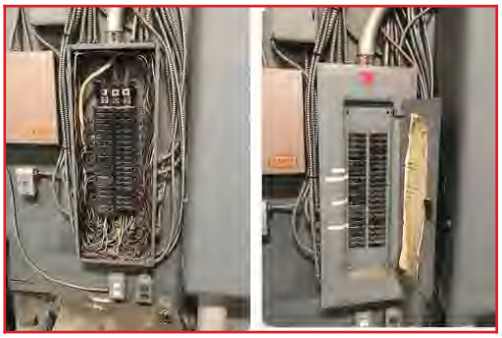
The electrical wiring in the facility mostly consists of armoured cable (BX), wiring run in EMT conduit or TECK cable. All observed cables appeared to be in fair condition.

Main Building (Vehicle Storage)

1.0 Comments

The Square D appears to a 200 amp 3 phase panel which is nearly fully utilized with few available stabs. Loading at time of testing was 17/9/21. The panel appears to be in fair condition.

See thermographic report for additional information.



Southside Addition Panel

1.0 Comments

This Commander brand distribution panel appears to be a 200 amp 3 phase panel with no available stabs. The breaker labelled 'Clothes Dryer Heating' was overloaded at the time of inspection and the overload condition should be addressed by a qualified electrician forthwith. The panel appears to be in fair condition loaded at 13/12/31 at time of testing.

See thermographic report for additional information.



2.0 Recommendations

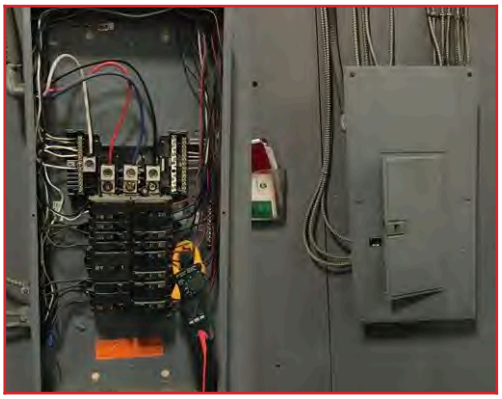
Ensure that overload condition is addressed as soon as possible.

Main Building (Vehicle Storage Sub-Panel)

1.0 Comments

The Square D panel is very lightly loaded and appears to be in fair condition.

See thermographic report for additional information.



Main Building Disconnect

1.0 Comments

This Taylor Electric disconnect employs a 400 Amp disconnect with 300 Amp fuses and appears to be original to the building. An issue with the C-phase cable is suspected and should be addressed by a qualified professional. The disconnect appears to be in poor condition.

See thermographic report for additional information.



Garage Main Disconnect

1.0 Comments

The Federal Pioneer Switchmatic disconnect is of a 200 Amp rating with 200 Amp fuses installed. A minor issue is suspected on the load side connection of the ‘A’ leg and should be investigated by a qualified professional. The disconnect appears to be in fair condition.

See thermographic report for additional information.

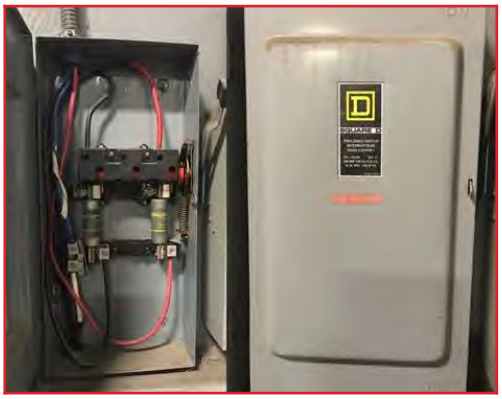


Outside Storage Building Disconnect (Cold Storage)

1.0 Comments

This 200 Amp rated Square D disconnect is wired for single phase and is equipped with 125 Amp fuses. The disconnect appears to be in good condition.

See thermographic report for additional information.



Southside Addition Disconnect

1.0 Comments

This Federal Pioneer, 200 Amp rated disconnect employs 150 Amp fuses. A minor issue is suspected on the load side connection of the 'A' phase and should be investigated by a qualified professional. The disconnect appears to be in fair condition.

See thermographic report for additional information.



Main Building (Substation Workshop) Disconnect

1.0 Comments

This Federal Pioneer Switchmatic disconnect is 100 Amp rated and utilizes 100 Amp fuses. The disconnect is prone to dirt and moisture ingress due to an open punch out on the top of the panel. The panel appears to be in fair condition.

See thermographic report for additional information.



Main Building (Boardroom) Disconnect

1.0 Comments

This Federal Pioneer Switchmatic disconnect is rated for 200 Amps and utilizes 200 Amp fuses. A minor issue is suspected on the load side connection of the 'B' phase and should be investigated by a qualified professional. The panel appears to be in fair condition.

See thermographic report for additional information.



Main Building Mezzanine Disconnect Splitter Panel

1.0 Comments

This 200 Amp rated Federal Pioneer Amalgamated Electric disconnect utilizes a 150 Amp fuses for the 'A' and 'B' phase, and a 200 Amp fuse for the 'C' phase. The panel appears to be in fair condition.

See thermographic report for additional information.



Main Building (Stores) Disconnect

1.0 Comments

This 200 Amp rated Federal Pioneer Amalgamated Electric Products disconnect 200 amp fuses. Although the switch was in the closed position, knives were barely engaged; this condition should be corrected immediately to prevent the risk of excessive heating. The disconnect appears to be in poor condition and must be repaired or replaced forthwith.

See thermographic report for additional information.

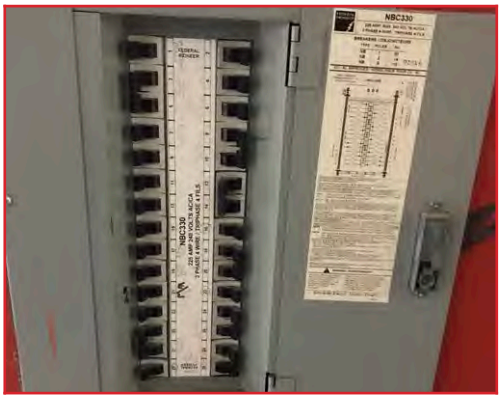


Main Building (Stores) Distribution Panel

1.0 Comments

The Federal Pioneer panel is rated for 225 Amps and appears to be in good condition.

See thermographic report for additional information.



Meter Shop Distribution Panel

1.0 Comments

The Eaton Electric panel employs a 150 Amp main breaker and appears to be in good condition.

See thermographic report for additional information.



Main Building (Printer Room) EPA Panel

1.0 Comments

This Federal Pioneer panel employs a 200 Amp main breaker and appears to be in good condition.

See thermographic report for additional information.



Main Building (Printer Room) Distribution Panel

1.0 Comments

The Federal Pioneer panel is rated for 225 Amps. Breaker #2 was observed to be overloaded with 18 amps at time of testing, and should be inspected by a qualified professional. The panel appears to be in otherwise good condition.

See thermographic report for additional information.



Main Building (Printer Room) Panel 'B'

1.0 Comments

This 225 Amp rated Square D panel appears to be lightly loaded and is in good condition.

See thermographic report for additional information.



Main Building (1st Floor Hallway) Panel

1.0 Comments

This 225 Amp rated Federal Pioneer panel appears to be in good condition.

See thermographic report for additional information.



6.2 Lighting

Light Fixtures - Across the Facility

1.0 Comments

Lighting across the facility is generally in fair to good condition. Many of the fixtures have been upgraded to more efficient fixtures with the exception of the lighting in the cold storage building which is still using T-12 lamps. Replacement cost have been provided but we recommend that current fixtures be run until reliability becomes an issue or an energy efficiency project or renovation creates an opportunity/need for replacement.

7.0 Fire Protection (Induspec)

The main source of fire protection throughout the facility is via fire extinguishers located throughout the space. This is combined with heat detectors and pull stations connected to a 10 zone fire alarm control panel located in the Southside Addition. The age of all associated heat detectors, pull stations and fire extinguishers varies across the facility depending on the respective age of the part of the building in question.

Fire Alarm Panel

1.0 Comments

The existing fire alarm control panel is a Honeywell Notifier series Model SFP-10UD, located in the Southside Addition entrance vestibule. The system is a ten zone conventional fire panel system that is in generally good condition however the age of the system could not be determined. These systems can be maintained until parts are no longer available or a new system is required due to capacity requirements.



Fire Alarm Bells & Pull Stations - Across the Facility

1.0 Comments

Pull stations and and alarm bells across the facility appear to range in age and condition relative to the part of the building in which they are installed. These devices are critical life safety elements and as such are tested on a routine basis. With this in mind these devices would only be updated upon failure or when they can no longer be serviced as spare parts are not available.



Heat Detectors - Across the Facility

1.0 Comments

The heat detectors across the facility appear to range in age and condition relative to the part of the building in which they are installed. A majority of the heat detectors on the main level of the office space appear to have been upgraded during the renovations in 2011. These devices are critical life safety elements and as such are tested on a routine basis. With this in mind these devices would only be updated upon failure or when they can no longer be serviced or spare parts are not available.



Fire Extinguishers - Across the Facility

1.0 Comments

There are numerous fire extinguishers distributed across the facility. These extinguishers are well maintained and from the inspection tags checked on a monthly basis.



Fire Shutter - Vehicle Storage

1.0 Comment

There is a fire shutter installed on the only window between the main building second-floor offices and the vehicle storage area. The shutter is designed to provide a fire-retarding barrier at the opening in the event of a fire in the vehicle storage area. The shutter appears to be in fair condition. This unit should be tested as part of the routine maintenance of the fire alarm system.



8.0 Emergency Systems (Induspec)

Exit Signs - Throughout Facility

1.0 Comments

There are a variety of exit signs throughout the campus. These signs are in fair condition.

2.0 Recommended

It is recommended that all older non-LED type exit signs be upgraded to new to reduce maintenance cost and down time but this will also reduce energy consumption.



Emergency Lighting - Throughout Facility

1.0 Comments

There is a variety of emergency lighting configurations throughout the campus. These lights are in fair to good condition.

2.0 Recommended

We recommend that a review of emergency lighting systems be completed to ensure that proper coverage is maintained/achieved throughout the facility. It is recommended that all emergency lighting battery packs be tested annually to determine which units require maintenance/ replacement.



Emergency Power - Natural Gas Generator

1.0 Comment

There is a natural gas powered emergency generator located in a lean-to at the rear of the main building: Olympian, model G150LG2, serial# *GXC03179, production date 08/19/14, 150 kW capacity, 188 kVA, 0.80 power factor. The generator is powered by a 231 hp natural gas engine: Generac, EGNXB06.82C3, production date 08/19/14. The system is 5 years old and appears to be in good condition. A maintenance plan is reportedly in place and carried out by the supplier of the generator.

A cost is included for the replacement of the generator.



Emergency Power - Switch Gear

1.0 Comment

The emergency power generator is connected to the electrical distribution of the building via a switchgear located in the vehicle storage area. The switchgear appears to be in good condition.

A cost is included for the replacement of the switchgear.



9.0 Life-safety (Induspec)

Fall Arrest Lifeline - Change Area Roof

1.0 Comment

There is a fall-arrest lifeline installed on the south side of the building above the linemen and lunch room addition, presumably to facilitate maintenance on the lower roof. The condition of the system is unknown.

The system should be reviewed to ensure that it meets the requirements for fall-arrest anchors as per applicable working at heights standards and regulations.

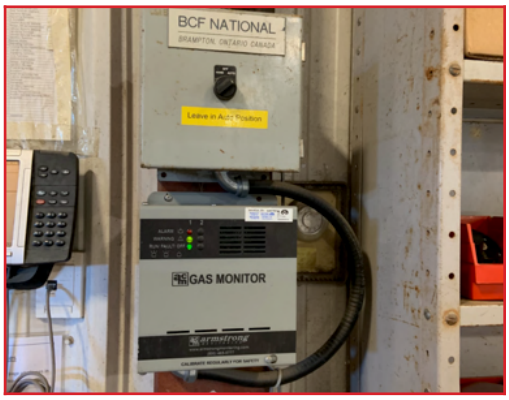


C02/N2 Detector - Main Building (Vehicle Storage)

1.0 Comment

The C02/N2 detector located in the vehicle storage area has been upgraded since the last BCA was completed in 2013.

Ensure maintenance is completed as per manufactures recommendations.



C02 Detector - Various Locations

1.0 Comments

There are C02 detectors located in various locations throughout the Southside Addition and the Office areas on the first and second floor. These units are in good condition but given they are battery powered they should be tested annually and the batteries replaced twice a year. Kidde the manufacturer of the units currently installed has noted a 10 year useful life for this model. A label should be added to the unit to note when the battery was last changed.



Eye Wash Station - Main Building (Vehicle Storage)

1.0 Comments

There is an eyewash station located next to the fire extinguishers in the vehicle storage area. The eyewash station is connected to a cold water line rather than a tempered water line, which does not meet the requirements of applicable safety standards.

A cost is included to install piping to tempered water line. These units should be inspected annually and operated on a routine basis to ensure they provide the required volume and temperature of water and to ensure they are free of contaminants.



10.0 Security Systems

Access Control - Campus Wide

1.0 Comment

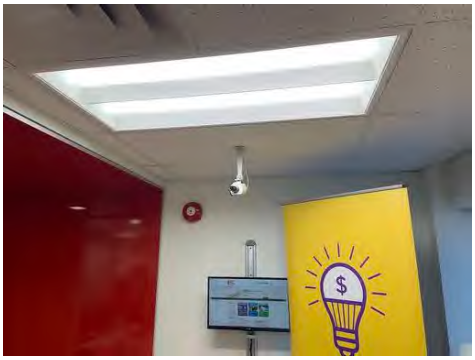
Access control is provided primarily via a key card system that appears to be in good condition. These systems are typically run until failure. Since these systems are computer based they can become obsolete as manufactures no longer support a certain product line.



CCTV - Campus Wide

1.0 Comment

The property is monitored by numerous CCTV camera's around the property and also within the building in key locations. These camera's are recorded on a digital recording system. The entire system appears to be in good condition. These systems are typically run until failure. Since these systems are computer based they can become obsolete as manufactures no longer support a certain product line.



4 Financial Analysis

Expenditure Summary

The results of the BCA have been summarized in the Findings Summary and Financial Analysis Spreadsheet included in Appendix A.

The costs and associated timing for the expected expenditures is as follow:

Cost Summary

Timing [years]	Budget
0–5	$352,100.00
6–10	$263,500.00
11–20	$185,800.00

As noted earlier this report shall not be used for purposes other than to provide guidance as part of a long-term financial strategy regarding building operation and maintenance. The estimated replacement costs and anticipated replacement timings are based on information which is subject to varying margins of errors and uncertainty. The contents of this report should be considered in their entirety; limited or partial consultation of the information provided may lead to inaccurate conclusions or unfavourable results.

5 Supporting Documentation

Appendix A - Findings Summary and Financial Analysis

Appendix B - Roof Thermographic Inspection

Appendix C - Building Exterior Thermographic Inspection

Appendix D - Electrical Equipment Thermographic Inspection

Priority Labels

Priority	Label
Life Safety	A
Structural Integrity	B
Legislative Requirements	C
Building Functionaiity	D
Cost-Effective Upgrade	E

Condition

G	Good
F	Fair
P	Poor

UOM

Unit of Measurement/Term	Abrv.
lump sum	LS
squarefoot	sqft
linear feet	ft
each	ea

Inflation Rate

Inflation Rate (%)	2.0

Cost Summary

Timing [years]	Budget
0–5	$352,100.00
6–10	$263,500.00
11–20	$185,800.00

FIndings Summary and Financial Analysis

Asset Class	Reviewer	Asset Type	Asset Descriptor	Year of Acquisition (* indicates unknown/ assumed)		Age	Normal Life Expectancy	Remaining Life	Priority	Condition	Quantity	UOM	Unit Cost	UOM	Current Cost (Replace, Repair, Allowance)	Timing [years]	Expected Cost	Comments	Recommendations
1.0 - Site	**BWA/ Induspec**	**Asphalt**	**Front Parking Lot (south and west side)**	2017		2	25	23	D	G	50,000	sqft	$4	/sqft	$200,000	>20		Cost to replace the asphalt	
		Asphalt	**Asphalt Apron (north side)**	1996	*	23	25	2	D	P	14,000	sqft	$4	/sqft	$49,000	0–5	$51,500	Frost heaves close to the building could pose a trip hazard doors and a number 2'x2' concrete pavers in front of the meter shop are broken.	Look at opportunity to cut and patch sections as required. Cost provided is to replace entire apron.
		Gravel Storage Area (north side)	**Enclosed Outdoor Storage Area**	1978	*	41	70	29	D	G				/	$0	>20			
		Fence	**Chain-Link**	1978	*	41	40	-1	D	G	240	ft	$30	/ft	$7,200	6–10	$8,400	Fence appears to be generally well maintained so cost provided to repair 20% of the chain-link mesh starting in year 6.	
		Signage	**Site identification**	1978	*	41	25	-16	D	F	1	ea		/ea	$3,000	11–20	$4,100	Cost to replace the sign.	
		Telecommunications	**Antenna**	1978	*	41	25	-16	D	F	1	ea		/ea	$8,000	11–20	$10,800	Cost to replace the antenna.	
		Bollards	**Front Parking Lot (south and west side)**	2002	*	17	50	33	D	F		LS		/LS		0–5	$100	The bollards are showing corrosion at their base.	The bollards should be repainted as needed as part of routine maintenance.
		Drainage	**French Drain Around Building**	Proposed					D		425	ft	$85	/ft	$36,125	0–5	$38,000	Building fascade directly in contract with grade causing degradation of building facade.	Installation of french drain and curb on North and south side would prevent further degradation of the building exterior.
2.0 - Structure	**BWA/ Induspec**	**Steel Structure**	**Main Building**	1978	*	41	70	29	B	F				/		>20		The asset is expected to last beyond the life of the building	
		Concrete Slab	**Main Building**	1978	*	41	100	59	B	G				/		>20		The asset is expected to last for the life of the building	
		Concrete Slab	**Southside Addition**	1986	*	33	100	67	B	G				/		>20		The asset is expected to last for the life of the building	
		Concrete Slab	**Stores**	2002	*	17	100	83	B	F	100	sqft	$7	/sqft	$2,800	0–5	$3,000	Settlement of slab in former grease pit	Level floor slab in area of differential settlement
		Concrete Slab	**Metering Area**	2009		10	100	90	B	G				/		>20		The asset is expected to last for the life of the building	
		Steel Structure	**Rear Lean-to**	1986	*	33	70	37	B	P	1	LS		/LS	$2,000	0–5	$2,200	Cost to perform a more thorough inspection of the structure	
		Steel Columns/Footings	**Visitor's Entrance**	2002	*	17	70	53	B	P	1	LS		/LS	$1,500	0–5	$1,600	Cost to refurbish to columns and the footings	The columns should be repainted as needed as part of routine maintenance. The top of the columns should be repaired before the erode further.
		Concrete Footing	**Telecomms Antenna**	1978	*	41	100	59	D	F	1	LS		/LS	$1,000	0–5	$1,100	Cost to repair the concrete footing of the antenna	
		Storage Building	**Rear Yard**	2002	*	17	50	33	D	G				/		>20		The assist has been built such that its structure should last beyond the timeline of this report with routine maintenance.	
		Foundation Flashing	**Southside Addition**	1986	*	33	50	17	D		125	ft	80	/ft	$10,000	0–5	$10,600	Flashing is badly damaged and deteriorated in many locations	Replace flashing ensuring that is sloped appropriately.
3.0 - Building Envelope	**BWA/ Induspec**					2019													
3.1 Roof		**Metal Roof**	**Main Building**	1978	*	41	70	29	B	F	18000	LS		/LS	$25,000	0–5	$26,300	Fasteners gaskets gone and previously applied sealant is failing.	Replace fasteners.
		Insulation	**Main Building**	1978	*	41	70	29	D	P		LS		/LS	$12500	0–5	$13,200	Insulation deficiencies in garage area as per roof inspection report.	Investigate further and repair areas noted. An overall review of the building envelope and opportunities associated with improvements should be undertaken. Price carried is for repairs and building envelope review.
		Coated Modified Bitumen	**Southside Addition**	1986	*	33	40	7	B	F	2600	sqft	18	/sqft	$46,800	6–10	$54,300	As per thermal imaging report roof section is showing signs of water infiltration.	Complete further investigation. Cost estimate provided is for replacement in next 5 years.
		Metal Roof	**Meter Shop**	2009		10	70	60	B	G	1600	LS		/LS	$3000	0–5	$3,200	Fasteners gaskets gone and an eave flashing has slipped leaving an unprotected opening. previously applied sealant is failing.	Replace fasteners when completing the main roof and replace flashing forthwith.

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		Metal Roof	**Lean To**	1986	*	33	70	37	B	F	640	sqft	18	/sqft	$11,520	0–5	$12,200	There are signs of leakage inside the building.	Cost provided in the even that the more detailed review noted earlier identifies that it should be replaced.
		Eaves Trough	**Southside Addition**	2014	*	5	20	15	D	G		LS		/LS	100	0–5	$200	Eaves trough generally in good shape but it has been damaged.	Repair.
		Eaves Trough Downspout	**Southside Addition**	2014	*	5	20	15	D	G		LS		/LS	500	0–5	$600	Eaves outflow damaging building exterior.	Redirect.
		Soffits and Fascia	**All Sections**	1986	*	33	40	7	B	F	420	sqft	10	/sqft	$4,200	6–10	$4,900	Soffit and Fascia still serviceable but starting to show its age.	
		Chevrons	**Addition on South Side**	1986	*	33	40	7	D		95	ft	50	/ft	$4,750	0–5	$5,000	Ice and snow sliding off building damaging eaves trough installed along edge of building.	Install ice shields along south edge.
		Metal Roofing Flute Seals	**Main Building**	1978	*	41	70	29	D	P	340	ft	25	/ft	$8,500	0–5	$9,000	Flute seals missing in a number of locations on north and south side of the main building.	Replace flute seals.
		Projecting Steel Roof Members	**Main Building**	1978	*	41	70	29	D	F	14	ea	750	/ea	$10,500	0–5	$11,100	Roof beams projecting to outside of the building not insulated causing thermal bridging.	Insulate and flash the end of each beam north and south side. Should also review this as overall envelope review to confirm need and timing for this.
Walls	**BWA/ Induspec**	**Metal Siding Repair**	**Main Building**	1978	*	41	70	29	B	P		LS		/LS	10000	0–5	$10,600	Numerous areas of corrosion and damage.	Repair to prevent possible water ingress into building envelope and accelerated degradation.
		Metal Siding Replacement	**Main Building**	TBD					B	P	5700	sqft	20	/sqft	$114,000	6–10	$132,300	Panels on main building are corroded and damaged in many locations and the paint is faded.	Cost provided is based on a recent over cladding project completed with an insulated panel system (R-28). This will have a payback and should be part of an overall building energy performance review.
		Exterior Masonry	**Addition**	1986	*	33	40	7	B	F		LS		/LS	1500	0–5	$1,600	Block erosion caused by down spout location.	Repair masonry once down spout has been redirected.
		Exterior Panels	**Meter Shop**	2009		10	70	60	B	G				/		>20		The asset is expected to last beyond the timeline for this report.	
		Windows	**Main Building**	1979	*	40	25	-15	D	F	18	ea	$750	/ea	$13,500	0–5	$14,200	See Thermography Report for prioritization	
		Windows	**Southside Addition**	1986	*	33	25	-8	D	F	6	ea	$750	/ea	$4,500	6–10	$5,300	Windows showing signs of aging with exterior sealing element starting to crack.	Consider replacement in years 6-10.
		Windows	**Meter Shop**	2009	*	10	25	15	D	G	3	ea	$750	/ea	$2,250	11–20	$3,100		
		Personnel Doors	**Main Building**	Various			25	25	D	F	7	LS		/LS	$3,200	0–5	$3,400	Many doors showing signs of corrosion, poor weather seals and damaged caulking.	Paint doors, service seals and replace caulking.
		Personnel Doors	**Addition on South Side**	Various			25	25	D	F	2			/	$900	0–5	$1,000	Doors showing signs of corrosion, poor weather seals and damaged caulking.	Paint doors, service seals and replace caulking.
		Personnel Doors	**Meter Shop**						D	F	2			/	$900	0–5	$1,000	Doors showing signs of corrosion.	Paint doors, monitor seals and caulking.
		Personnel Doors	**Outdoor Storage Building**	2002		17	25	8	D	F	1	ea	$500	/ea	$500	6–10	$600		Maintenance/Replacement of door.
		Caulking Sealant	**All Penetrations & Windows all sections.**	Various			15	15	D	P		LS		/LS	$1,000	0–5	$1,100	Many windows and other penetrations have caulking that has failed.	Remove and replace caulking.
		Garage Doors	**Main Building**	Various			25	25	D	F	2	ea	$10000	/ea	$20,000	0–5	$21,100	Two remaining original doors. Thermographic indicates they are not performing that much worse than new doors except at seals. The doors do have some corrosion on the bottom edge.	Replace doors if condition warrants service seals to improve energy performance.
		Garage Door	**Meter Shop**	Various			25	25	D	G	1	ea	$10000	/ea	$10,000	11–20	$13,500		
		Garage Door	**Outdoor Storage Building**	2002		17	25	8	D	G	4	ea	$5000	/ea	$20,000	6–10	$23,300		Cost provided are for the eventual replacement of the doors in years 6-10.
4.0 - Interior Elements	**BWA**	**Millwork**	**All Sections**	Various			35				1	ft	$250			>20		Generally in good condition with upgrading occurring as various renovation projects are completed.	
		Doors	**All Sections**	Various			70	70	D	G	1	ea	$1900	/ea		>20		Generally in fair to good condition.	
		Carpet Tile	**All Sections**	Various			10	10	D	F				/		>20		System allows for ongoing maintenance to replace damaged or worn tiles.	
		Vinyl TIle	**All Sections**	Various			20	20	D	F				/		>20		System allows for ongoing maintenance to replace damaged or worn tiles.	
		Ceilings	**Main Building (1st Floor)**	2011	*	8	15	7	D	G	4,000		$5	/	$20,000	>20			
		Ceilings	**Main Building (2nd Floor)**	2009	*	10	15	5	E	P	1	LS	$1000	/LS	$1,000	0–5	$1,100	Numerous damaged tiles.	Replace tiles.
		Ceilings	**Addition on South Side**	2014		5	15	10	G	G	2,200	sf	$5	/sf	$11,000	>20			
5.0 MECHANICAL	**Induspec**																		
5.1- Plumbing																			

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5.1.1. Water Supply/ Sewer																			
		Water Supply Piping & Meter	**All Sections**	1978	*	41	40	-1	D	F	1	LS		/LS	$15,000	0–5	$15,800	Allowance to repair or replace a proportion of the water supply line to the building and in the building.	**All cold water and hot water piping should be properly insulated and labelled to prevent any excess corrosion due to condensation on the lines during warmer summer months and shoulder seasons. This will also reduce heat loss on the domestic hot water lines while protecting personnel in any space that contains exposed hot water piping.**
		Sanitary Drainage Piping	**All Sections**	1978	*	41	40	-1	D	F	1	LS		/LS	$8,000	0–5	$8,500	Cost to repair or replace a proportion (25%) of the sanitary drainage piping	
		Hot Water Tank	**Southside Addition**	2019		0	10	10	D	G	1	ea	$1000	/ea	$1,000	6–10	$1,200		
		Hot Water Tank	**Main Building (1st Floor)**	2014		5	10	5	D	G	1	ea	$500	/ea	$500	0–5	$600		
		Hot Water Tank	**Main Building (2nd Floor)**	2018		1	10	9	D	G	1	ea	$500	/ea	$500	6–10	$600		
		Hot Water Tank	**Main Building (Stores)**	2015		4	10	6	D	G	1	ea	$500	/ea	$500	0–5	$600		
5.1.2 Fixtures		**Urinals**	**Southside Addition**	2012	*	7	20	13	D	F	2	ea	$1100	/ea	$2,200	11–20	$3,000	Plumbing fixtures generally in a reasonable condition.	Replace with low flow fixtures at next scheduled upgrade/replacement.
		Sink	**Southside Addition**	2012	*	7	20	13	D	F	3	ea	$500	/ea	$1,500	11–20	$2,100	Plumbing fixtures generally in a reasonable condition.	Replace with low flow fixtures at next scheduled upgrade/replacement.
		Toilets	**Southside Addition**	2012	*	7	20	13	D	F	3	ea	$1900	/ea	$5,700	11–20	$7,700	Plumbing fixtures generally in a reasonable condition.	Replace with low flow fixtures at next scheduled upgrade/replacement.
		Showers	**Southside Addition**	2012	*	7	20	13	D	F	2	ea	$1200	/ea	$2,400	11–20	$3,300	Plumbing fixtures generally in a reasonable condition.	Replace with low flow fixtures at next scheduled upgrade/replacement.
		Urinals	**Main Building (1st Floor)**	2011	*	8	20	12	D	F	1	ea	$1100	/ea	$1,100	11–20	$1,500	Plumbing fixtures generally in a reasonable condition.	Replace with low flow fixtures at next scheduled upgrade/replacement.
		Sink	**Main Building (1st Floor)**	2011	*	8	20	12	D	F	4	ea	$500	/ea	$2,000	11–20	$2,700	Plumbing fixtures generally in a reasonable condition.	Replace with low flow fixtures at next scheduled upgrade/replacement.
		Toilets	**Main Building (1st Floor)**	2011	*	8	20	12	D	F	2	ea	$1900	/ea	$3,800	6–10	$4,500	Plumbing fixtures generally in a reasonable condition.	Replace with low flow fixtures at next scheduled upgrade/replacement.
		Urinals	**Main Building (2nd Floor)**	2009	*	10	20	10	D	F	1	ea	$1100	/ea	$1,100	6–10	$1,300	Plumbing fixtures generally in a reasonable condition.	Replace with low flow fixtures at next scheduled upgrade/replacement.
		Sink	**Main Building (2nd Floor)**	2009	*	10	20	10	D	F	2	ea	$500	/ea	$1,000	6–10	$1,200	Plumbing fixtures generally in a reasonable condition.	Replace with low flow fixtures at next scheduled upgrade/replacement.
		Toilets	**Main Building (2nd Floor)**	2009	*	10	20	10	D	F	2	ea	$1900	/ea	$3,800	6–10	$4,500	Plumbing fixtures generally in a reasonable condition.	Replace with low flow fixtures at next scheduled upgrade/replacement.
5.1.3. HVAC Equipment		**Air Handling Unit**	**#1**	2013		6	25	19	D	G	1	ea	$15000	/ea	$15,000	11–20	$20,200		The exterior air filters/screens should be cleaned as part of routine maintenance. Exterior duct work also seems to be leaking as water dripping from over cladding well after the last rain event.
		Air Handling Unit	**#2**	2013		6	25	19	D	G	1	ea	$12000	/ea	$12,000	11–20	$16,200		The exterior air filters/screens should be cleaned as part of routine maintenance. Exterior duct work also seems to be leaking as water dripping from over cladding well after the last rain event.
		Air Handling Unit	**#3**	2013		6	25	19	D	G	1	ea	$17000	/ea	$17,000	11–20	$22,900	During the inspection on October 8th C02 measurements were taken to confirm adequate fresh air was being provided to the building. During the initial walk through the area served by AHU#3 had C02 levels in excess of 1000 ppm which is the limit suggested by ASHRAE. Upon double checking the area later in the inspection it had dropped back to 550 ppm.	The exterior air filters/screens should be cleaned as part of routine maintenance. Exterior duct work also seems to be leaking as water dripping from over cladding well after the last rain event. The system configuration should be reviewed to see why the elevated C02 levels are occurring.
		Air Handling Unit	**#4**	2013		6	25	19	D	G	1	ea	$13500	/ea	$13,500	11–20	$18,200		The exterior air filters/screens should be cleaned as part of routine maintenance. Exterior duct work also seems to be leaking as water dripping from over cladding well after the last rain event.
		HVAC Control Panels	**Mech. Room (AHU #3 & #4)**	2013		6	20	14	D	G	1	ea	$5000	/ea	$5,000	11–20	$6,800		
		HVAC Control Panels	**Mech. Room (AHU #1 & #2)**	2013		6	20	14	D	G	1	ea	$5000	/ea	$5,000	11–20	$6,800		
		Ducting	**Main Building Exterior**	2013		6	50	44	D	G	1	LS	$10000	/LS	$10,000	>20			
		Ducting	**Main Building Interior**	2013		6	50	44	D	G	1	LS	$100000	/LS	$100,000	>20			
		Ducting	**Southside Addition**	2013	*	6	50	44	D	G	1	LS	$5000	/LS	$5,000	>20			
		Ducting	**Meter Shop**	2002	*	17	50	33	D	G	1	LS	$3000	/LS	$3,000	>20			

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		Baseboard Heaters	Main Building (1st Floor)	2011	*	8	25	17	D	F	5	ea	$300	/ea	$1,500	11–20	$2,100	These are typically run to failure.	Clean coils to extend life and improve performance.
		Baseboard Heaters	Main Building (2nd Floor)	2009	*	10	25	15	D	F	8	ea	$300	/ea	$2,400	11–20	$3,300	These are typically run to failure.	Clean coils to extend life and improve performance.
		Fan Forced Heater	Main Building (Employee Vestibule)	2011	*	8	25		D	F	2	ea	$1000	/ea	$2,000	0–5	$2,200	These are typically run to failure.	Clean coils to extend life and improve performance.
		Split AC Condenser	Main Building West End	2013		6	25	19	D	G	1	ea	$1200	/ea	$1,200	11–20	$1,700		
		Split AC Evaporator	Main Building (Server Room)	2013		6	25	19	D	G	1	ea	$1000	/ea	$1,000	11–20	$1,400		
		Split AC Condenser	Main Building (Shop)	2013		6	25	19	D	G	1	ea	$1000	/ea	$1,000	11–20	$1,400		
		Split AC Evaporator	Main Building (Telecom Room 2nd Floor)	2013		6	25	19	D	G	1	ea	$1000	/ea	$1,000	11–20	$1,400		
		Air Handling Unit	Meter Shop	2009		10	25	15	D	G	1	ea	$12000	/ea	$12,000	11–20	$16,200		
		Unit Heater	Meter Shop	2009		10	25	15	D	G	1	ea	$1000	/ea	$1,000	11–20	$1,400		
		Baseboard Heaters	Meter Shop	2009		10	25	15	D	G	2	ea	$300	/ea	$600	11–20	$900		
		Fan Forced Heater	Meter Shop	2009	*	10	25	15	D	F	2	ea	$1000	/ea	$2,000	0–5	$2,200	These are typically run to failure.	Clean coils to extend life and improve performance.
		Gas-fired Radiant Heaters	Main Building (Vehicle Storage)	1978	*	41	25	-16	D	F	1	LS	$40000	/LS	$40,000	0–5	$42,100	Exact age unknown so have listed it as the same age as the building but this is unlikely.	Replacement cost provided but recommend to run until reliability becomes an issue.
		Exhaust Fan	Main Building (Vehicle Storage)	1978	*	41	20	-21	D	F	2	ea	$1000	/ea	$2,000	0–5	$2,200	Exact age unknown so have listed it as the same age as the building but this is unlikely.	Replacement cost provided but recommend to run until reliability becomes an issue.
		Unit Heaters	Main Building (Stores)	2002	*	17	25	8	D	F	2	ea	$1000	/ea	$2,000	0–5	$2,200	It was noted that the stores area including the office is cold in the winter.	This area would benefit from the overall building envelope review.
		PTAC Unit	Main Building (Stores)	2002	*	17	20	3	D	F	1	ea	$2500	/ea	$2,500	0–5	$2,700	It was noted that the stores area including the office is cold in the winter.	This area would benefit from the overall building envelope review.
		Split AC Condenser	Southside Addition (Exterior East End)	2013		6	25	19	D	G	1	ea	$1000	/ea	$1,000	11–20	$1,400		
		Split AC Evaporator	Southside Addition (Locker Room)	2013		6	25	19	D	G	1	ea	$1000	/ea	$1,000	11–20	$1,400		
		PTAC Units	Southside Addition (Office & Lunch Room)	2013		6	25	19	D	G	1	ea	$2500	/ea	$2,500	11–20	$3,400		
		Fan-Forced Heater	Southside Addition (Locker Room)	1986		33	25	-8	D	F	1	ea	$1000	/ea	$1,000	0–5	$1,100	Exact age unknown so have listed it as the same age as the building but this is unlikely.	Replacement cost provided but recommend to run until reliability becomes an issue.
		Heat Recovery Ventilator	Southside Addition (Locker Room)	2013		6	25	19	D	F	1	ea	$3000	/ea	$3,000	11–20	$4,100		Units should have filters replaced bi-annually as a minimum and the heat recovery core should be cleaned/washed annually.
		Heat Recovery Ventilators	Southside Addition	1986		33	25	-8	D	F	2	ea	$1500	/ea	$3,000	0–5	$3,200	Exact age unknown so have listed it as the same age as the building but this is unlikely.	Replacement cost provided but recommend to run until reliability becomes an issue. Units should have filters replaced bi-annually as a minimum and the heat recovery core should be cleaned/washed annually.
		Fan-Forced Heater	Southside Addition (men's washroom)	2012	*	7	25	18	D	F	1	ea	$1000	/ea	$1,000	11–20	$1,400		
		Fan-Forced Heater	Southside Addition (women washroom)	2012	*	7	25	18	D	F	1	ea	$1000	/ea	$1,000	11–20	$1,400		
		Baseboard Heaters	Main Building (Substation Workshop)	1978	*	41	25	-16	D	P	1	ea	$300	/ea	$300	0–5	$400	Exact age unknown so have listed it as the same age as the building but this is unlikely.	Replacement cost provided but recommend to run until reliability becomes an issue.
6.0 - Electrical	**Induspec**																		
6.1 Distribution		**Electrical Power Supply**	**Main Building**	1978	*	41	40	-1	B	F		ea		/ea	$0	11–20	$0	We understand that routine inspections are completed of he HV feed to the building and that these inspections have not uncovered any issues.	**We recommend that all electrical equipment receive general maintenance in accordance with NFPA 70B (Recommended Practice for Electrical Equipment Maintenance - 2019 Edition). Also, all existing electrical panels should be complete with type written panel schedules and be labelled to ease any maintenance or electrical upgrades in the future.**
		Electrical Wiring	Campus Wide	1978	*	41	40	-1	B	F	1	ea		/ea	$0	11–20	$0	Cables installed in the facility mostly consist of armoured cable (BX), run in EMT conduit and some TECK cabling. The cabling appears to be in fair to good condition.	Replace cabling as various areas are renovated going forward. Ensure circuits are not overloaded which will minimize the risk of cable failure.
		Breaker Panel	Main Building (Vehicle Storage)	1978	*	41	40	-1	B	F	1	ea	$1500	/ea	$5,000	0–5	$5,300	Refer to Electrical Thermography report for specific comments re. each panel.	

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		Breaker Panel	**Addition on South Side**	2002	*	17	40	23	B	F	1	ea	$1500	/ea	$5,000	>20		Refer to Electrical Thermography report for specific comments.	Panel loaded at 13(A)/12(B)/31(C), breaker labelled as “Clothes Dryer Heating” was loaded at 19 amps. Breaker temperature eat > 41 °C is excessive and should be addressed.
		Spare Sub-Panel	**Main Building (Vehicle Storage)**	1978	*	41	40	-1	B	F	1	ea	$1000	/ea	$2,500	0–5	$2,700	Refer to Electrical Thermography report for specific comments	
		Disconnect	**Main Building**	1978	*	41	40	-1	B	P	1	ea	$2800	/ea	$2,800	0–5	$3,000	Refer to Electrical Thermography report for specific comments	Loaded at 94(A)/70(B)/100(C) 400A disconnect with 300A fuses. C phase is over 54 deg.C on the line side. Indication of a potential issue with improper contact, loose connection or similar.
		Disconnect	**Main Building (Vehicle Storage)**	1978	*	41	40	-1	B	F	1	ea	$1000	/ea	$2,000	0–5	$2,200	Refer to Electrical Thermography report for specific comments	There may be a minor issue on the load side connection of A leg.
		Storage Building Disconnect (Cold Storage)	**Rear Yard**	2002	*	17	40	23	B	F	1	ea	$1500	/ea	$2,000	>20		Refer to Electrical Thermography report for specific comments	
		Disconnect	**Southside Addition**	1986	*	33	40	7	B	F	1	ea	$1000	/ea	$2,000	6–10	$2,400	Refer to Electrical Thermography report for specific comments	There is a potential minor issue on the connection of the A phase lug (load side).
		Disconnect	**Main Building (Substation Workshop)**	1978	*	41	40	-1	B	F	1	ea	$1000	/ea	$2,000	0–5	$2,200	Refer to Electrical Thermography report for specific comments	B leg seems slightly warm on the load side.
		Disconnect	**Main Building (1st Floor Boardroom)**	2011	*	8	40	32	B	F	1	ea	$1000	/ea	$2,000	>20		Refer to Electrical Thermography report for specific comments	There may be a minor issue on a connection on the load side of B phase.
		Disconnect Splitter Panel	**Mezzanine Main Building**		*		40	40	B	F	1	ea	$1000	/ea	$2,000	0–5	$2,200	Refer to Electrical Thermography report for specific comments	
		Disconnect	**Main Building (Stores)**	2002	*	17	40	23	B	F	1	ea	$1000	/ea	$2,000	>20		Refer to Electrical Thermography report for specific comments	It is strongly recommended that the switch mechanism be repaired to ensure full knife engagement.
		Distribution Panel	**Main Building (Stores)**	2002	*	17	40	23	B	F	1	ea	$1500	/ea	$5,000	>20		Refer to Electrical Thermography report for specific comments	
		Distribution Panel	**Meter Shop**	2009	*	10	40	30	B	F	1	ea	$1500	/ea	$5,000	>20		Refer to Electrical Thermography report for specific comments	
		EPA Distribution Panel	**Main Building (Printer Room)**	2011	*	8	40	32	B	F	1	ea	$1500	/ea	$5,000	>20		Refer to Electrical Thermography report for specific comments	
		Distribution Panel	**Main Building (Printer Room)**	2011	*	8	40	32	B	F	1	ea	$1500	/ea	$5,000	>20		Refer to Electrical Thermography report for specific comments	Breaker #2 is a 15 amp breaker loaded at 18 amps. Breaker should likely be tripping. Loading on breaker #2 should be investigated and circuit corrected.
		Distribution Panel B	**Main Building (Printer Room)**	2011	*	8	40	32	B	F	1	ea	$1500	/ea	$5,000	>20		Refer to Electrical Thermography report for specific comments	
		Distribution Panel	**Main Building (1st Floor Hallway)**	2011	*	8	40	32	B	F	1	ea	$1500	/ea	$5,000	>20		Refer to Electrical Thermography report for specific comments	
6.2 Lighting		**Light Fixtures**	**Main Building (1st Floor)**	2011	*	8	20	12	D	F		LS	$250	/LS	$0	11–20	$0	Exact age unknown so have listed it as the same age as the building but this is unlikely.	Replacement cost provided but recommend to run until reliability becomes an issue or an energy efficiency improvement or renovation creates an opportunity for replacement.
		Light Fixtures	**Main Building (2nd Floor)**	2009	*	10	20	10	D	F		LS	$250	/LS	$0	6–10	$0	Exact age unknown so have listed it as the same age as the building but this is unlikely.	Replacement cost provided but recommend to run until reliability becomes an issue or an energy efficiency improvement or renovation creates an opportunity for replacement.
		Light Fixtures	**Addition on South Side**	1986	*	33	20	-13	D	F		LS	$250	/LS	$0	0–5	$0	Exact age unknown so have listed it as the same age as the building but this is unlikely.	Replacement cost provided but recommend to run until reliability becomes an issue or an energy efficiency improvement or renovation creates an opportunity for replacement.
		Light Fixtures	**Main Building (Vehicle Storage)**	Varies	*		20	20	D	F		LS	$500	/LS	$0	0–5	$0	Exact age unknown so have listed it as the same age as the building but this is unlikely.	Replacement cost provided but recommend to run until reliability becomes an issue or an energy efficiency improvement or renovation creates an opportunity for replacement.
		Light Fixtures	**Main Building (Stores)**	2002	*	17	20	3	D	F		LS	$250	/LS	$0	0–5	$0	Exact age unknown so have listed it as the same age as the building but this is unlikely.	Replacement cost provided but recommend to run until reliability becomes an issue or an energy efficiency improvement or renovation creates an opportunity for replacement.
		Light Fixtures	**Meter Shop**	2009		10	20	10	D	F		LS	$250	/LS	$0	6–10	$0	Exact age unknown so have listed it as the same age as the building but this is unlikely.	Replacement cost provided but recommend to run until reliability becomes an issue or an energy efficiency improvement or renovation creates an opportunity for replacement.

FIndings Summary and Financial Analysis

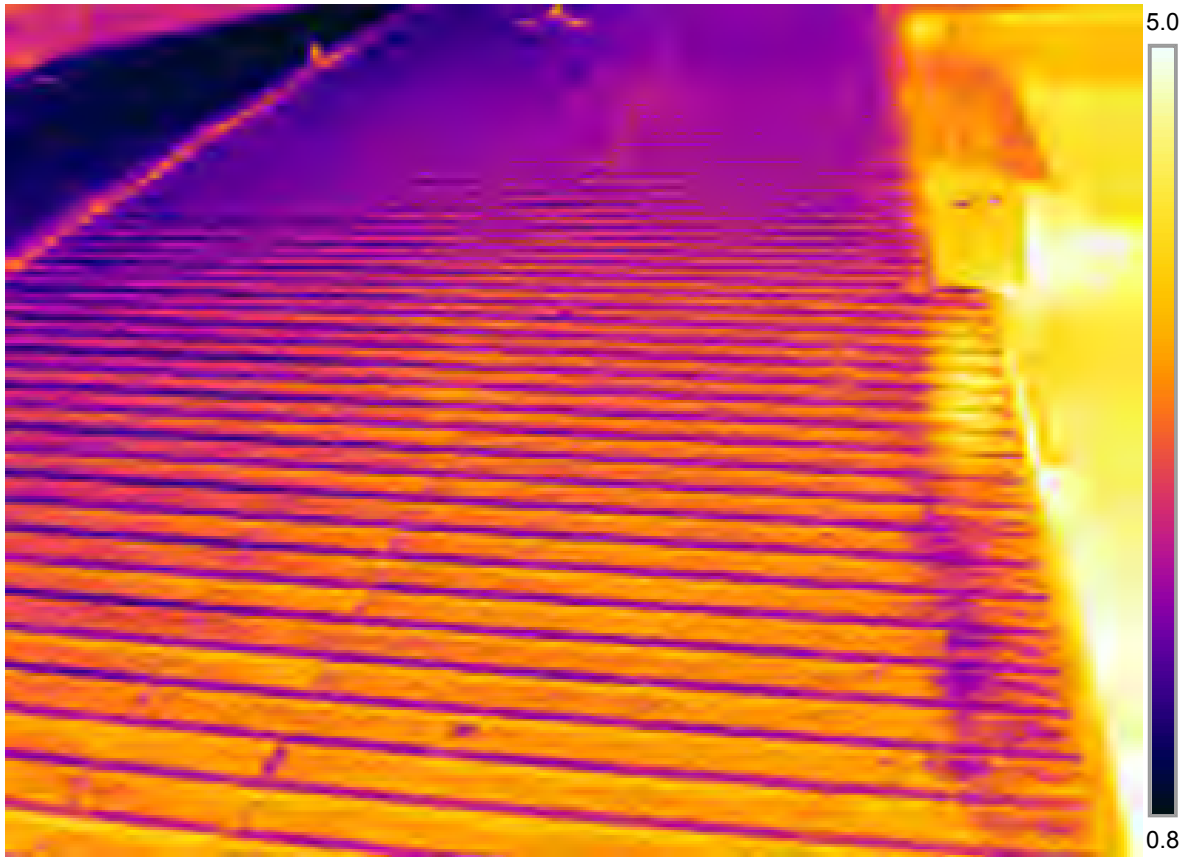
Asset Class	Reviewer	Asset Type	Asset Descriptor	Year of Acquisition (* indicates unknown/ assumed)		Age	Normal Life Expectancy	Remaining Life	Priority	Condition	Quantity	UOM	Unit Cost	UOM	Current Cost (Replace, Repair, Allowance)	Timing [years]	Expected Cost	Comments	Recommendations
		Light Fixtures	**Outdoor Lighting**	2015	*	4	20	16	D	F		LS		/LS	$0	>20		Outdoor lighting has been replaced since completion of last BCA.	
7.0 - Fire Protection	**Induspec**																		
		Fire Alarm Panel	**Main Building**		*		20		A	F	1			/		>20		Unable to confirm age of system.	
		Fire Alarm Bells & Pull Stations	**Main Building (1st Floor)**	2011		8	25	17	A	G		LS		/LS		11–20			
		Fire Alarm Bells & Pull Stations	**Main Building (2nd Floor)**	Varies			25		A	F	1			/		>20			
		Fire Alarm Bells & Pull Stations	**Southside Addition**	Varies			25		A	F	1			/		>20			
		Fire Alarm Bells & Pull Stations	**Main Building (Vehicle Storage)**	Varies			25		A	F	1			/		>20			
		Fire Alarm Bells & Pull Stations	**Main Building (Stores)**	Varies			25		A	F	1			/		>20			
		Fire Alarm Bells & Pull Stations	**Meter Shop**	Varies			25		A	F	1			/		>20			
		Heat/Smoke Detectors	**Main Building (1st Floor)**	2011		8	15	7	A	G	1			/		6–10			
		Heat/Smoke Detectors	**Main Building (2nd Floor)**	Varies			15		A	F	1	ea	$500	/ea		0–5		Most of the heat detectors appear much older than those on the first floor.	Older detectors should be upgraded as part of general life safety upgrade along with exit signs and emergency lighting upgrade.
		Heat/Smoke Detectors	**Southside Addition**	Varies			15		A	F	1	ea	$500	/ea		6–10			
		Heat/Smoke Detectors	**Main Building (Vehicle Storage)**	Varies			15		A	F	1	ea	$500	/ea		6–10			
		Heat/Smoke Detectors	**Main Building (Stores)**	Varies			15		A	F	1	ea	$500	/ea		6–10			
		Heat/Smoke Detectors	**Meter Shop**	Varies			15		A	F	1	ea	$500	/ea		0–5			
		Carbon Monoxide Detectors	**Southside Addition**	Varies			15		A	F	1			/		>20			
		Fire Shutter	**Vehicle Storage**	Varies			15		A	F	1			/					Complete routine maintenance to ensure shutter will operate as expected.
8.0 Emergency Systems	**Induspec**													/					**We recommend that a full review of the exit signs and emergency lighting systems be completed to ensure that proper coverage is maintained/achieved throughout the facility.**
		Exit Signs	**Main Building (1st Floor)**	2011		8	15	7	A	F	1	LS	$6000	/LS	$6,000	6–10	$7,000	The cost provided is an estimate to replace all of the exit signs throughout the facility.	It is recommended that all older non-LED type exit signs be upgraded to new to reduce maintenance cost and down time but this will also reduce energy consumption.
		Exit Signs	**Main Building (2nd Floor)**	Varies			15		A	F	1			/		>20			It is recommended that all older non-LED type exit signs be upgraded to new to reduce maintenance cost and down time but this will also reduce energy consumption.
		Exit Signs	**Southside Addition**	Varies			15		A	F	1			/		>20			It is recommended that all older non-LED type exit signs be upgraded to new to reduce maintenance cost and down time but this will also reduce energy consumption.
		Exit Signs	**Main Building (Vehicle Storage)**	Varies			15		A	F	1			/		>20			It is recommended that all older non-LED type exit signs be upgraded to new to reduce maintenance cost and down time but this will also reduce energy consumption.
		Exit Signs	**Main Building (Stores)**	Varies			15		A	F	1			/		>20			It is recommended that all older non-LED type exit signs be upgraded to new to reduce maintenance cost and down time but this will also reduce energy consumption.
		Exit Signs	**Meter Shop**	Varies			15		A	F	1			/		>20			It is recommended that all older non-LED type exit signs be upgraded to new to reduce maintenance cost and down time but this will also reduce energy consumption.
		Emergency Lighting	**Main Building (1st Floor)**	Varies			15		A	F	1	LS	10000	/LS	$10,000	6–10	$11,700	The cost provided is an estimate to replace all of the emergency lighting throughout the facility.	It is recommended that all emergency lighting battery packs be tested annually to determine which units require maintenance/replacement.
		Emergency Lighting	**Main Building (2nd Floor)**	Varies			15		A	F	1			/		>20			It is recommended that all emergency lighting battery packs be tested annually to determine which units require maintenance/replacement.
		Emergency Lighting	**Southside Addition**	Varies			15		A	F	1			/		>20			It is recommended that all emergency lighting battery packs be tested annually to determine which units require maintenance/replacement.

FIndings Summary and Financial Analysis

Asset Class	Reviewer	Asset Type	Asset Descriptor	Year of Acquisition (* indicates unknown/ assumed)		Age	Normal Life Expectancy	Remaining Life	Priority	Condition	Quantity	UOM	Unit Cost	UOM	Current Cost (Replace, Repair, Allowance)	Timing [years]	Expected Cost	Comments	Recommendations
		Emergency Lighting	**Main Building (Vehicle Storage)**	Varies			15		A	F	1			/		>20			It is recommended that all emergency lighting battery packs be tested annually to determine which units require maintenance/replacement.
		Emergency Lighting	**Main Building (Stores)**	Varies			15		A	F	1			/		>20			It is recommended that all emergency lighting battery packs be tested annually to determine which units require maintenance/replacement.
		Emergency Lighting	**Meter Shop**	Varies			15		A	F	1			/		>20			It is recommended that all emergency lighting battery packs be tested annually to determine which units require maintenance/replacement.
		Emergency Power	**Natural Gas Generator**	2014		5	30	25	D	G	1	ea	$100000	/ea	$100,000	>20			Ensure manufacturers recommendation are followed re. maintenance.
		Emergency Power	**Switch Gear**	2014		5	40	35	D	G	1	ea	$40000	/ea	$40,000	>20			Ensure manufacturers recommendation are followed re. maintenance.
9.0 Life Safety	**Induspec**										1			/		>20			
		Fall-Arrest Lifeline	**Addition on South Side**	1986	*	33	25	-8	A	P	1	LS	$5000	/LS	$5,000	0–5	$5,300	No information on system and its design parameters.	**Do not use this system until the design has been verified by a structural engineer and the system has been tested appropriately.**
		C02/N2 Detector	**Main Building (Vehicle Storage)**	2015	*	4	15	11	A	G	1			/		11–20			Ensure manufacturers recommendation are followed re. maintenance and calibration.
		C02 Detectors	**Main Building**		*		10		A	G	5	ea	50	/ea	$250	0–5	$300		Since the units are battery powered they should have batteries replaced replaced every 6 months. Units should be labelled with the last date the battery was changed. The manufacturer recommends that these units be replaced every 10 years.
		Eye Wash Station	**Main Building (Vehicle Storage)**	1986	*	33	25	-8	A	F	1	ea	$1000	/ea	$1,000	0–5	$1,100	Eye wash station should have a tempered water supply.	Provide hot water line and mixing valve to provide tempered water supply to eye wash station.
10.0 Security Systems	**Induspec**																		I
		Security Door Hardware	**All Sections**	Varies			15		D	F	1			/		6–10			Typically these systems are run until failure.
		Security Cameras	**All Sections**	Varies			10		D	F	1			/		6–10			Typically these systems are run until failure.
		Security System	**All Sections**		*		10		D	F	1			/		6–10		//	Typically these systems are run until failure. Routinely check recordings to ensure system is working as expected.

Appendix B - Roof Thermographic Inspection

18/10/19 8:52:31 AM



IR_7925.jpg FLIR T400 48802798

Parameters

Emissivity	0.95
Refl. temp.	20 °C

Note

North Side Roof (East Corner) showing no drastic anomalies

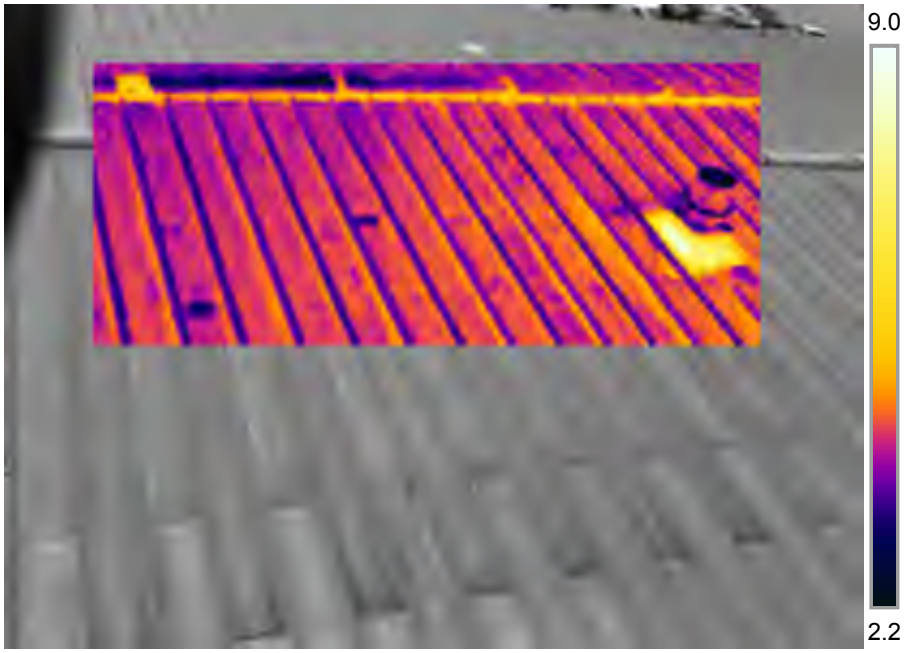
Parameters

Emissivity	0.95
Refl. temp.	20 °C

Note

East end roof showing peak vent and various vents. No significant issues noted

18/10/19 8:53:24 AM



IR_7927.jpg FLIR T400 48802798

18/10/19 8:53:24 AM



IR_7927.jpg FLIR T400 48802798

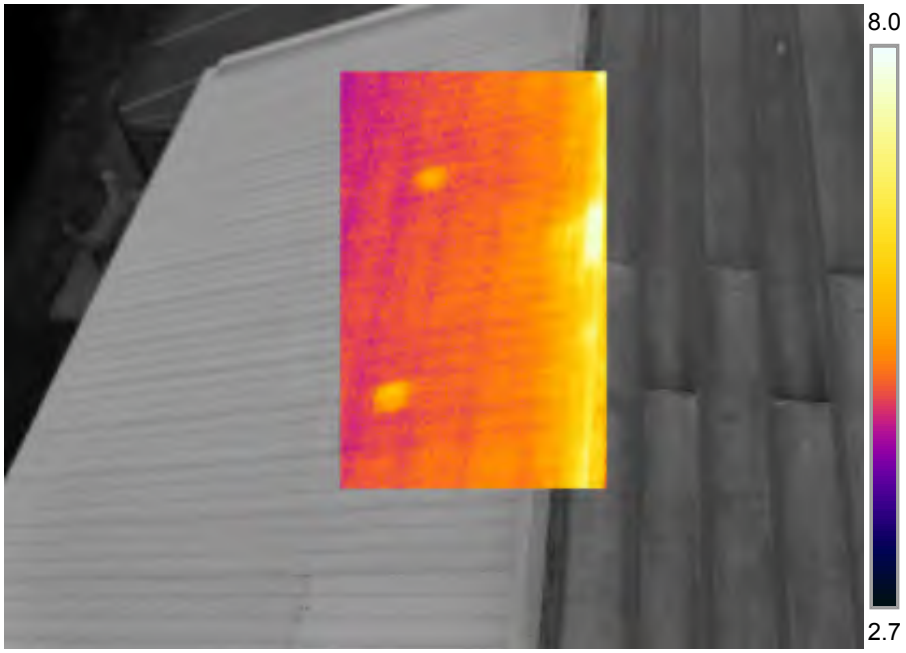
Parameters

Emissivity	0.95
Refl. temp.	20 °C

Note

Connection between shop and stores roof. Notice significant heat leakage from vertical connection. Warm circles may be ceiling lights in stores or similar heat source. Overall roof shows no major anomalies.

18/10/19 8:54:00 AM



IR_7928.jpg FLIR T400 48802798

18/10/19 8:54:00 AM



IR_7928.jpg FLIR T400 48802798

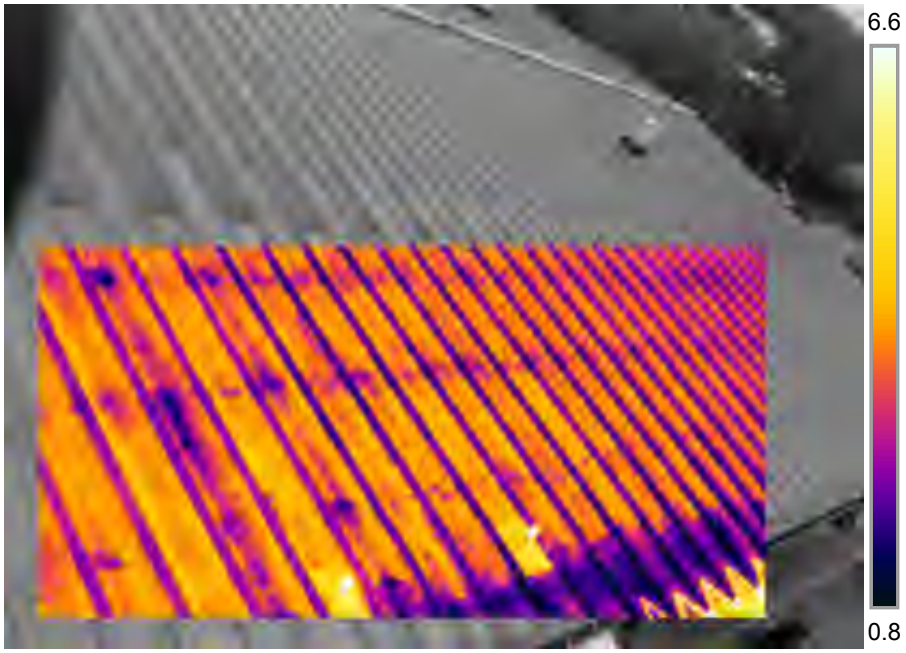
Parameters

Emissivity	0.95
Refl. temp.	20 °C

Note

South facing shop roof showing normal patterns at vents and fasteners. Heat tracing is likely not turned on but only appears warm due to emissivity characteristics. No significant fault noticed.

18/10/19 9:16:22 AM



IR_7929.jpg FLIR T400 48802798

18/10/19 9:16:22 AM



IR_7929.jpg FLIR T400 48802798

Measurements

Bx1	Max	3.2 °C
	Min	-0.1 °C
Sp1		1.2 °C

Parameters

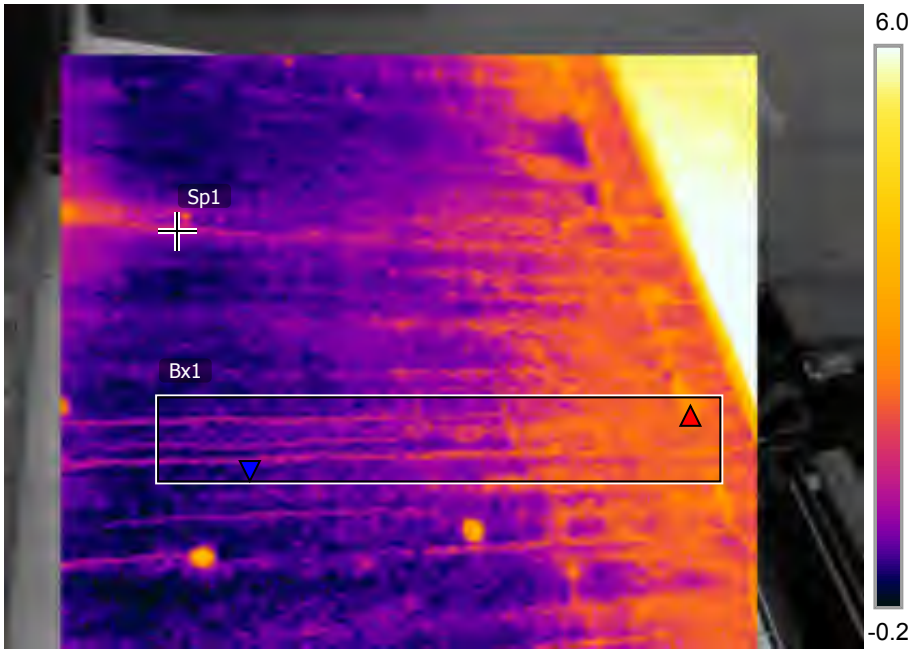
Emissivity	0.95
Refl. temp.	20 °C

Note

Office roof (lower South section) showing some evidence of potential water infiltration into the roofing material.

Notice the warm "runs" from some of the patched areas down the slope of the roof indicating less insulation potentially due to moisture affected insulation. Also notice warmer surface along lower edge of building which could indicate more moisture accumulation at bottom of slope.

18/10/19 9:17:14 AM



IR_7931.jpg FLIR T400 48802798

18/10/19 9:17:14 AM



IR_7931.jpg FLIR T400 48802798

Measurements

Bx1	Max	2.1 °C
	Min	-0.2 °C

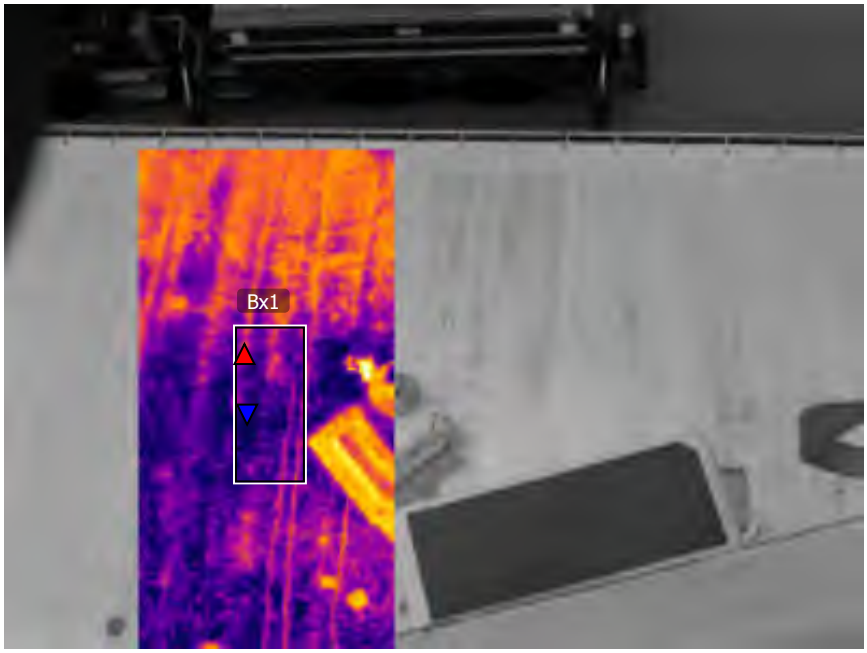
Parameters

Emissivity	0.95
Refl. temp.	20 °C

Note

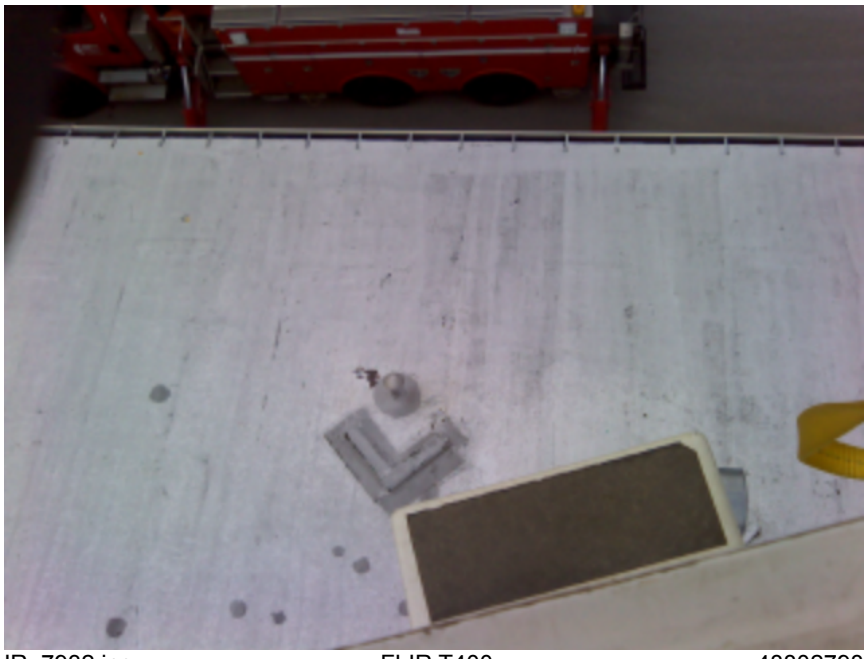
Lower south facing office roof indicating potential moisture infiltration into roof membrane.

18/10/19 9:17:39 AM



IR_7932.jpg FLIR T400 48802798

18/10/19 9:17:39 AM



IR_7932.jpg FLIR T400 48802798

Measurements

Bx1	Max	21.9 °C
	Min	18.3 °C

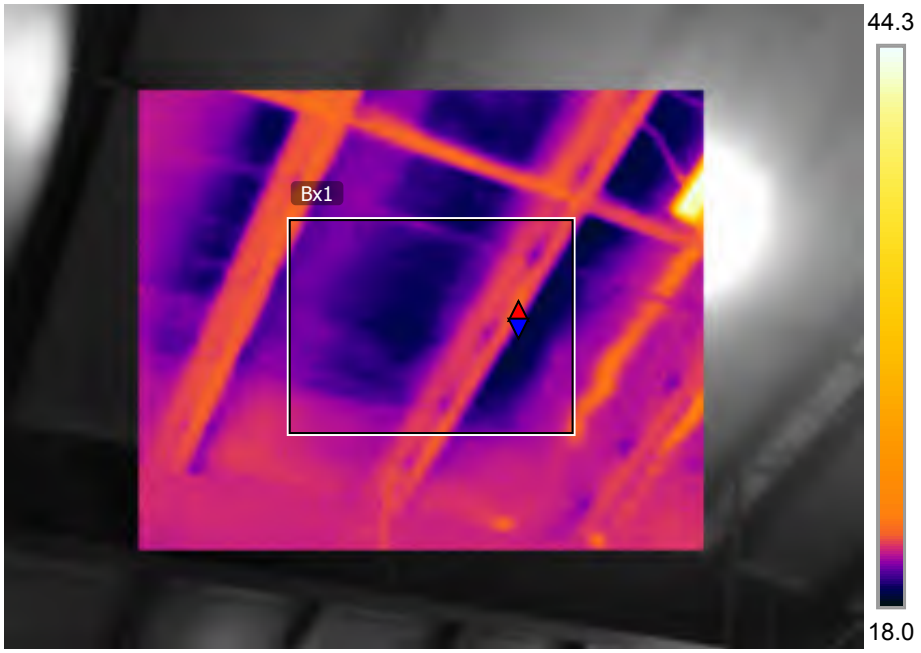
Parameters

Emissivity	0.95
Refl. temp.	20 °C

Note

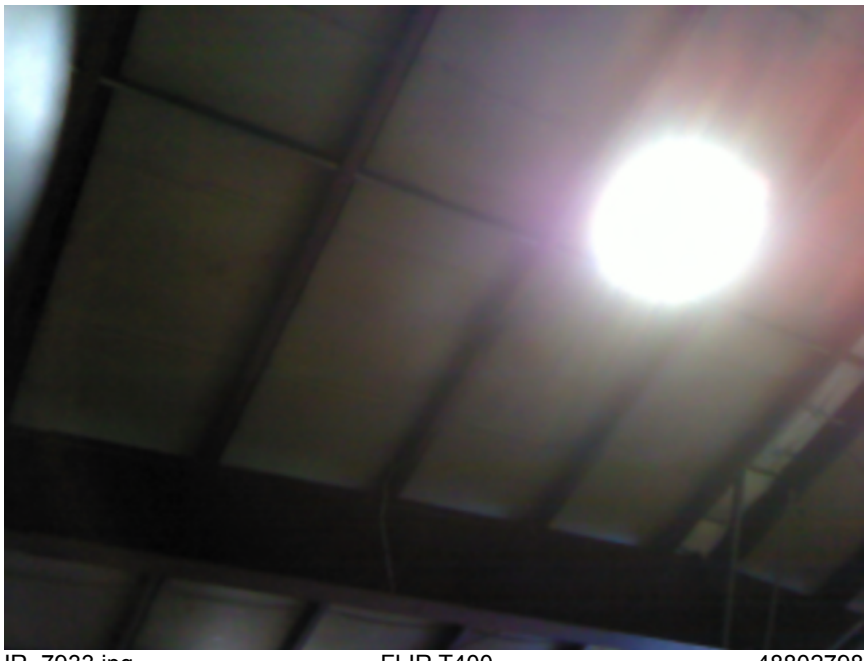
Internal thermal image of shop roof showing suspicious cold area in insulation. Should be investigated further for potential water infiltration onto insulation.

18/10/19 9:26:28 AM



IR_7933.jpg FLIR T400 48802798

18/10/19 9:26:28 AM



IR_7933.jpg FLIR T400 48802798

Measurements

Bx1	Max	22.0 °C
	Min	18.0 °C

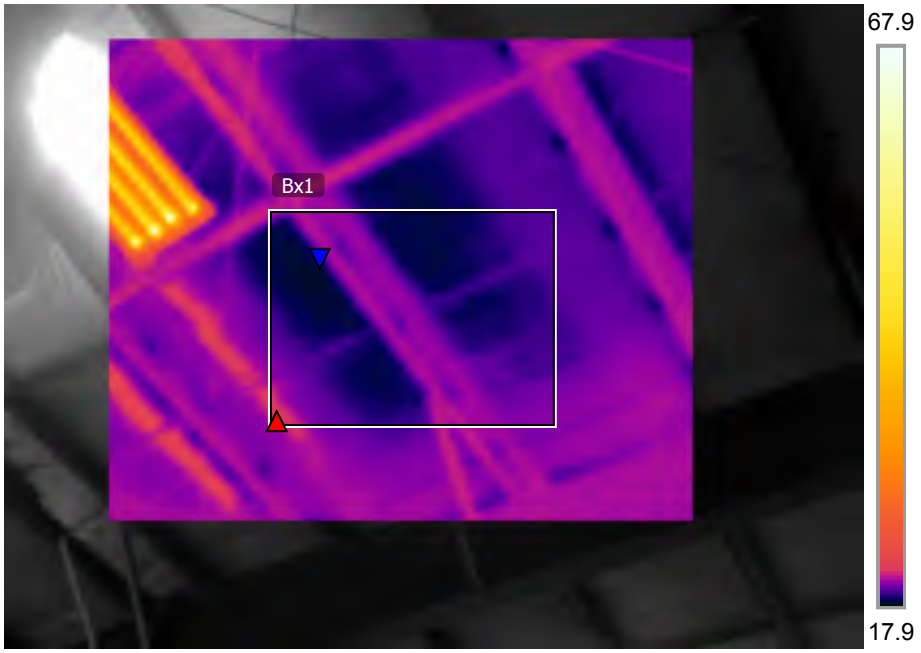
Parameters

Emissivity	0.95
Refl. temp.	20 °C

Note

Additional image of potential insulatin damage in shop ceiling

18/10/19 9:27:20 AM



IR_7934.jpg FLIR T400 48802798

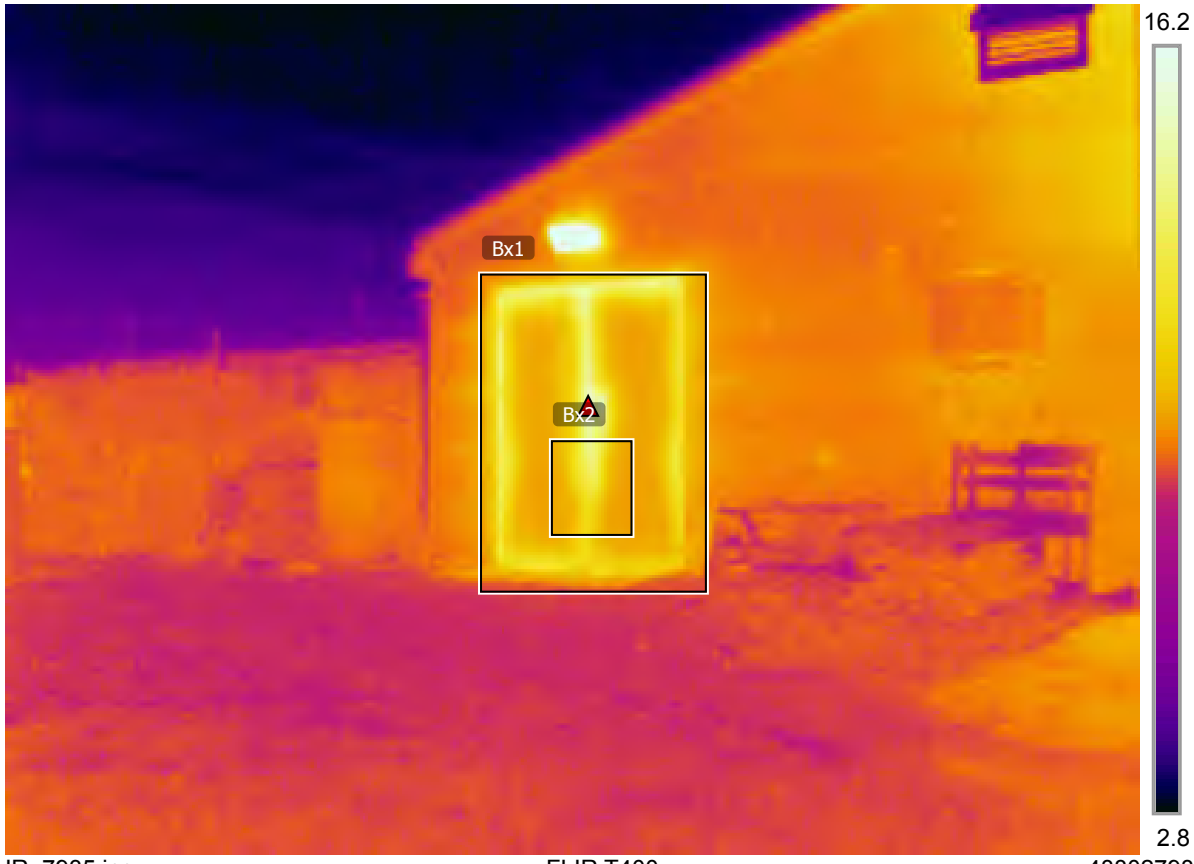
18/10/19 9:27:20 AM



IR_7934.jpg FLIR T400 48802798

Appendix C Building Exterior Thermographic Inspection

30/10/19 6:57:50 PM



IR_7935.jpg FLIR T400 48802798

Measurements

Bx1	Max	15.3 °C
Bx2	Average	10.9 °C

Parameters

Emissivity	0.95
Refl. temp.	7 °C

Note

North Side
Bx1 Meter shop back door showing average air leakage. Internal temperature is approximately 21 deg C and the building is slightly positive in pressure when compared to the ambient conditions.
Bx2 Better than average insulation value.

30/10/19 6:58:35 PM



IR_7936.jpg FLIR T400 48802798

Measurements

Bx1	Max	16.3 °C
Bx2	Max	14.2 °C
Bx3	Max	9.9 °C
	Average	9.5 °C

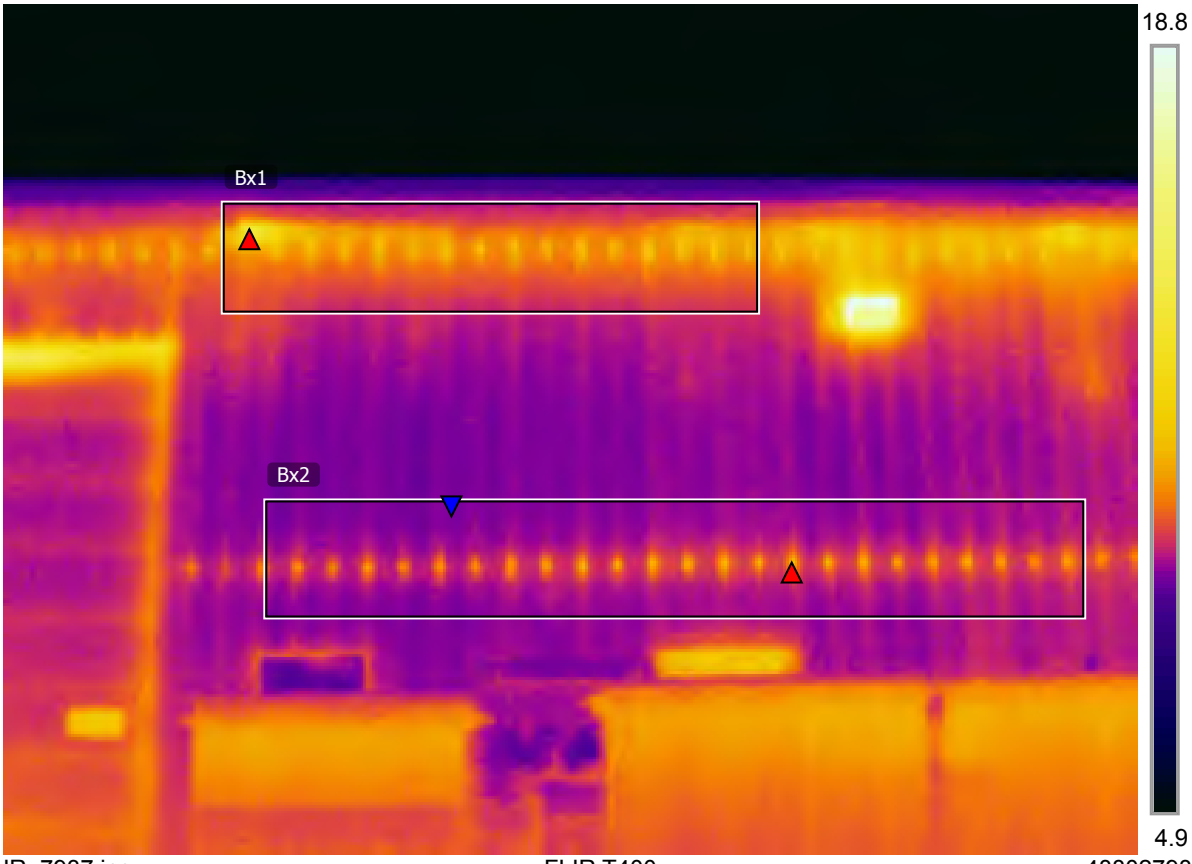
Parameters

Emissivity	0.95
Refl. temp.	7 °C

Note

North Side
Bx1 & Bx3 Warehouse door leakage is deemed average.
Garage door appears well insulated with an average exterior temperature of 9.5 degC versus a 7 degree ambient background.
Apparent hot spot on left hand side under eaves is security camera.
Bx2 Thermal bridging under eave and at connection points for exterior sheeting.heeting.

30/10/19 6:59:21 PM



IR_7937.jpg FLIR T400 48802798

Measurements

Bx1	Max	14.8 °C
Bx2	Max	12.1 °C
	Min	9.2 °C
	Average	9.8 °C

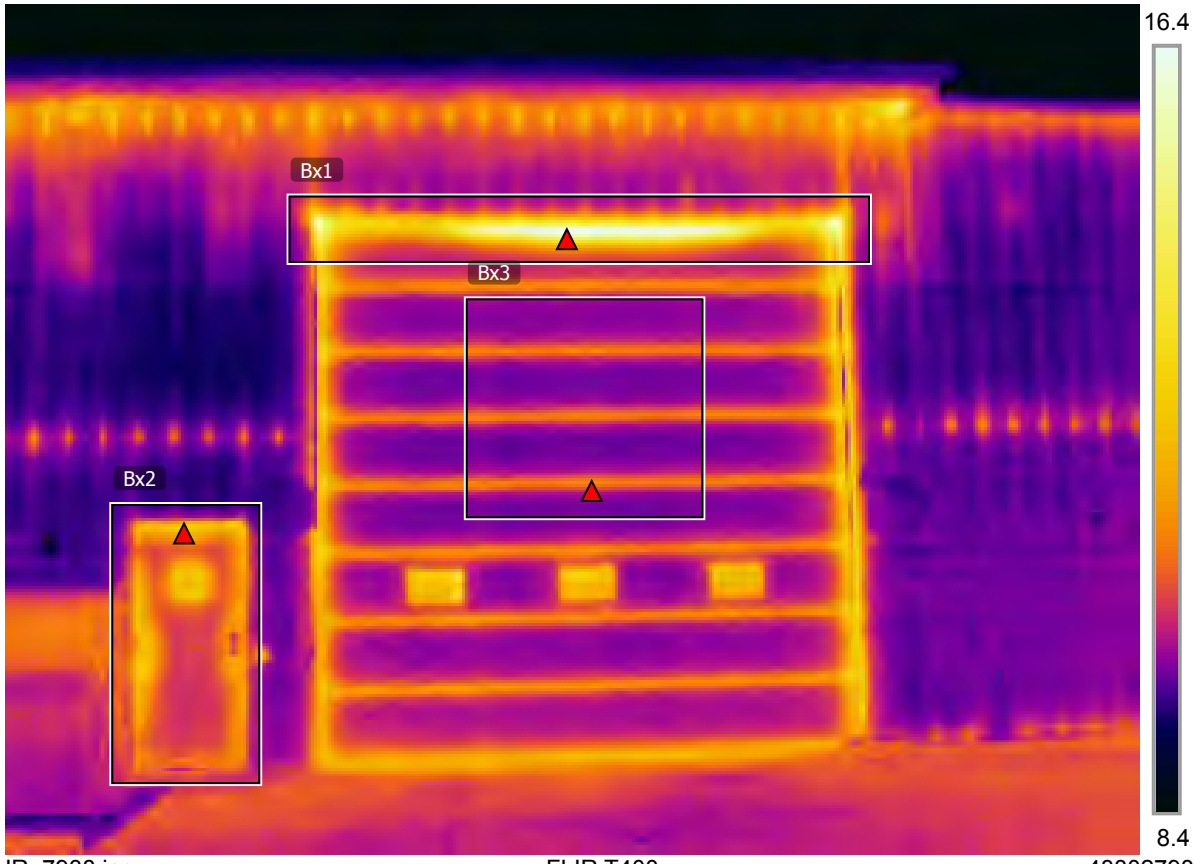
Parameters

Emissivity	0.95
Refl. temp.	7 °C

Note

North Side
Bx1 further examples of thermal bridging just below building eve.
Bx2 thermal briding where exterior sheeting attaches to building structure.
Hot spot on right is exterior light.

30/10/19 7:00:08 PM



IR_7938.jpg FLIR T400 48802798

Measurements

Bx1	Max	17.0 °C
Bx2	Max	13.1 °C
	Average	11.0 °C
Bx3	Max	11.7 °C
	Average	10.2 °C

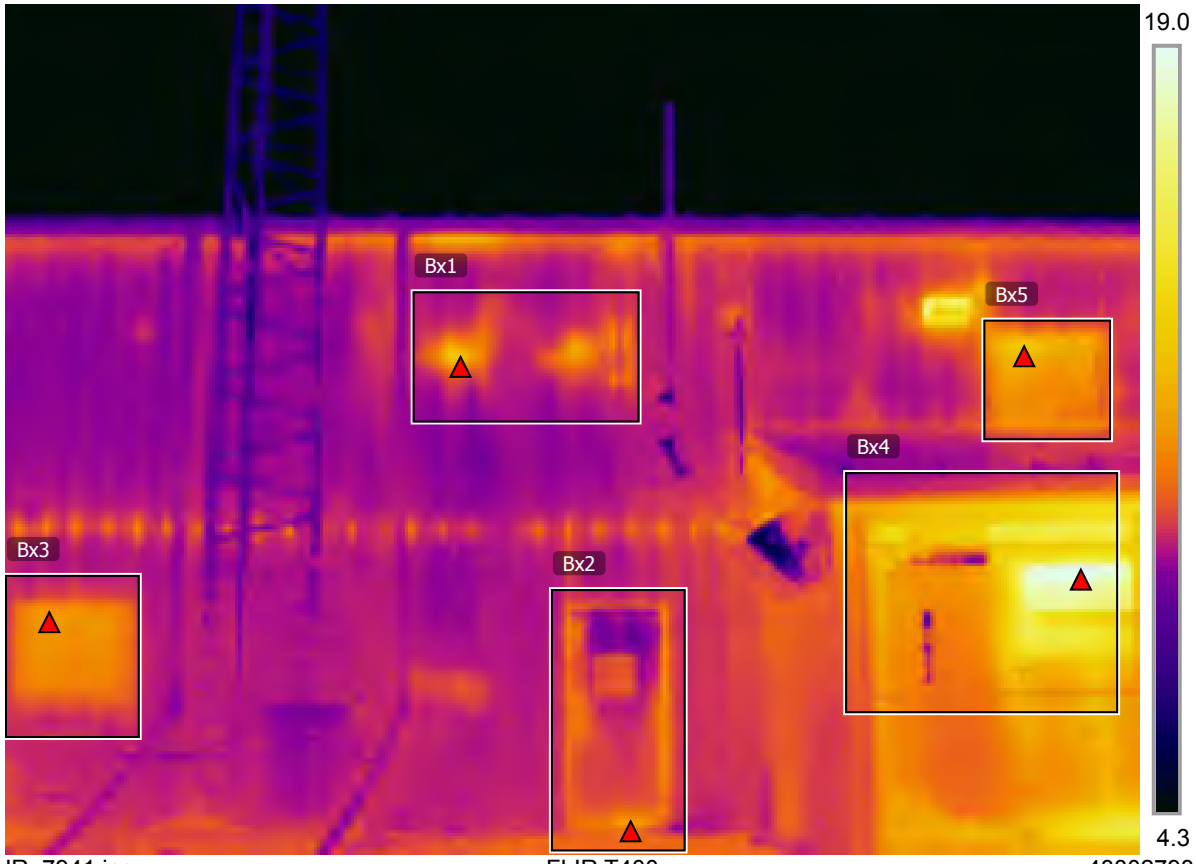
Parameters

Emissivity	0.95
Refl. temp.	7 °C

Note

North Side
Bx1 & Bx3 Warehouse door leakage is slightly worse than average. Garage door average temp is 11C which is comparable to previous door, thermal bridging between panels.
Bx2 Average leakage at perimeter of door. Door appears reasonably insulated,average exterior temperature of 11.0C versus a 7C ambient.

30/10/19 7:01:59 PM



IR_7941.jpg FLIR T400 48802798

Measurements

Bx1	Max	13.7 °C
Bx2	Max	12.0 °C
	Average	10.3 °C
Bx3	Max	12.4 °C
	Average	10.8 °C
Bx4	Max	19.8 °C
	Average	12.8 °C
Bx5	Max	13.5 °C
	Average	11.5 °C

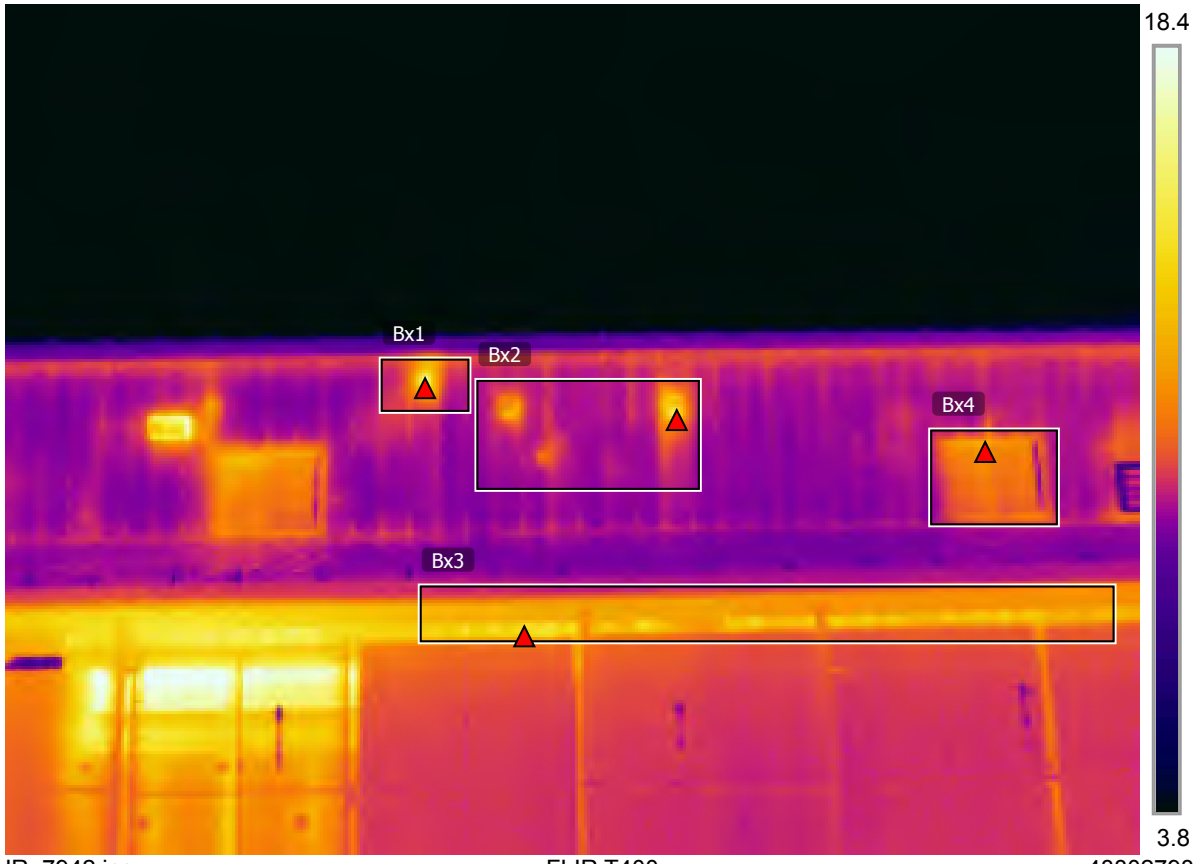
Parameters

Emissivity	0.95
Refl. temp.	7 °C

Note

North Side
Bx1 Vent and patch on building exterior.
Bx2 Average leakage at perimeter of door. Door appears reasonably insulated average exterior temperature of 10.3C versus a 7C ambient.
Bx3 Window, some leakage at perimeter but still performing reasonably well average temperature of 10.6C versus ambient of 7C .
Bx4 Generator unit kept warm 19.8 C?
Bx5 Window, some leakage at perimeter but still performing reasonably well with an average temperature of 11.5C. 5C.

30/10/19 7:02:44 PM



IR_7942.jpg FLIR T400 48802798

Measurements

Bx1	Max	17.7 °C
Bx2	Max	16.5 °C
	Average	10.3 °C
Bx3	Max	16.2 °C
Bx4	Max	13.0 °C
	Average	11.1 °C

Parameters

Emissivity	0.95
Refl. temp.	7 °C

Note

North Side
Bx1 Building exhaust.
Bx2 Two buidling exhausts.
Bx3 Warm in generator shed.
Bx4 Below average leakage and better than average insulation.

30/10/19 7:04:13 PM



IR_7943.jpg FLIR T400 48802798

Measurements

Bx1	Max	13.2 °C
Bx2	Max	29.4 °C
	Average	10.3 °C

Parameters

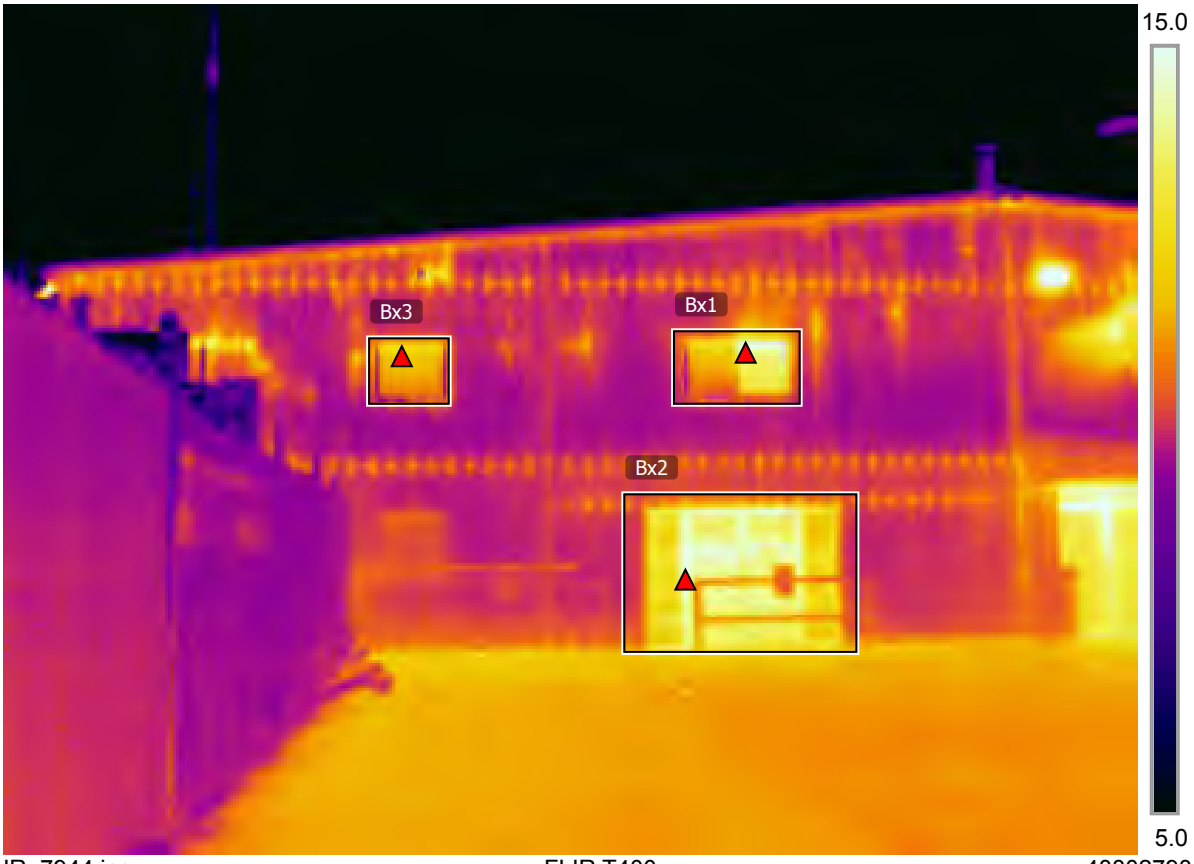
Emissivity	0.95
Refl. temp.	7 °C

Note

West Side
Bx1 Thermal Briding at the eaves but better than on North side.
Bx2 AHU's

Note: Duct work appears dark due to clear night and reflective cladding.

30/10/19 7:04:58 PM



IR_7944.jpg FLIR T400 48802798

Measurements

Bx1	Max	16.3 °C
	Average	11.8 °C
Bx2	Max	14.9 °C
	Average	12.5 °C
Bx3	Max	12.7 °C
	Average	11.2 °C

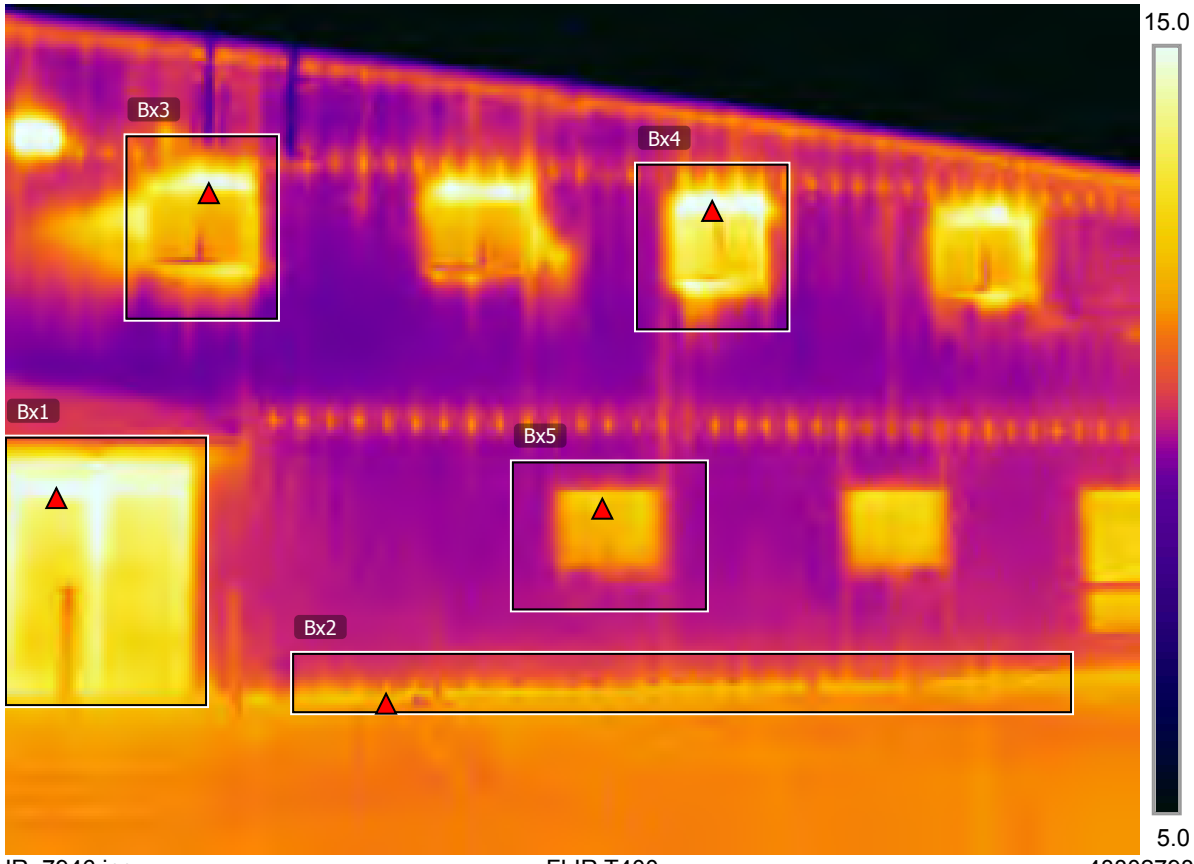
Parameters

Emissivity	0.95
Refl. temp.	7 °C

Note

West Side
Bx1 Window higher than average leakage at perimeter overall insulation value average.
Bx2 Staff entrance worse than average leakage at perimeter overall insulation value average.
Bx3 Window average leakge rate and insulation value.

30/10/19 7:06:20 PM



IR_7946.jpg FLIR T400 48802798

Measurements

Bx1	Max	16.0 °C
	Average	13.4 °C
Bx2	Max	12.8 °C
	Average	11.3 °C
Bx3	Max	15.2 °C
	Average	11.7 °C
Bx4	Max	16.3 °C
	Average	11.9 °C
Bx5	Max	13.1 °C
	Average	10.7 °C

Parameters

Emissivity	0.95
Refl. temp.	7 °C

Note

West Side
Bx1 Public Entrance worse than average leakage. Worse than average insulation value.
Bx2 Thermal bridging at foundation interface. Thermal bridging at junction between first and second floor and at top of second floor.
Bx3 & Bx4 Excessive leakage around perimeter of windows on upper floor. Other windows in picture very similar.
Bx5 Lower floor window performing better.

30/10/19 7:07:45 PM



IR_7948.jpg FLIR T400 48802798

Measurements

Bx1	Max	14.7 °C
	Average	11.5 °C
Bx2	Max	10.3 °C
	Average	9.9 °C
Bx3	Max	13.0 °C
	Average	12.7 °C
Bx4	Max	14.2 °C
	Average	13.0 °C

Parameters

Emissivity	0.95
Refl. temp.	7 °C

Note

West Side Main Bldg
Bx1 Window above average leakage at lower slider average insulation.
Bx2 & Bx3 Masonary wall warmer than metal sliding due to retained heat from sunlight during the day.
Bx4 Above average leakage and below average insualtion.

30/10/19 7:08:48 PM



IR_7950.jpg FLIR T400 48802798

Measurements

Bx1	Max	14.3 °C
	Average	12.9 °C
Bx2	Max	15.9 °C
	Average	12.8 °C
Bx3	Max	17.2 °C
	Average	14.7 °C

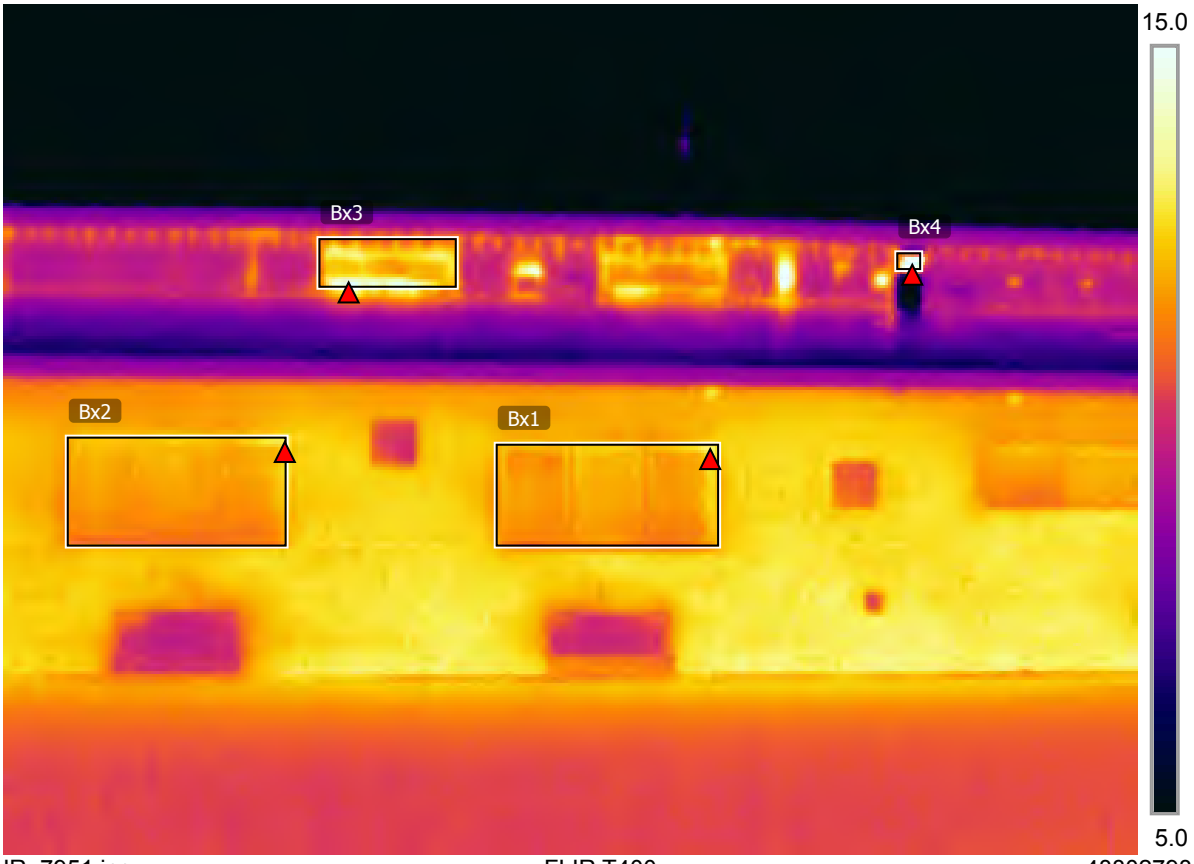
Parameters

Emissivity	0.95
Refl. temp.	7 °C

Note

South Side Addition
Bx1 Window above average leakage and below average insulation value.
Bx2 Window significantly above average leakage and below average insulation value.
Bx3 Staff entrance south side addition. Above average leakge and below average insulation value.

30/10/19 7:09:23 PM



IR_7951.jpg FLIR T400 48802798

Measurements

Bx1	Max	13.3 °C
	Average	11.9 °C
Bx2	Max	13.2 °C
	Average	11.9 °C
Bx3	Max	15.5 °C
	Average	12.6 °C
Bx4	Max	16.5 °C

Parameters

Emissivity	0.95
Refl. temp.	20 °C

Note

Southside Addition
Bx1 & Bx2 Windws average leakage and average insulation value.
Bx3 Window in main bldg above average leakage and average insulation value.
Bx4 Vent.

30/10/19 7:10:25 PM



IR_7953.jpg FLIR T400 48802798

Measurements

Bx1	Max	16.1 °C
	Average	13.3 °C

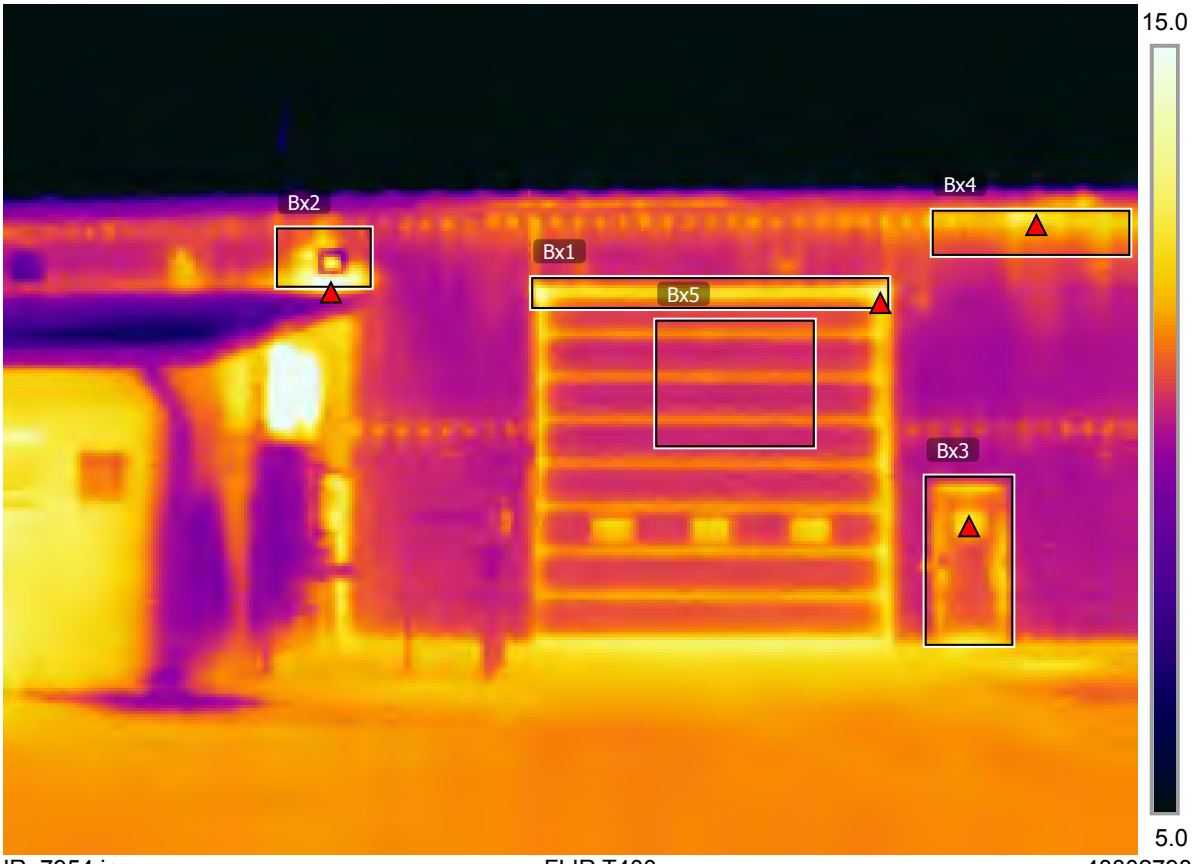
Parameters

Emissivity	0.95
Refl. temp.	7 °C

Note

South Addition
Bx1 Window above average leakage and average insulation value.

30/10/19 7:10:59 PM



IR_7954.jpg FLIR T400 48802798

Measurements

Bx1	Max	14.4 °C
Bx2	Max	16.2 °C
Bx3	Max	12.9 °C
	Average	11.3 °C
Bx4	Max	13.3 °C
Bx5	Average	10.7 °C

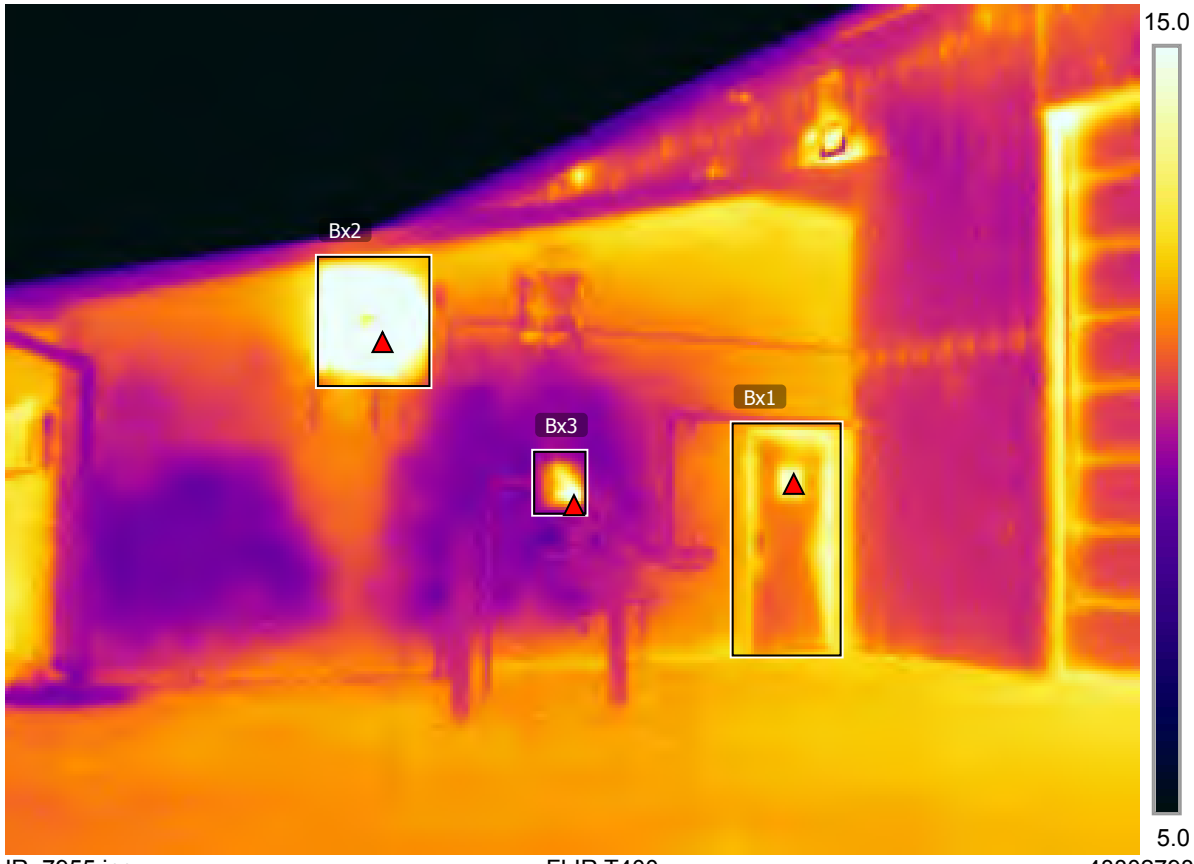
Parameters

Emissivity	0.95
Refl. temp.	7 °C

Note

South side Main Bldg
Bx1&Bx5 Garage door average leakage and better than average insualtion value. Some thermal bridging bewteen panels.
Bx2 HRV vent.
Bx3 Door better than average air leakage and better than average insulation.
Bx4 Thermal bridging below eve.

30/10/19 7:11:28 PM



IR_7955.jpg FLIR T400 48802798

Measurements

Bx1	Max	14.6 °C
	Average	12.2 °C
Bx2	Max	34.7 °C
Bx3	Max	17.8 °C

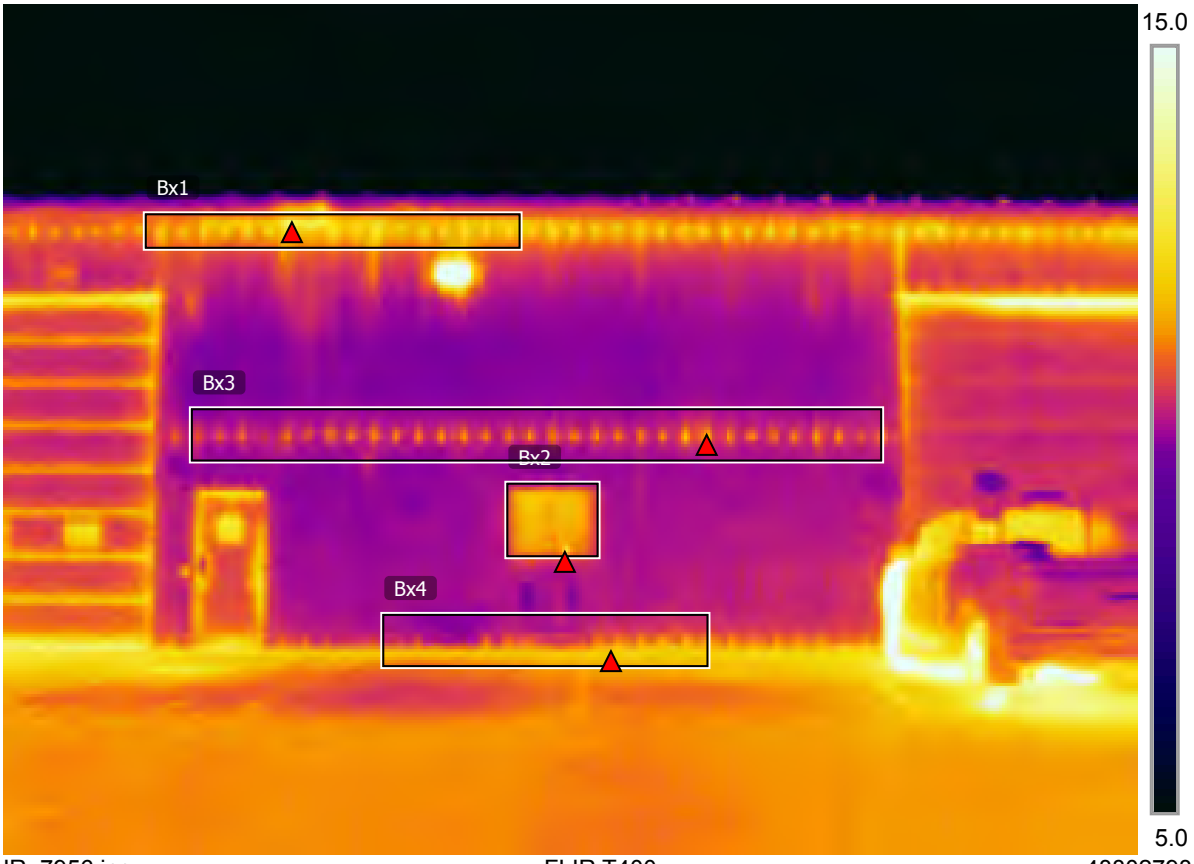
Parameters

Emissivity	0.95
Refl. temp.	7 °C

Note

East End of Addition
Bx1 worse than verage air leakage, average insulation value.
Bx2 Condensing Unit
Bx3 Gas Meter Corrector

30/10/19 7:12:03 PM



IR_7956.jpg FLIR T400 48802798

Measurements

Bx1	Max	13.8 °C
Bx2	Max	12.8 °C
	Average	11.3 °C
Bx3	Max	12.5 °C
Bx4	Max	12.3 °C

Parameters

Emissivity	0.95
Refl. temp.	7 °C

Note

South Side Main Bldg
Bx1 Thermal bridging at eave.
Bx2 Window average leakage and average insulation value.
Bx3 Thermal bridging where exterior connects to building.
Bx4 Thermal bridging where wall meets foundation.

30/10/19 7:12:48 PM



IR_7957.jpg FLIR T400 48802798

Measurements

Bx1	Max	15.4 °C
Bx2	Average	10.2 °C

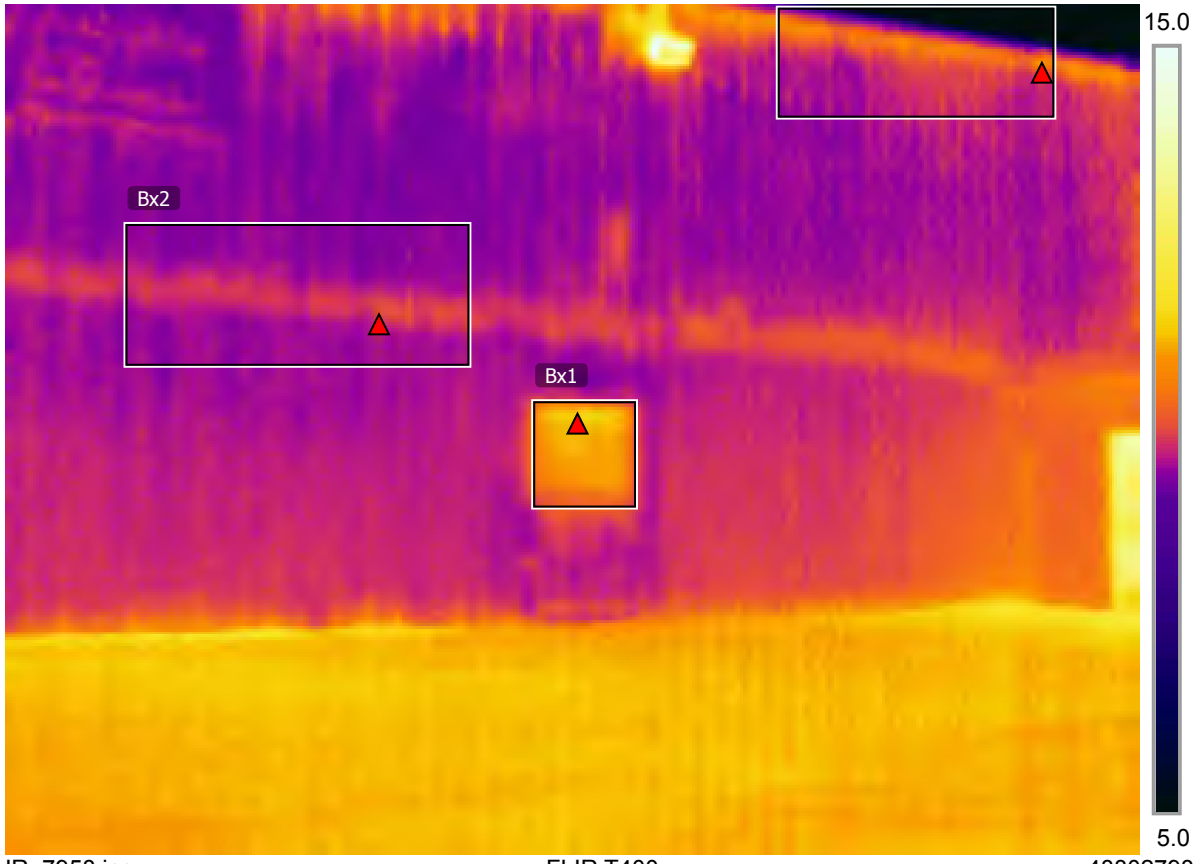
Parameters

Emissivity	0.95
Refl. temp.	7 °C

Note

South Side Main Bldg
Bx1 Warehouse door air leakgae deemed average.
Bx2 Better than average insulation.

30/10/19 7:13:40 PM



IR_7958.jpg FLIR T400 48802798

Measurements

Bx1	Max	12.0 °C
	Average	10.9 °C
Bx2	Max	10.5 °C
Bx3	Max	11.2 °C

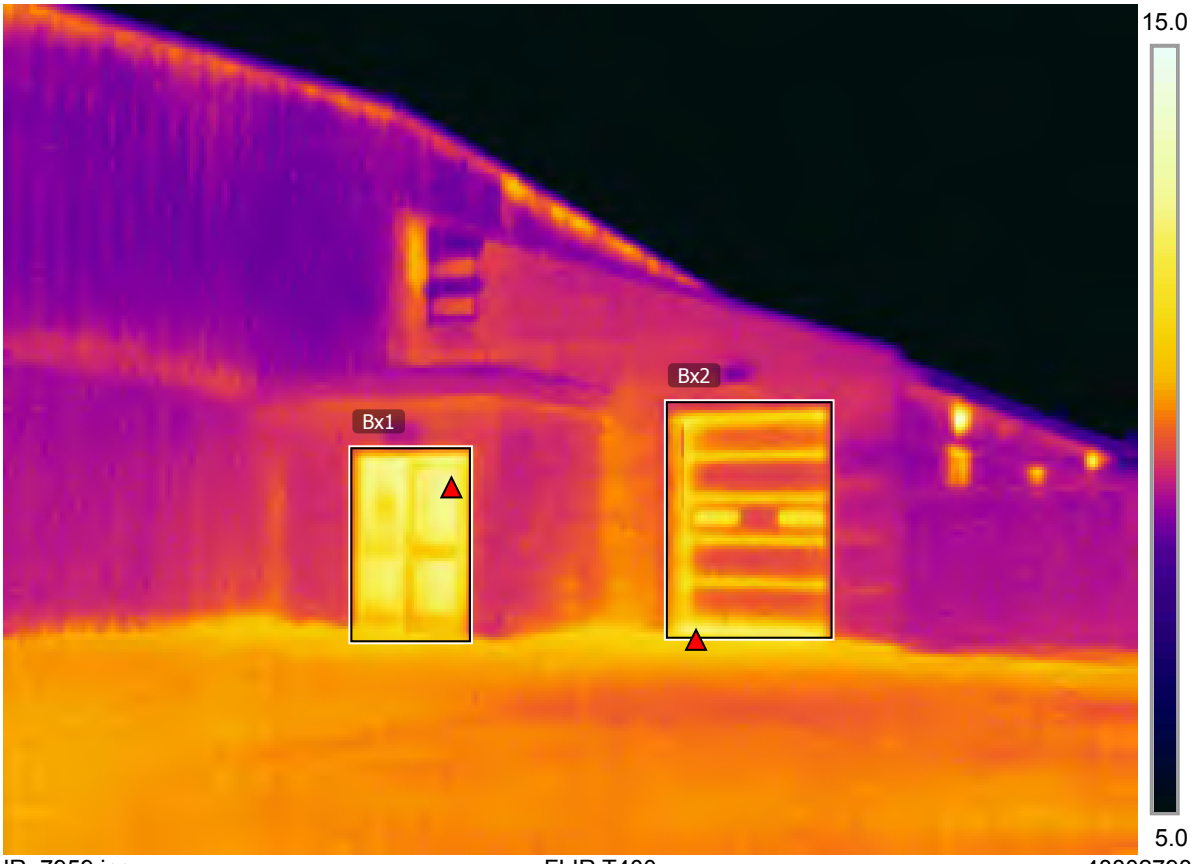
Parameters

Emissivity	0.95
Refl. temp.	7 °C

Note

East End Main Bldg
Bx1 Window better than average seal and better than average insulation.
Bx2 & Bx3 less thermal bridging.

30/10/19 7:14:06 PM



IR_7959.jpg FLIR T400 48802798

Measurements

Bx1	Max	13.4 °C
	Average	11.9 °C
Bx2	Max	12.9 °C
	Average	10.6 °C

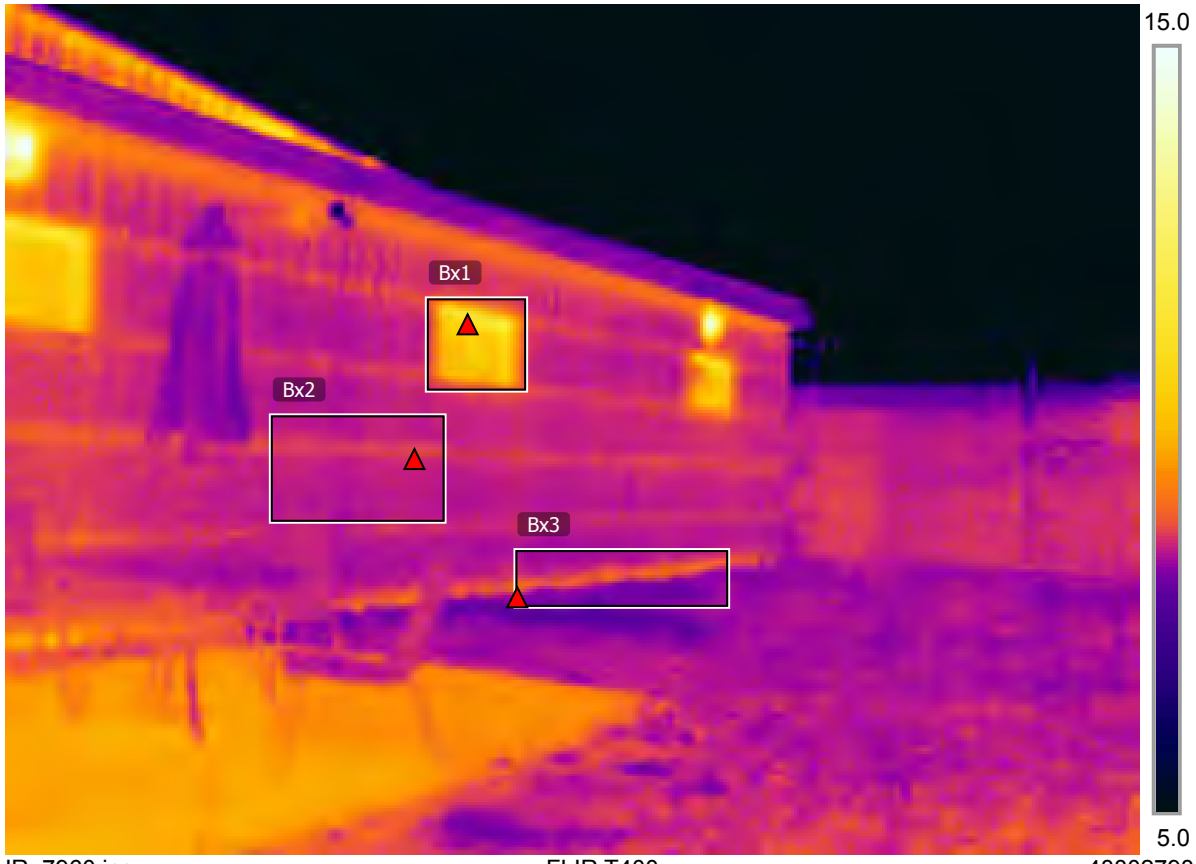
Parameters

Emissivity	0.95
Refl. temp.	20 °C

Note

South Side Meter Shop
Bx1 Entrance average leakage and average insulation value.
Bx2 Meter shop garage door better than average leakage and insulation value. Some thremal bridging at the panel points.

30/10/19 7:15:43 PM



IR_7960.jpg FLIR T400 48802798

Measurements

Bx1	Max	11.7 °C
	Average	9.9 °C
Bx2	Max	8.9 °C
	Average	8.6 °C
Bx3	Max	9.3 °C

Parameters

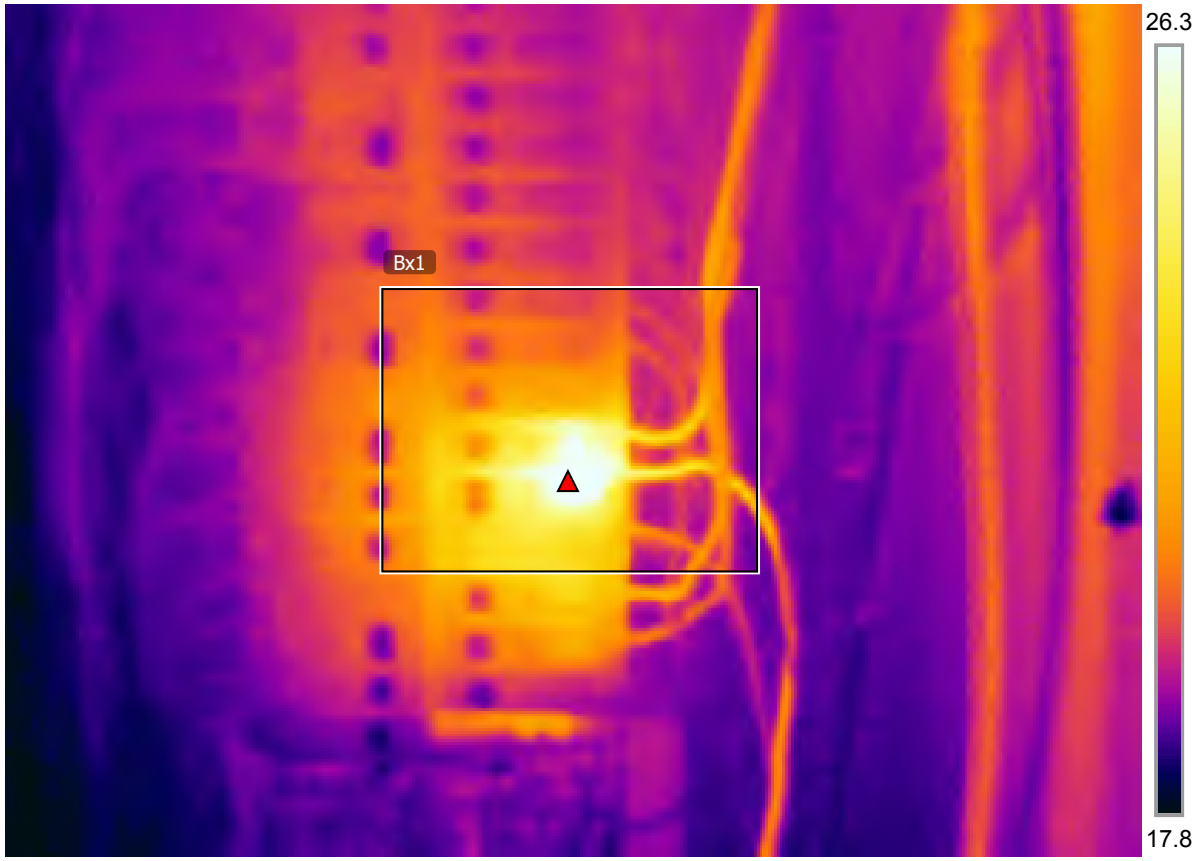
Emissivity	0.95
Refl. temp.	20 °C

Note

West Wall Meter Shop
Bx1 Window less than average leakage and better than average insulation.
Bx2 Wall better than average insulation.
Bx3 Less than average thermal bridging between wall and foundation.

Appendix D - Electrical Equipment Thermographic Inspection

16/10/19 7:16:56 AM



IR_7907.jpg FLIR T400 48802798

Measurements

Bx1	Max	28.0 °C

Parameters

Emissivity	0.95
Refl. temp.	20 °C

Note

GARAGE BREAKER PANEL
Single breaker for roof heating showing warm due to load (9.5 amps). Panel is loaded 17(A) / 9(B) / 21(C).
No concern noted.





Measurements

Bx1	Max	41.3 °C

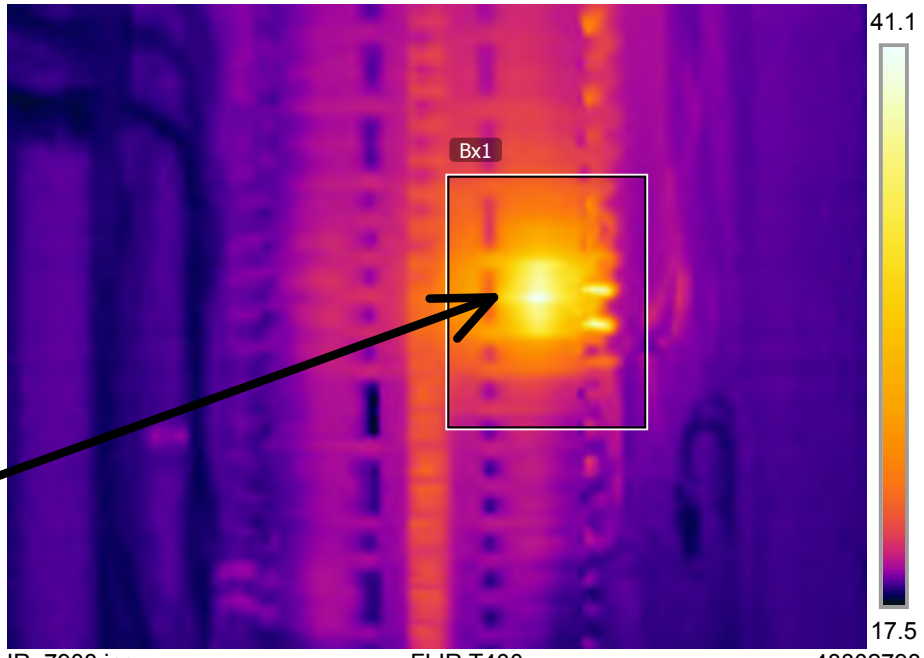
Parameters

Emissivity	0.95
Refl. temp.	20 °C

Note

Panel for Addition
Panel loaded at 13(A)/12(B)/31(C)
Breaker labelled as "Clothes Dryer Heating" was loaded at 19 amps.
Breaker temperature at >41 degC is excessive and should be addressed.

16/10/19 7:19:28 AM



IR_7908.jpg FLIR T400 48802798

16/10/19 7:19:28 AM



IR_7908.jpg FLIR T400 48802798

Measurements

Bx1	Max	20.1 °C

Parameters

Emissivity	0.95
Refl. temp.	20 °C

Note

SPARE GARAGE SUB PANEL
Low current draw and maximum temperature at ambient. No concerns noted.

16/10/19 7:23:20 AM



IR_7909.jpg FLIR T400 48802798



Measurements

Bx1	Max	54.3 °C
Bx2	Max	30.0 °C
Dt1	Bx1.Max - Bx2.Max	24.3 °C

Parameters

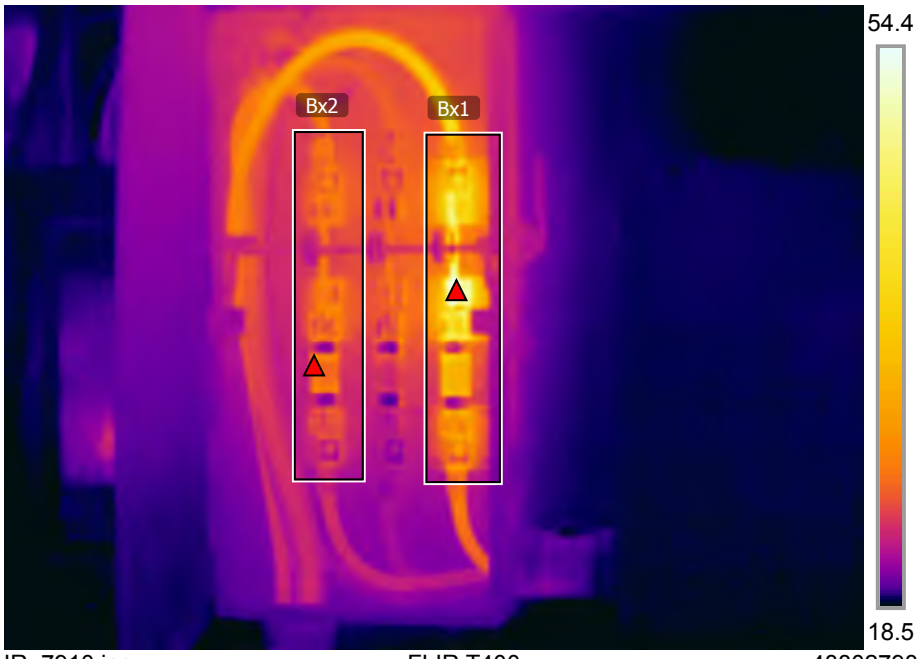
Emissivity	0.95
Refl. temp.	20 °C

Note

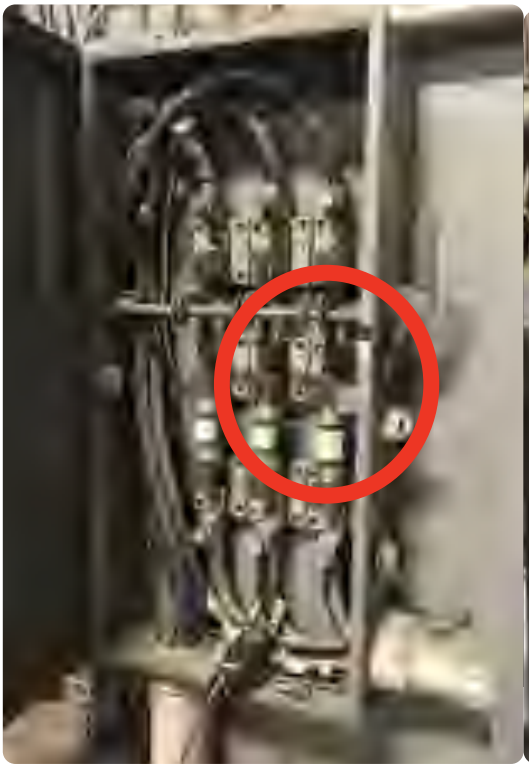
BUILDING MAIN

Loaded at 94(A)/70(B)/100(C)
400A disconnect with 300A fuses
C Phase is over 54 deg. C on the line side. Indication of a potential issue with improper contact, loose connection or similar

16/10/19 7:29:06 AM



IR_7910.jpg FLIR T400 48802798





Measurements

Bx1	Max	20.5 °C
Bx2	Max	19.5 °C
Dt1	Bx1.Max - Bx2.Max	1.0 °C

Parameters

Emissivity	0.95
Refl. temp.	20 °C

Note

GARAGE MAIN DISCONNECT

200A Disconnect w/ 200A fuses
Draw is 17/7.5/21
Even though the draw through the A leg is 24% less than through the C leg, the A leg is 1 degC warmer at the load connection.

There may be a minor issue on the load side connection of A leg

16/10/19 7:33:05 AM



IR_7911.jpg FLIR T400 48802798



IR_7911.jpg FLIR T400 48802798

Measurements

Bx1	Max	20.9 °C
Bx2	Max	23.1 °C

Parameters

Emissivity	0.95
Refl. temp.	20 °C

Note

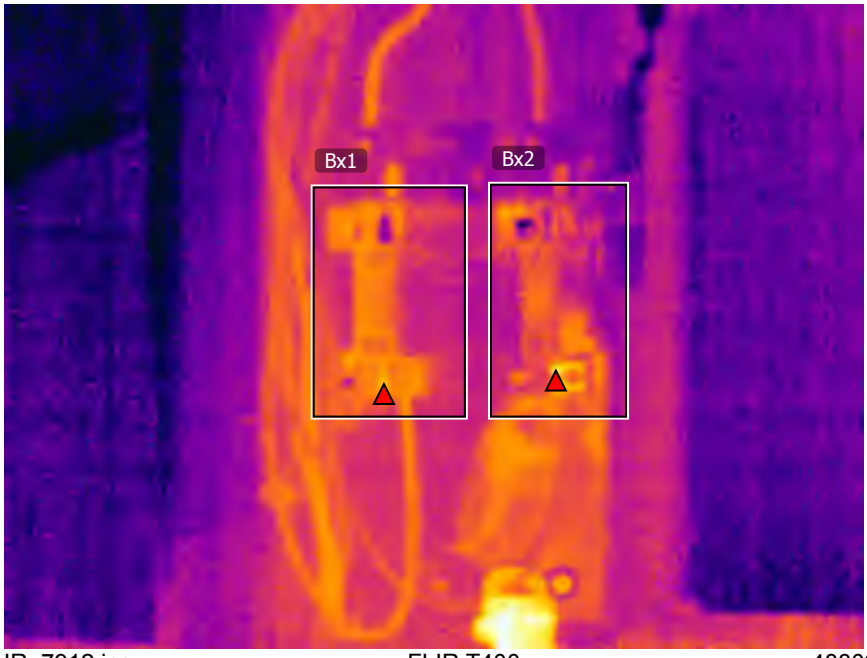
OUTSIDE GARAGE DISCONNECT

200 AMP DISCONNECT
125 AMP FUSES (SINGLE PHASE)

19A on L1
25A on L2

No concerns noted

16/10/19 7:37:53 AM



IR_7912.jpg FLIR T400 48802798



Measurements

Bx1	Max	22.4 °C
Bx2	Max	22.2 °C
Dt1	Bx1.Max - Bx2.Max	0.2 °C

Parameters

Emissivity	0.95
Refl. temp.	20 °C

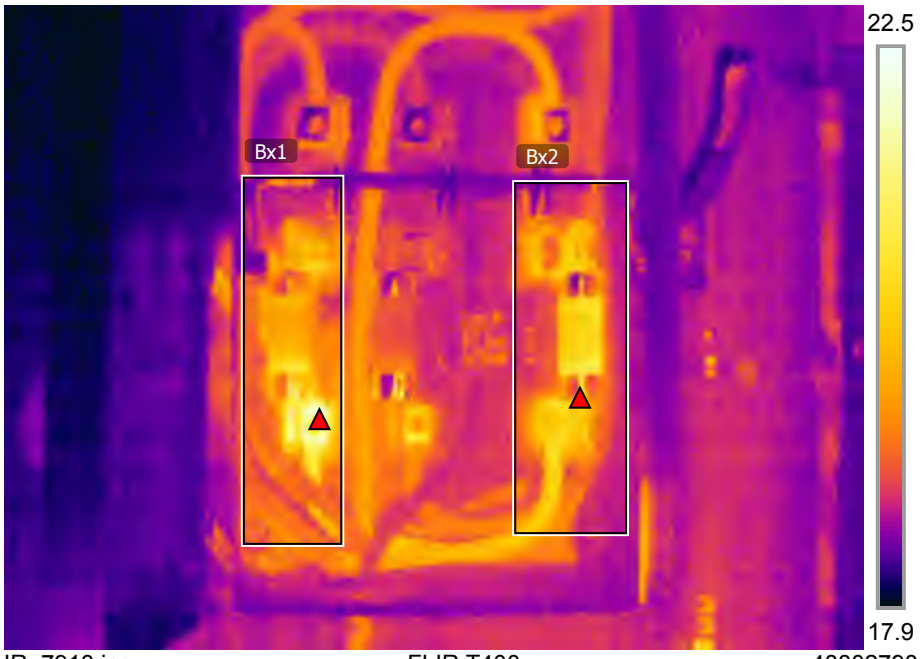
Note

ADDITION MAIN DISCONNECT
200 Amp disconnect with 150 Amp fuses

Loaded at 26(A)/13(B)/31(C)
Load side connection on A phase is very slightly warmer than C phase even though C phase is loaded 15% higher.

There is a potential of a minor issue on the connection of the A phase lug (load side).

16/10/19 7:40:00 AM



IR_7913.jpg FLIR T400 48802798



Measurements

Bx1	Max	21.8 °C
Bx2	Max	23.1 °C
Bx3	Max	22.5 °C
Dt2	Bx1.Max - Bx3.Max	-0.7 °C
Dt1	Bx2.Max - Bx3.Max	0.5 °C

Parameters

Emissivity	0.95
Refl. temp.	20 °C

Note

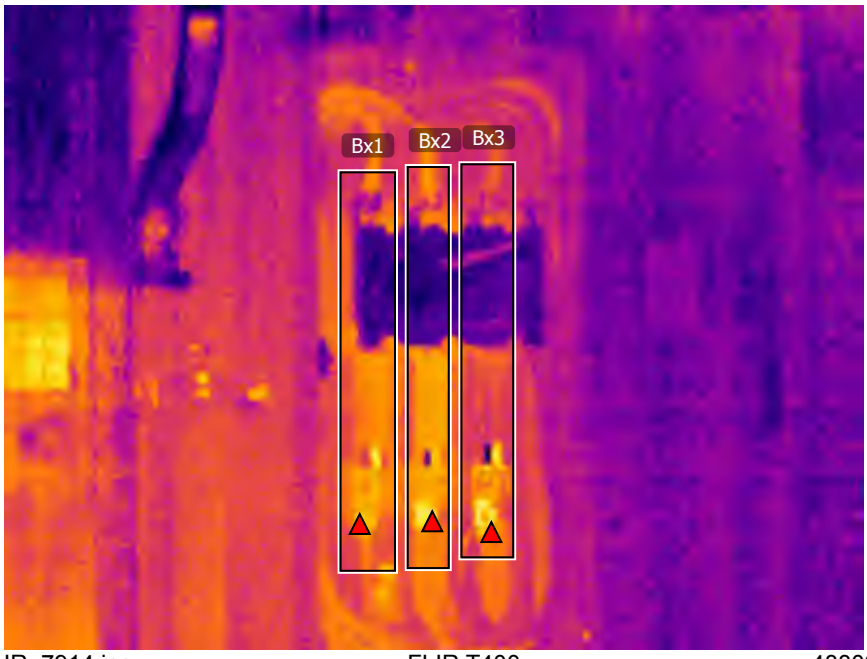
SUBSTATION SHOP MAIN DISCONNECT

100 Amp disconnect
100 Amp fuses

Loaded 10(A)/11(B)/15(C)

B leg seems slightly warm on load side

16/10/19 7:41:44 AM



IR_7914.jpg FLIR T400 48802798



Measurements

Bx1	Max	21.7 °C
Bx2	Max	23.2 °C
Bx3	Max	22.9 °C
Dt2	Bx1.Max - Bx3.Max	-1.3 °C
Dt1	Bx1.Max - Bx2.Max	-1.6 °C

Parameters

Emissivity	0.95
Refl. temp.	20 °C

Note

BOARDROOM MAIN DISCONNECT

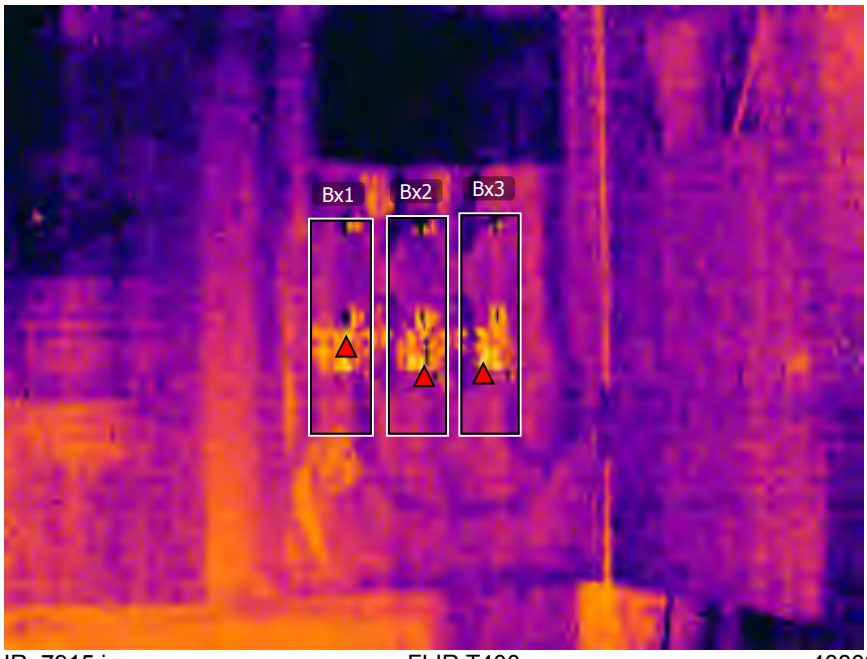
200A disconnect
200A fuses

Loaded at 11/2/6 although A phase was cycling from 11 to 22 at time of testing.

It is noteworthy that the B phase is 1.6 degC warmer on the load side than A phase even though A phase is carrying 5 X the current when compared to B.

There may be a minor issue on a connection on the load side of B phase.

16/10/19 7:44:32 AM



IR_7915.jpg FLIR T400 48802798



Measurements

Bx1	Max	23.0 °C
Bx2	Max	20.7 °C
Bx3	Max	21.7 °C

Parameters

Emissivity	0.95
Refl. temp.	20 °C

Note

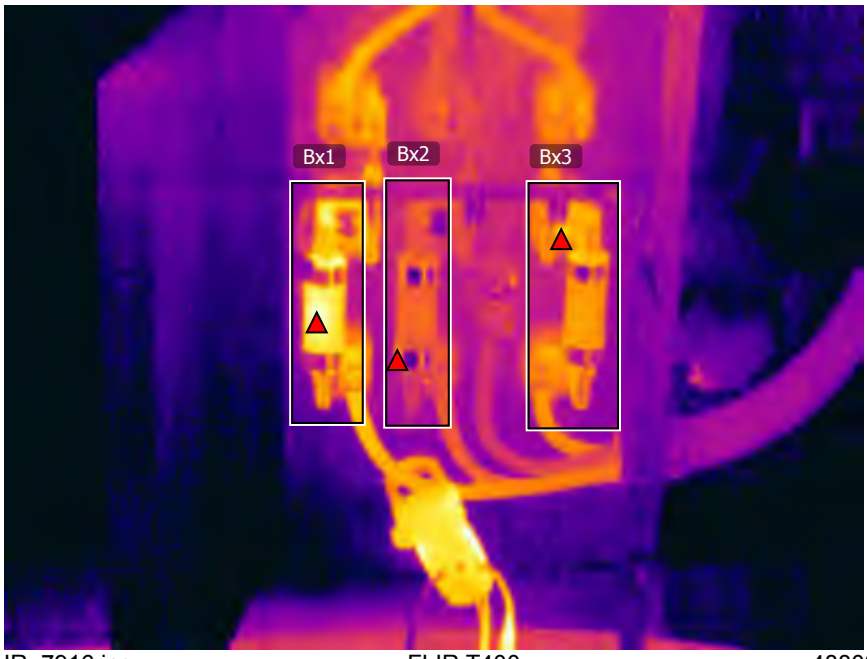
MEZZANINE MAIN DISCONNECT
SPLITTER PANEL

200A Disconnect
A & B Fuses at 150 Amp
C Fuse at 200 Amp

The circuit is loaded at 41/21/48
Temperatures appear to be consistent with loading and fuse sizes.

No issues noted.

16/10/19 7:48:00 AM



IR_7916.jpg FLIR T400 48802798



Measurements

Bx1	Max	25.0 °C
Bx2	Max	25.8 °C
Bx3	Max	23.5 °C

Parameters

Emissivity	0.95
Refl. temp.	20 °C

Note

STORES DISCONNECT

200A disconnect
200 A fuses

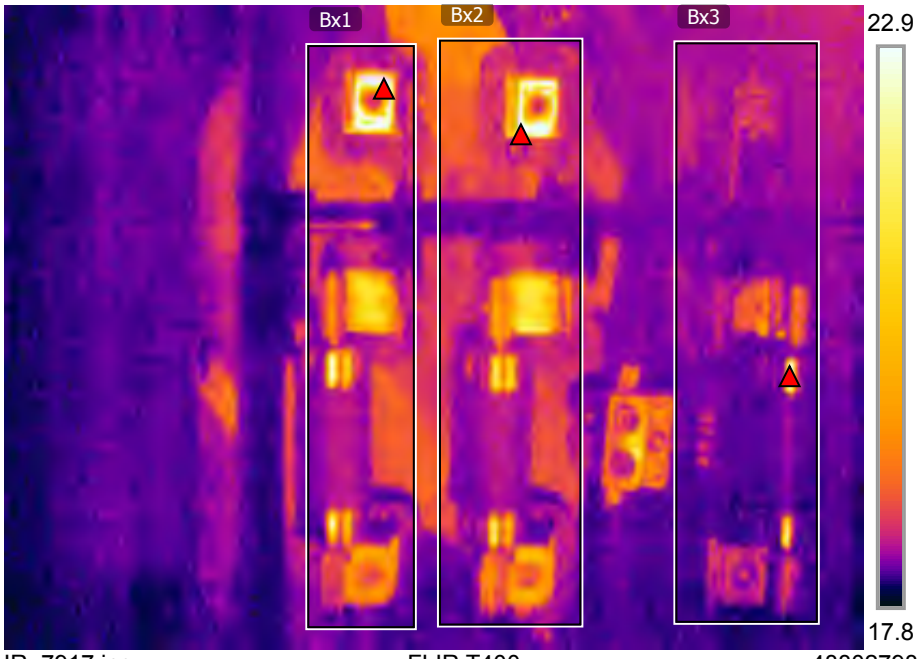
Loaded at 1/8/1

It was noticed that the discoonect knives were barely engaged despite the circuit being closed.

It is strongly recommended that the switch mechanism be repaired to ensure full knife engagement.

Due to the very low loading, thermal information is deemed to be somewhat unreliable. No further faults found at low loading.

16/10/19 7:52:12 AM



IR_7917.jpg FLIR T400 48802798



Measurements

Bx1	Max	21.7 °C

Parameters

Emissivity	0.95
Refl. temp.	20 °C

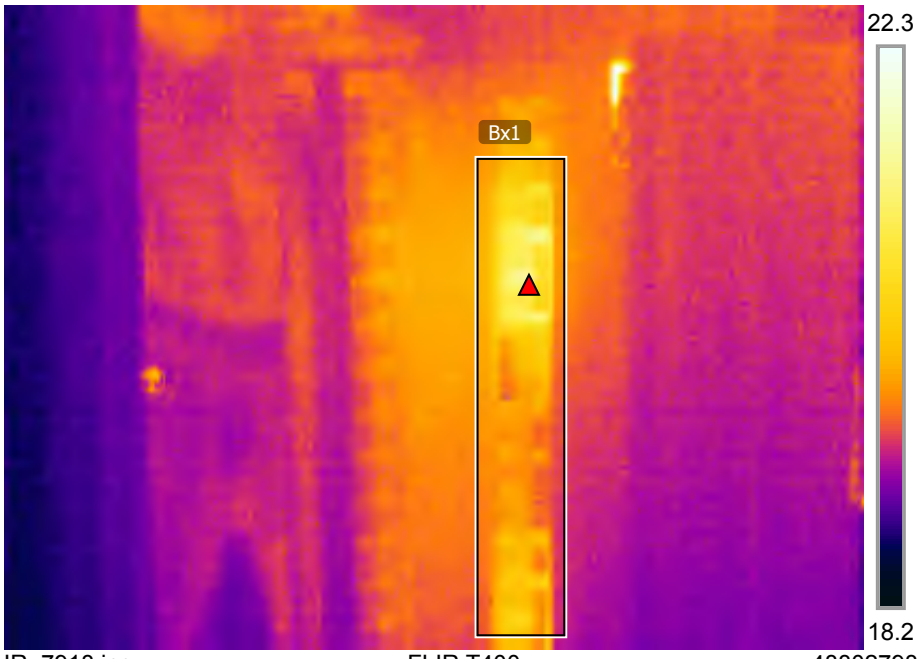
Note

STORES DISTRIBUTION PANEL

225 Amp rated panel
Warm spot shown is on heater circuit and slight temperature rise over ambient is deemed to be normal for loading situation.

No concerns noted.

16/10/19 7:57:02 AM



IR_7918.jpg FLIR T400 48802798



Measurements

Bx1	Max	20.2 °C
	Min	18.2 °C
	Average	19.1 °C

Parameters

Emissivity	0.95
Refl. temp.	20 °C

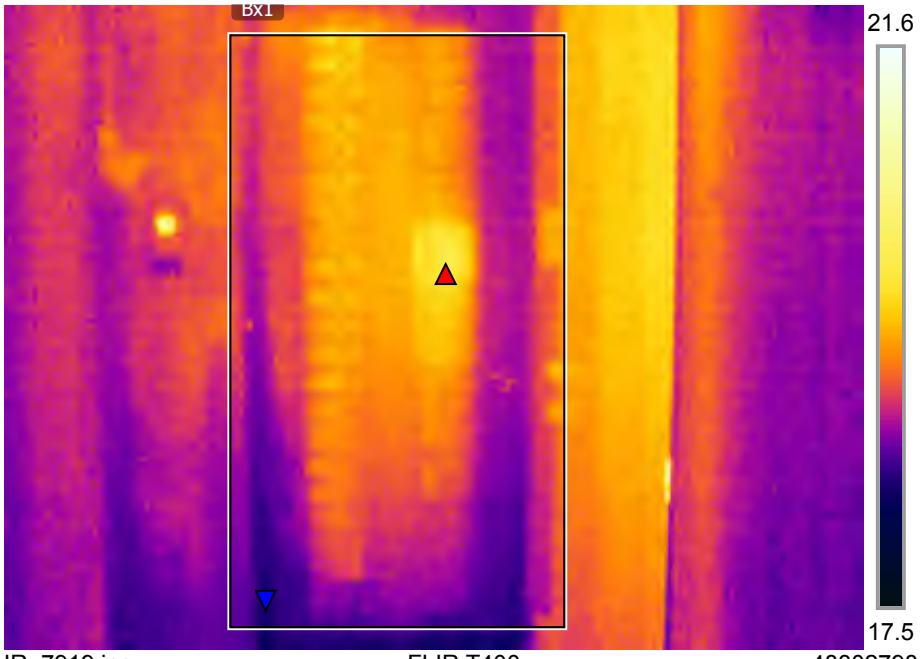
Note

METERING DISTRIBUTION PANEL

150 Amp main disconnect.

No concerns noted

16/10/19 7:58:36 AM



IR_7919.jpg FLIR T400 48802798

16/10/19 7:58:36 AM



IR_7919.jpg FLIR T400 48802798

Measurements

Bx1	Max	24.1 °C
	Min	21.3 °C
	Average	21.9 °C

Parameters

Emissivity	0.95
Refl. temp.	20 °C

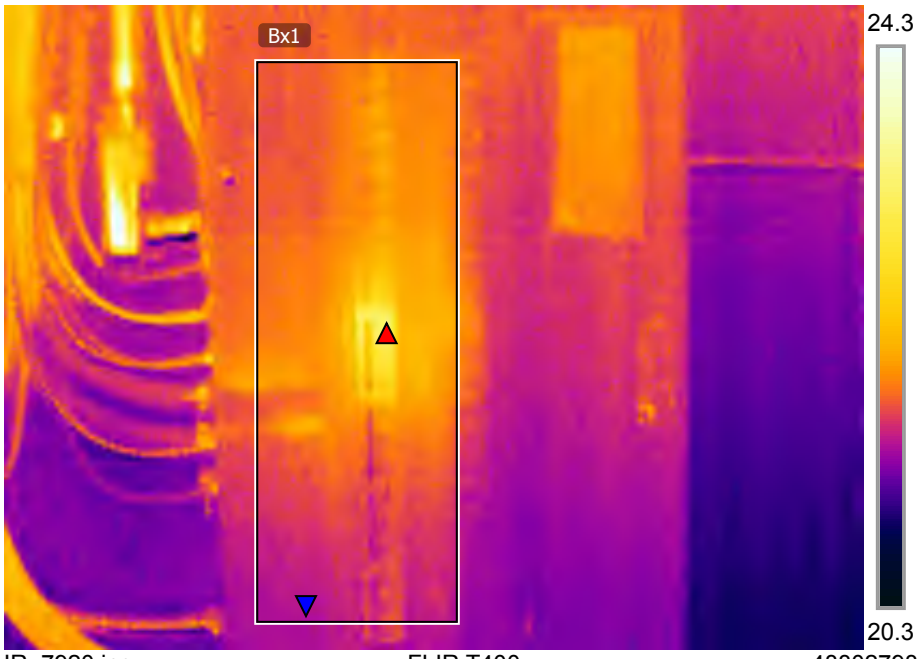
Note

EPA Panel in Printer Room

200 Amp Main Breaker

No concerns noted

16/10/19 8:02:33 AM



IR_7920.jpg FLIR T400 48802798

16/10/19 8:02:33 AM



IR_7920.jpg FLIR T400 48802798

Measurements

Bx1	Max	29.4 °C
Bx2	Max	25.8 °C

Parameters

Emissivity	0.95
Refl. temp.	20 °C

Note

Breaker Panel in Printer Room

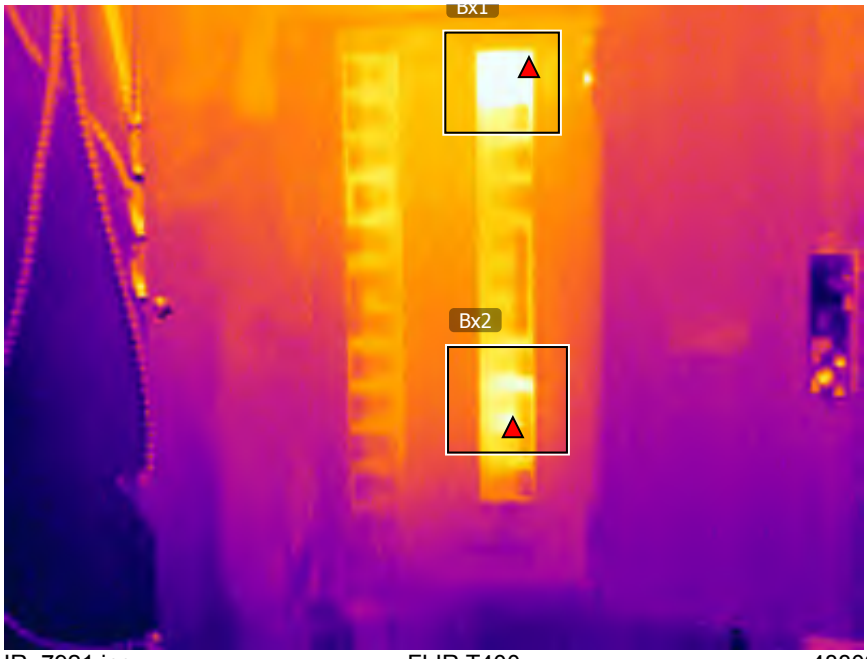
225A Panel Rating

Breaker #2 is a 15 amp breaker loaded at 18 amps. Breaker should likely be tripping.

Stabs 18-20 are Sub B Feed, loaded at 8 amps. No issue with 25.8 deg.C temperature.

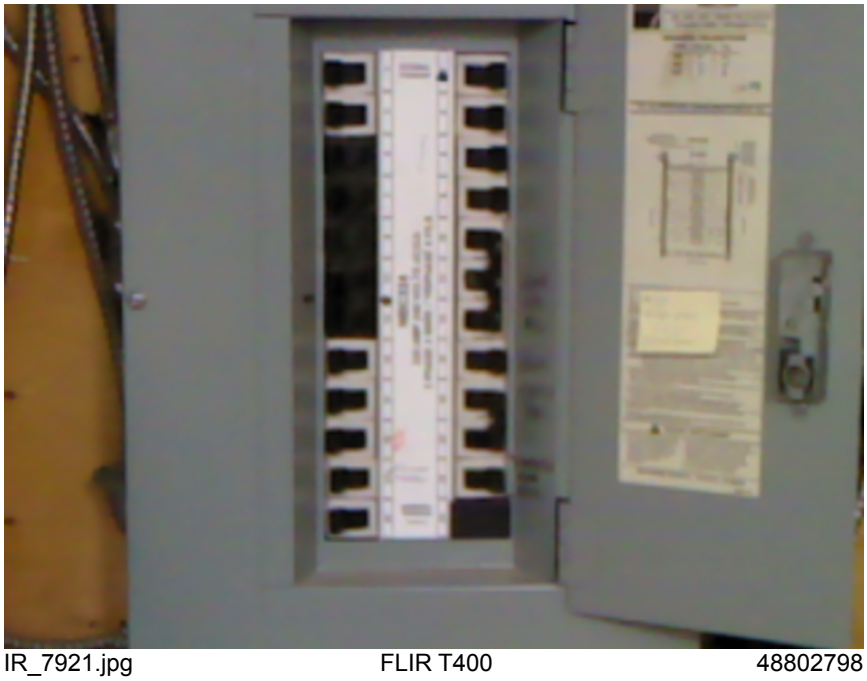
Loading on Breaker #2 should be investigated and circuit corrected.

16/10/19 8:03:20 AM



IR_7921.jpg FLIR T400 48802798

16/10/19 8:03:20 AM



IR_7921.jpg FLIR T400 48802798

Measurements

Bx1	Max	33.8 °C

Parameters

Emissivity	0.95
Refl. temp.	20 °C

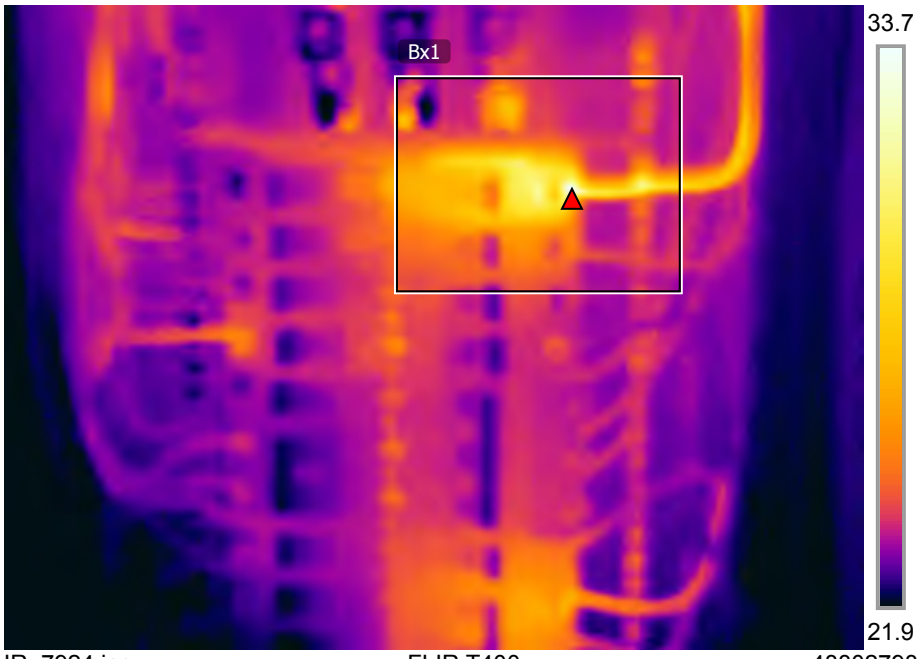
Note

DISTRIBUTION PANEL IN PRINTER ROOM WITH COVER OFF

Notice 34 degC temperature in overloaded circuit (stab #2).

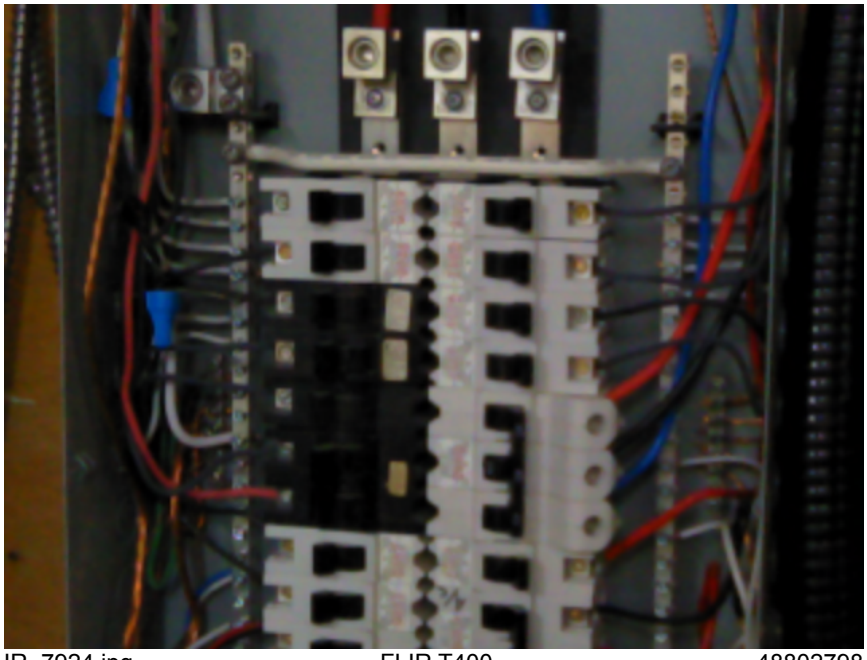
Circuit loaded at 18 amps on 15 amp breaker. Overload condition should be corrected.

16/10/19 8:50:36 AM



IR_7924.jpg FLIR T400 48802798

16/10/19 8:50:36 AM



IR_7924.jpg FLIR T400 48802798

Measurements

Bx1	Max	24.0 °C

Parameters

Emissivity	0.95
Refl. temp.	20 °C

Note

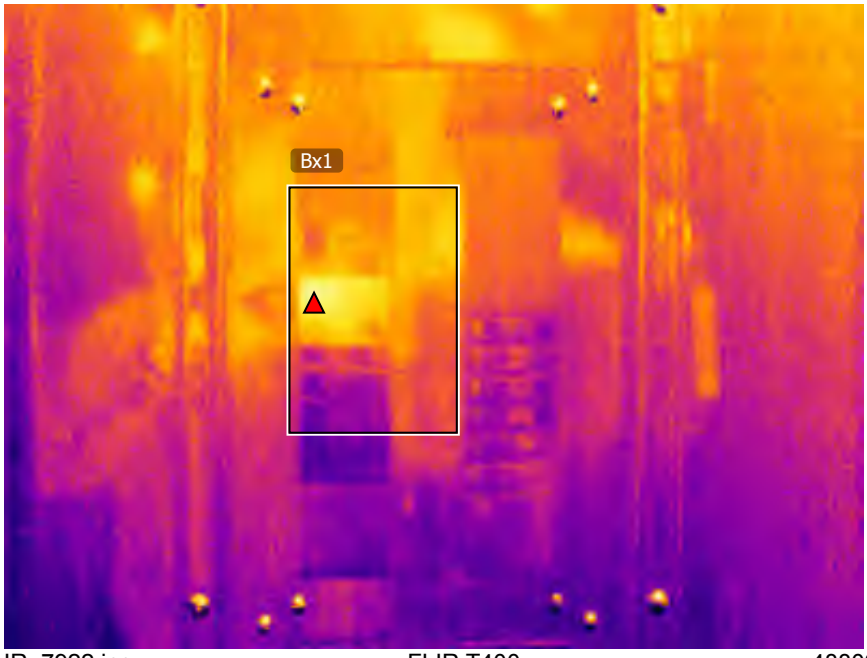
PANEL B in Printer Room

225 Amp Panel

Warm circuit is loaded at 9 amps on 30 amp single breaker. Circuit is used to pwer 30 amp circuit in UPS room.

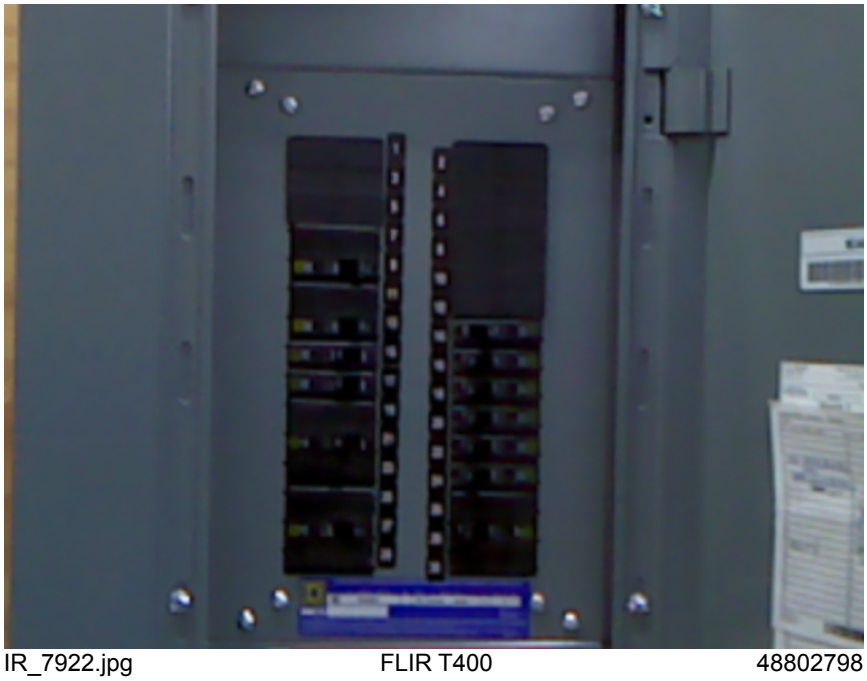
No concern noted.

16/10/19 8:07:07 AM



IR_7922.jpg FLIR T400 48802798

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Parameters

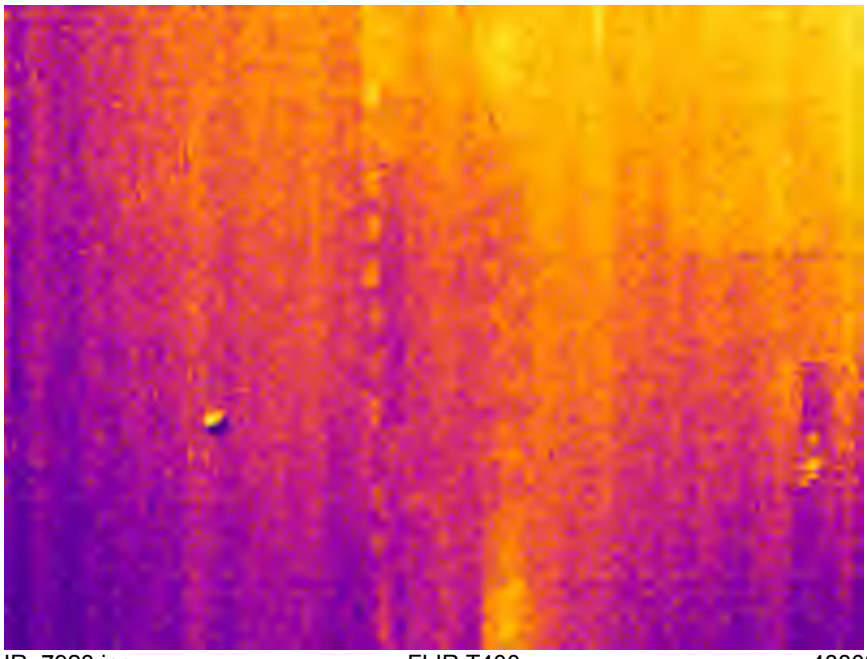
Emissivity	0.95
Refl. temp.	20 °C

Note

PANEL IN OFFICE HALLWAY

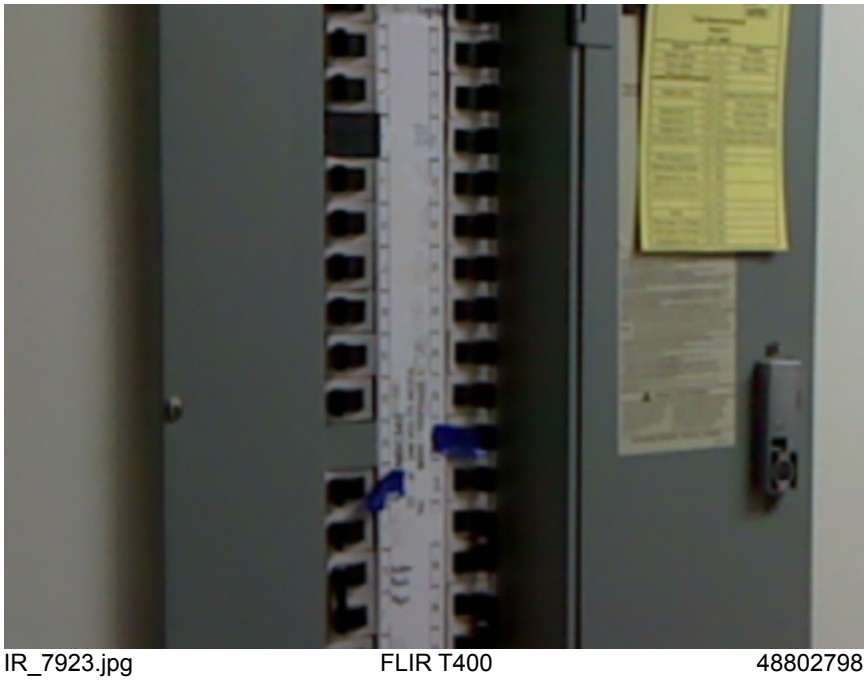
225 amp panel appears to be very lightly loaded. No concerns noted.

16/10/19 8:09:40 AM



IR_7923.jpg FLIR T400 48802798

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Appendix F Table - Building Assessment Recommendations 2021-2025

FIndings Summary and Financial Analysis

Asset Class	Reviewer	Asset Type	Asset Descriptor	Year of Acquisition (* indicates		Age	Normal Life Expectancy	Remaining Life	Priority	Condition	Quantity	UOM	Unit Cost	UOM	Current Cost (Replace, Repair, Allowance)	Timing [years]	Expected Cost	Planned Year	Comments	Recommendations
		Foundation Flashing	**Southside Addition**	1986	*	33	50	17	D		125	ft	80	/ft	$10,000	0–5	$10,600	2021	Flashing is badly damaged and deteriorated in many locations	Replace flashing ensuring that is sloped appropriately.
Walls	**BWA/Indusp ec**	**Metal Siding Repair**	**Main Building**	1978	*	41	70	29	B	P		LS		/LS	10000	0–5	$10,600	2021	Numerous areas of corrosion and damage.	Repair to prevent possible water ingress into building envelope and accelerated degradation.
		Metal Roofing Flute Seals	**Main Building**	1978	*	41	70	29	D	P	340	ft	25	/ft	$8,500	0–5	$9,000	2021	Flute seals missing in a number of locations on north and south side of the main building.	Replace flute seals.
		Breaker Panel	**Main Building (Vehicle Storage)**	1978	*	41	40	-1	B	F	1	ea	$1500	/ea	$5,000	0–5	$5,300	2021	Refer to Electrical Thermography report for specific comments re. each panel	
		Fall-Arrest Lifeline	**Addition on South Side**	1986	*	33	25	-8	A	P	1	LS	$5000	/LS	$5,000	0–5	$5,300	2021	No information on system and its design parameters.	**Do not use this system until the design has been verified by a structural engineer and the system has been tested appropriately**
		Chevrons	**Addition on South Side**	1986	*	33	40	7	D		95	ft	50	/ft	$4,750	0–5	$5,000	2021	Ice and snow sliding off building damaging eaves trough installed along edge of building.	Install ice shields along south edge.
		Disconnect	**Main Building**	1978	*	41	40	-1	B	P	1	ea	$2800	/ea	$2,800	0–5	$3,000	2021	Refer to Electrical Thermography report for specific comments	Loaded at 94(A)/70(B)/100(C) 400A disconnect with 300A fuses. C phase is over 54 deg.C on the line side. Indication of a potential issue with improper contact, loose connection or similar
		Spare Sub-Panel	**Main Building (Vehicle Storage)**	1978	*	41	40	-1	B	F	1	ea	$1000	/ea	$2,500	0–5	$2,700	2021	Refer to Electrical Thermography report for specific comments	
		Disconnect	**Main Building (Vehicle Storage)**	1978	*	41	40	-1	B	F	1	ea	$1000	/ea	$2,000	0–5	$2,200	2021	Refer to Electrical Thermography report for specific comments	There may be a minor issue on the load side connection of A leg.
		Disconnect	**Main Building (Substation Workshop)**	1978	*	41	40	-1	B	F	1	ea	$1000	/ea	$2,000	0–5	$2,200	2021	Refer to Electrical Thermography report for specific comments	B leg seems slightly warm on the load side.
		Disconnect Splitter Panel	**Mezzanine Main Building**		*		40	40	B	F	1	ea	$1000	/ea	$2,000	0–5	$2,200	2021	Refer to Electrical Thermography report for specific comments	
		Steel Columns/Footings	**Visitor's Entrance**	2002	*	17	70	53	B	P	1	LS		/LS	$1,500	0–5	$1,600	2021	Cost to refurbish to columns and the footings	The columns should be repainted as needed as part of routine maintenance. The top of the columns should be repaired before the erode
		Caulking Sealant	**All Penetrations & Windows all sections.**	Various			15	15	D	P		LS		/LS	$1,000	0–5	$1,100	2021	Many windows and other penetrations have caulking that has failed.	Remove and replace caulking.
		Eye Wash Station	**Main Building (Vehicle Storage)**	1986	*	33	25	-8	A	F	1	ea	$1000	/ea	$1,000	0–5	$1,100	2021	Eye wash station should have a tempered water supply.	Provide hot water line and mixing valve to provide tempered water supply to eye wash station
		Eaves Trough Downspout	**Southside Addition**	2014	*	5	20	15	D	G		LS		/LS	500	0–5	$600	2021	Eaves outflow damaging building exterior.	Redirect.
		C02 Detectors	**Main Building**		*		10		A	G	5	ea	50	/ea	$250	0–5	$300	2021		Since the units are battery powered they should have batteries replaced replaced every
		Bollards	**Front Parking Lot (south and west side)**	2002	*	17	50	33	D	F		LS		/LS		0–5	$100	2021	The bollards are showing corrosion at their base.	The bollards should be repainted as needed as part of routine maintenance.
		Water Supply Piping & Meter	**All Sections**	1978	*	41	40	-1	D	F	1	LS		/LS	$15,000	0–5	$15,800	2022	Allowance to repair or replace a proportion of the water supply line to the building and in the building.	**All cold water and hot water piping should be properly insulated and labelled to prevent any excess corrosion due to condensation on the lines during warmer**
		Insulation	**Main Building**	1978	*	41	70	29	D	P		LS		/LS	$12500	0–5	$13,200	2022	Insulation deficiencies in garage area as per roof inspection report.	Investigate further and repair areas noted. An overall review of the building envelope and opportunities associated with improvements
		Personnel Doors	**Main Building**	Various			25	25	D	F	7	LS		/LS	$3,200	0–5	$3,400	2022	Many doors showing signs of corrosion, poor weather seals and damaged caulking	Paint doors, service seals and replace caulking
		Concrete Slab	**Stores**	2002	*	17	100	83	B	F	100	sqft	$7	/sqft	$2,800	0–5	$3,000	2022	Settlement of slab in former grease pit	Level floor slab in area of differential settlement
		Steel Structure	**Rear Lean-to**	1986	*	33	70	37	B	P	1	LS		/LS	$2,000	0–5	$2,200	2022	Cost to perform a more thorough inspection of the structure	
		Exterior Masonry	**Addition**	1986	*	33	40	7	B	F		LS		/LS	1500	0–5	$1,600	2022	Block erosion caused by down spout location.	Repair masonry once down spout has been redirected.

		Concrete Footing	**Telecomms Antenna**	1978	*	41	100	59	D	F	1	LS		/LS	$1,000	0–5	$1,100	2022	Cost to repair the concrete footing of the antenna	
		Ceilings	**Main Building (2nd Floor)**	2009	*	10	15	5	E	P	1	LS	$1000	/LS	$1,000	0–5	$1,100	2022	Numerous damaged tiles.	Replace tiles.
		Personnel Doors	**Addition on South Side**	Various			25	25	D	F	2			/	$900	0–5	$1,000	2022	Doors showing signs of corrosion, poor weather seals and damaged caulking.	Paint doors, service seals and replace caulking.
		Personnel Doors	**Meter Shop**						D	F	2			/	$900	0–5	$1,000	2022	Doors showing signs of corrosion.	Paint doors, monitor seals and caulking.
		Eaves Trough	**Southside Addition**	2014	*	5	20	15	D	G		LS		/LS	100	0–5	$200	2022	Eaves trough generally in good shape but it has been damaged.	Repair.
		Drainage	**French Drain Around Building**	Proposed					D		425	ft	$85	/ft	$36,125	0–5	$38,000	2023	Building fascade directly in contract with grade causing degradation of building facade.	Installation of french drain and curb on North and south side would prevent further degradation of the building exterior
		Windows	**Main Building**	1979	*	40	25	-15	D	F	18	ea	$750	/ea	$13,500	0–5	$14,200	2023	See Thermography Report for prioritization	
		Metal Roof	**Lean To**	1986	*	33	70	37	B	F	640	sqft	18	/sqft	$11,520	0–5	$12,200	2023	There are signs of leakage inside the building.	Cost provided in the even that the more detailed review noted earlier identifies that it should be replaced
		Metal Roof	**Meter Shop**	2009		10	70	60	B	G	1600	LS		/LS	$3000	0–5	$3,200	2023	Fasteners gaskets gone and an eave flashing has slipped leaving an unprotected opening. previously applied sealant is failing.	Replace fasteners when completing the main roof and replace flashing forthwith.
		Unit Heaters	**Main Building (Stores)**	2002	*	17	25	8	D	F	2	ea	$1000	/ea	$2,000	0–5	$2,200	2023	It was noted that the stores area including the office is cold in the winter.	This area would benefit from the overall building envelope review.
		Projecting Steel Roof Members	**Main Building**	1978	*	41	70	29	D	F	14	ea	750	/ea	$10,500	0–5	$11,100	2024	Roof beams projecting to outside of the building not insulated causing thermal bridging.	Insulate and flash the end of each beam north and south side. Should also review this as overall envelope review to confirm need and timing for this.
		Asphalt	**Asphalt Apron (north side)**	1996	*	23	25	2	D	P	14,000	sqft	$4	/sqft	$49,000	0–5	$10,000	2024	Frost heaves close to the building could pose a trip hazard doors and a number 2'x2' concrete pavers in front of the meter shop are broken. Cut and patch sections	Look at opportunity to cut and patch sections as required. Cost provided is to replace entire apron
		PTAC Unit	**Main Building (Stores)**	2002	*	17	20	3	D	F	1	ea	$2500	/ea	$2,500	0–5	$2,700	2024	It was noted that the stores area including the office is cold in the winter.	This area would benefit from the overall building envelope review.
		Fan Forced Heater	**Main Building (Employee Vestibule)**	2011	*	8	25		D	F	2	ea	$1000	/ea	$2,000	0–5	$2,200	2024	These are typically run to failure.	Clean coils to extend life and improve performance.
		Fan Forced Heater	**Meter Shop**	2009	*	10	25	15	D	F	2	ea	$1000	/ea	$2,000	0–5	$2,200	2024	These are typically run to failure.	Clean coils to extend life and improve performance.
		Heat Recovery Ventilators	**Southside Addition**	1986		33	25	-8	D	F	2	ea	$1500	/ea	$3,000	0–5	$3,200	2025	Exact age unknown so have listed it as the same age as the building but this is unlikely.	Replacement cost provided but recommend to run until reliability becomes an issue. Units should have filters replaced bi-annually as a minimum and the heat recovery cores should be
		Exhaust Fan	**Main Building (Vehicle Storage)**	1978	*	41	20	-21	D	F	2	ea	$1000	/ea	$2,000	0–5	$2,200	2025	Exact age unknown so have listed it as the same age as the building but this is unlikely.	Replacement cost provided but recommend to run until reliability becomes an issue.
		Fan-Forced Heater	**Southside Addition (Locker Room)**	1986		33	25	-8	D	F	1	ea	$1000	/ea	$1,000	0–5	$1,100	2025	Exact age unknown so have listed it as the same age as the building but this is unlikely.	Replacement cost provided but recommend to run until reliability becomes an issue.
		Baseboard Heaters	**Main Building (Substation Workshop)**	1978	*	41	25	-16	D	P	1	ea	$300	/ea	$300	0–5	$400	2025	Exact age unknown so have listed it as the same age as the building but this is unlikely.	Replacement cost provided but recommend to run until reliability becomes an issue.

DSP

Timing (years)	Needs	Budget and Planned Spending
2021	$62,900.00	$ 130,300
2022	$52,100.00	$ 22,400
2023	$69,800.00	$ 22,400
2024	$28,200.00	$ 22,400
2025	$6,900.00	$ 22,400
Total	**$ 219,900**	**$ 219,900**

Appendix G - IT Strategy through 2025

2020

INFORMATION TECHNOLOGY STRATEGY

FORWARD TO 2025

CAREY LACROIX - SR MANAGER, INFORMATION TECHNOLOGY

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EXECUTIVE SUMMARY

During the period of 2015 through to 2020, IT has evolved considerably: from a simple necessity to a business partner and enabler. However, IT needed to change its approach to achieve its goals to build a reliable, secure, and responsive environment that would enable the business to grow but not be overly restrictive.

With a methodology of planning, communication, and execution, IT was able to achieve many objectives as outlined in the *2015 Information Technology Strategy: Forward to 2020* document. Not all objectives were met, due to priorities and relevance but the main goals were met in some fashion.

Going forward, IT has set goals to meet its obligations of compliance with the OEB Cyber Security Framework, provide platforms for growth, and provide services that will ensure that the business can meet its goals.

To achieve these goals, IT will continue on its modernization plan, ensuring that cyber security, asset renewal, privacy, communications, planning, value-add services, and customer-focus continues to be the priority, which will drive both its capital and operating expense plans.

REVIEW OF IT EXECUTION FROM 2015 TO 2020

SUMMARY OF IT SERVICE DELIVERY

The *2015 Information Technology Strategy: Forward to 2020* (referred herein as the *2015 IT Strategy*) was a good document to create a framework for IT to build upon. However, it lacked the details on how to achieve it: what were the priorities, what are the timelines, how to identify and remove barriers to achieve the goals, and how to get business buy-in. Implementing ITIL processes, while good practice, would not resolve the systemic issues IT was dealing with: inexperience, lack of resources, no communication, and inaction. It would be a challenge to show that IT was able to achieve any of its goals during this five-year timeline when goals were not set other than spending its capital budget.

Until mid-2017, IT was lean with one IT manager, who had the additional responsibility for Billing, and a contracted IT Specialist, who was mainly responsible for the CIS system. IT did not have a good reputation for strategy or execution, with the minimum being done to maintain systems, with no advancement in security or infrastructure. While the *2015 IT Strategy* had suggestions for improvements including a higher organizational status and adoption of ITIL best practices, IT was unable to deliver having few IT resources, inexperienced management (with respect to IT strategy, requirements, planning, and execution), and competing priorities between Billing and IT.

From mid-2017 to current, significant changes were made to the IT organization that brought experience, focus, discipline, and renewed trust in IT. IT now reflected a more structured, plan-focused methodology and added resources to help it deliver value and confidence to the business.

REVIEW OF IT SERVICE DELIVERY

The following will use the same criteria as the *2015 IT Strategy* to describe the path forged by IT during this time period: Organization Improvements and Development of IT Skills, Operational Effectiveness, Engagement/Communications, and Strategy and Planning.

ORGANIZATIONAL IMPROVEMENTS

Organizational improvements included elevating IT within the organization to be under the CEO in order for it to be more engaged with the overall business strategy, ensure the senior levels of management have regular input into the IT strategy, and engage with the Board of Directors on things such as strategy and cyber security. IT would also be able to better position itself to drive initiatives, whether department-specific or enterprise-wide, ensure that resources are properly allocated and skilled, skill/personnel gaps are identified, and priority is agreed upon by all the stakeholders.

In 2016, senior management made the decision to change the IT organization: by moving IT under the CEO to give it a more pan-business portfolio (per the *2015 IT Strategy*); by removing the Billing portfolio so that it can be more specifically-focused on IT; and by starting the search for an experienced IT manager to bring reliability, stability, and credibility back to IT.

By June 2017, the company was able to bring on-board a Sr IT manager with over 20-years' experience with a large enterprise, and with the last role as infrastructure manager. Additionally, the new manager had application development and database skills, project and operational management skills, and had a realistic approach to how to move the department forward. An organizational change was required to supplement evaluated skill gaps and,

to complement the new manager's skillset, an additional resource was required to focus on networking with an expertise in cyber security. This analyst was hired in Jan 2018, with skills in networking, end-user engagement, PC and server building, and brought forth needed enthusiasm.

As the environment continued to be evaluated and tuned, opportunities for standardization emerged that required training to take full advantage of the systems interoperability. Additional training was made available as required. The skills gaps in the department shrank considerably, with the Sr Manager, IT Analyst, and IT Specialist all being able to cover aspects of each other's role (but not complete overlap, which was still a gap).

The *2015 IT Strategy* identified in its ***IT Organization***[1], the desire to realign "the Billing and Customer Accounts staff to enhance customer service [to] provide greater redundancy… One FTE with [*sic*] be shifted from Billing to IT centric functions." This position was to be an IT conduit to Billing and, by extension, to Metering. This would not be addressed until 2020 with the approval to hire a Meter to Cash IT Specialist.

OPERATIONAL EFFECTIVENESS

Operational effectiveness included adoption of formal ITIL practices like incident and change management, establishing currency program[2], establishing good security practices, and perform operational planning. Additional services such as business intelligence (reporting, data mining) was seen as an important evolution to enable the business to make use of their data, be self-sufficient, be efficient, and make better business decisions. Automation was also cited as a benefit to pursue offloading of repetitive tasks from staff so that they could focus on value-add activities.

When the new IT manager was hired, time was taken to identify quick wins: evaluate the environment to find issues that needed to be immediately addressed, act quickly on those to show that IT can evaluate the request, make a plan, execute, and communicate the plan to senior management while regularly engaging staff in an awareness campaign. IT also made itself more "accessible" by removing the help desk system implemented to track IT's effectiveness and implementing an "open door policy"[3], which was intended to address issues quickly and bring some credibility back to IT.

IT staff was also evaluated for skill gaps and other intangibles. It was during this evaluation that it was decided that the skill gap needed to be fulfilled with different personnel. By bringing in additional technical experience, IT was able to achieve a number of improvements, continuing into 2020 including: patching, security, monitoring, network tuning, removal/replacement of geriatric assets, centralized endpoint protection, and email spam filtering

[1] [2015] North Bay Hydro Distribution System Plan, Appendix E: IT Assessment Report, Information Technology Strategy: Forward to 2020, "Appendices". p. 283.

[2] Also known as KEC or "Keep[ing] the Environment Current", which includes an asset lifecycle management program (ALCM), patching, upgrades, standards, license management, health monitoring, capacity planning, and guidance on avoiding geriatric assets.

[3] The issue was that help desk tickets were going into a black hole – no one was actioning them. After a while, users stopped entering them as inaction caused end user frustration. The idea behind the "open door policy" was that if it was **important for the end user** to stand in the door to say they have a problem then IT will address it immediately. If the request is sent via email (or text), then it would be treated as less urgent. The intent is to force end users to identify critical issues **to them** - IT should not be setting the priority. These were easy wins as IT was now engaged directly with their customers and the end users found an avenue to get their critical issues addressed quickly. While issue tracking has its value, it was more important to address the issues than to track them.

– all of which brought stability and reliability to the environment[4]. An Asset Lifecycle Management plan was put in place which helped in budgeting and cost control. Asset tagging allowed for tracking of assets. Formalized provisioning and de-provisioning ensured approvals and auditability. Many of the implementations matched the *2015 IT Strategy* framework but now it had IT ownership to drive it, with a task plan and constant communication with the stakeholders.

IT also started to participate in supporting SCADA and other non-traditional networks. Using in-house networking expertise, IT was able to map the network infrastructure, help diagnose issues, coordinate with the support vendor, and suggest design and security strategies for new builds. IT also took on the SCADA server asset management to ensure that physical hardware and operating systems are current.

COMMUNICATIONS

Communications, or lack thereof, greatly contributes to the perceived effectiveness of IT, whether it be with staff, management, or the Board of Directors. Business engagement, including training, awareness campaigns, and consultation would breed buy-in of the IT direction by the business. Timelines, successful delivery of services, and a system maintenance plan with a communication strategy would improve IT's image as enabling the business and being a business partner, not just IT being a "necessary evil".

The major change in the relationship between IT and the rest of the organization was with communications. Since mid-2017, IT was transparent, accessible, and approachable.

IT would report on project and initiatives at the bi-weekly management meetings. Not only were the presentations meant to show progress, but to inform management of the different activities that were occurring, how it may impact them, get stakeholder buy-in for these activities, and to educate. IT was no longer a "necessary evil" but trying to be a business enabler. By consistently presenting to senior management on "how IT works" and "what are the driving factors in the decisions being made in IT", they became engaged with the strategy and could start to relate to what was being done. While senior management still could not effectively provide oversight (scrutiny) to what IT was proposing and implementing, at least they understood the benefits from what was being proposed and could hold IT accountable if what was being proposed did not meet the stated goals.

IT also made sure that issues were not only fixed but the solution communicated to the end user (where possible) to educate them. Training and awareness programs, particularly concerning cyber-threats such as phishing and malware, further engaged end users for safety and compliance purposes. Planned outages are announced in advance, schedules distributed, and opportunity given for feedback in case of conflict or concern. Unplanned outages are communicated, with ETR (or at least when the next update will be) and impact information is given. Major incidents follow a response script with communications built into it.

Good practice using ITIL methods (not necessarily the formal processes) with frequent communication resulted in a more stable relationship between the business and IT.

A place of improvement for communication is at the Board of Directors level. While IT provides a quarterly summary of activities for the Board and is well-represented by Executive Management, IT has not been able to directly present any strategic plans nor give updates on critical activities such as cyber security readiness. With the

[4] See Appendix A: Improvements from mid-2017 to end-2019.

importance of IT within the organization to protect staff, customers, information, and reputation of the business, IT's elevation within the organization should evolve into more visibility at the Board[5] level.

STRATEGIC PLANNING

Finally, a strategic plan for ensuring that IT assets are continuing to perform as expected (beyond 2-years), including timelines, communication, business continuity, security and network evolution, growth (scalability, organizationally), and agility to be able to adapt to regulatory and environment changes is key to IT continuing to bring the expected value to the business.

The communication strategy as well as the operational effectiveness is driven by strategy and planning. Determining the gaps and priorities in the enterprise, evaluating solutions, getting stakeholder buy-in, and implementing solutions all come from a planning paradigm.

After mid-2017, operational (less than 2-year) and strategic (greater than 2-year) planning became an essential umbrella that IT works under. Priorities in cyber security, network remediation, asset renewal, and implementation of foundational tools (like enterprise-class Wi-Fi, SharePoint, Office 16, Windows 10, Hyper-converged Infrastructure…) have enabled the company to meet its capital goals to 2020 and enable it to be meet future demands of the business. With much of the foundation now in place, implementing a disaster recovery site and services, redundant internet, and advanced cyber security tools are slated to be implemented in 2020.

IT has taken ownership of the five-year strategy to 2025, with priorities and costs already estimated. IT is also nimble enough to take on new priorities or urgent requests without having the strategy breakdown. Tasks are communicated to all IT Staff and allocated according to skillsets and availability. Past successful implementations have risen the bar of future expectations.

The five-year strategy will be detailed in the next section.

SUMMARY OF PROGRESS

Reviewing the effectiveness of the *2015 IT Strategy* to how it was actually implemented, there was little progress to mid-2017. After that point, there was much improvement but not all objectives met. Some were due to prioritization (infrastructure stability, asset management, and network security were most important) but many formal processes were not continued due to the overhead and value of the objective (like the service desk or self-services) overall to the business. Due to the size of the business itself, sometimes the objective is actually more work for very little value.

With a more formal discipline of planning and communication, coupled with the reduction our risk posture by commencement of the *OEB Cyber Security Framework* implementation, North Bay Hydro is on a path to efficient, reliable, and secure IT systems that will enable the business to take advantage of technology to meet their goals.

[5] [2015] North Bay Hydro Distribution System Plan, Appendix E: IT Assessment Report, Information Technology Strategy: Forward to 2020, "Periodic Reporting / Status". p. 272.

IT continues to evolve, improve, and strive to operational excellence.

		Level of Implementation (0-5)			Level (0-5)
Category	DSP Objective	to mid-2017	to end-2019	Comments	to end-2025
Operational Efficiencies	ITIL Processes	0	1	While formal ITIL processes would be ideal, small shop with limited resources requires us to be flexible and responsive	3
Operational Efficiencies	Self-Help	0	0	No real requirement for Self-Help at this time; IT is better available and responsive to immediate needs	0
Operational Efficiencies	Currency/KEC	1	4	Windows server and desktop patching in place; qtrly outages planned for additional updates	4
Operational Efficiencies	Security	2	4	Comprehensive audit performed and recommendations implemented; monitored and adjusted as needed	4
Operational Efficiencies	Standards	2	4	Standard desktops, laptops, servers, switches	4
Operational Efficiencies	Self-Management	0	0	Due to Cyber Security rigor, IT retains the role	0
Operational Efficiencies	Monitoring	1	3	Critical assets/firewalls monitored	4
Operational Efficiencies	Service Desk	1	0	IT is better responsive through personal interaction than thru SD	0
Operational Efficiencies	Asset Database	2	4	Retired Spiceworks; assets maintained in Excel and updated monthly for better visibility	4
Planning	ALCM	0	4	Most IT assets on 5-year LC and are planned for replacement accordingly	4
Personnel	Organization	3	4	IT reports to CEO; additional IT Analyst position in 2018	4
Personnel	Skillset	1	3	IT Analyst is network and security specialist, filling a skills gap; IT Specialist retired/replacement ramping up	4
Engagement/Communications	Business Responsiveness	1	4	Building trust and expertise; can handle most issues and requests immediately	4
Engagement/Communications	Comm. with Sr Mgmt	1	4	Dedicated agenda at Sr Management bi-weekly meetings; one-on-one communications with managers	4
Engagement/Communications	Comm. With BoD	1	1	IT summary presented at BoD; no direct engagement	3
Engagement/Communications	Business Engagement	1	3	Bi-directional communications important; continue to build trust	4
Operational Efficiencies	KPI Measurements	1	1	No formal KPIs established	3
Operational Efficiencies	Operational Planning	1	4	Plans for Y1 and Y2 in-place	4
Stategy	IT Strategy (beyond 2-yrs)	1	4	IT engaged with DSP/CoS process; owns 5-yr plan; tools in place to support	4
Operational Efficiencies	System Reliability	3	4	Number of unplanned outages reduced to minimum; responsiveness to outages immediate; ownership with IT	4
Stategy	BCP/DRP	0	1	Plan to execute DRP in 2020; BCP in 2021	4
Stategy	Incident Response Plan	0	3	Incident response plan in place, tested, and executed	4
Operational Efficiencies	Business Intelligence	1	1	GAP in IT skillset; inadequate tools in place to have business-driven solutions	3
Operational Efficiencies	Operational Expenses	2	3	IT has good visibility on month-to-month Operating to Budget performance; invoices being paid on-time	4
Planning	Budgeting	1	3	Annual budgets prepared on-time	4
Planning	Partnering	3	3	More opportunity for partnering; growing network outside DL	4
Operational Efficiencies	Service Delivery	2	3	Able to deliver services as promised but more focus needed to deliver added benefits	4
Operational Efficiencies	Automation	0	1	Excel queries in place to better allow some to extract data; still opportunity for more automation of repetitive tasks	3

IT STRATEGY FORWARD TO 2025

The strategy for IT going forward is to continue to build on its program of asset renewal, foundational platform implementation, security, reliability, and redundancy. As technology is demanded and deployed, IT will become more important and needs to be sufficiently resourced and agile to support those demands.

ORGANIZATION EVOLUTION

To support the additional demands on IT, 2 additional resources are required: an IT Specialist with a focus on Meter-to-Cash to support the Billing and Metering functions and a database/analytics specialist that can drive business efficiencies from mining and analyzing existing data, such as meter data, billing data, infrastructure data (such as poles, transformers, load) to help with operational and strategic decision-making. The desired skillsets will bring a project management acumen, database and programming skills, documentation/workflow mapping skills, business decision support, as well as technical backup for the current IT Specialist for CIS/Billing support. This will enhance the overall skillset, providing more redundancy between all of the IT staff.

This will also allow the IT manager to further focus on strategic initiatives, operational efficiencies, communications, and interactions with senior management and the Board of Directors.

PLANNING AND COMMUNICATIONS

The goal of the planning and communications objectives is to ensure that, where possible, activities are planned and those plans are disseminated to the proper stakeholders. Good planning allows all stakeholders the opportunity to understand the initiatives brought forward and the impacts on them. Buy-in is key with communication.

During an incident or crisis, proper protocols are followed, including workflows and communication plans. Staff are updated in regular intervals on progress and ETR and senior management is given more detailed reports on progress, assembling a “war room”, if necessary, to ensure that all aspects of the business are being considered during a crisis.

IT will continue to present to senior management on progress of initiatives and projects to ensure that projects are delivered on-time, on-budget, and on-quality. Staff engagement in awareness campaigns, training, and understanding requirements will continue. The intent is not to deliver “IT for IT’s sake” but to educate all on how to be safe and efficient users of IT.

CYBER SECURITY AND PRIVACY

Protecting our assets to maintain privacy, security, and integrity without compromising reliability, costs, and accessibility is the goal of the *North Bay Hydro Cyber Security Framework*, which is built upon the foundation of the *OEB Cyber Security Framework*. Realistically, we cannot be 100% secure as the cyber environment is constantly in flux; however, due diligence, proper processes and procedures, continuous improvements, and organizational buy-in are required to maintain an appropriate security level to protect our people, customers, reputation, and assets.[6]

[6] 2019 North Bay Hydro Cyber Security Framework, *Value Proposition*, p 1.

Implementation of new tools to help protect and identify potential threats will be a priority. As new systems are brought online, the mantra of "security first" and "least privilege" will be at the forefront. Eventually, IT will want to move to a "Zero Trust"[7] footprint that all precautions are taken to ensure the right people have access to the right resources at the right time and place. The beginning of this is to implement Cisco ISE (Identity Services Engine) to segregate the network by user, function, device, and location. Further controls such as security keys (physical or virtual) and two-factor authentication are to be explored to enhance end user security.

Third-party bi-annual security audits will ensure that IT remains vigilant and prepared for risks that we may not be aware of. And as most cyber-experts have pointed out, the end user is the most vulnerable point in our security scheme. Continued training and awareness campaigns on phishing and cyber security in general is a priority. More details can be found in the *North Bay Hydro Cyber Security Framework* document. Complying with our internal framework and the *OEB Cyber Security Framework* will drive our Networking/Cyber capital and operating expenses, primarily in the networking area but will affect all aspects of IT and the user base.

Privacy also is gaining momentum as a priority in the business. As artifacts of personal information are gathered, we need good policy and governance on how to handle them. From an IT perspective, does staff have the appropriate level of access to personal (customer, staff, vendor) information? Where is the information stored? How is the information stored (encrypted/non-encrypted)? How do we audit this? There are IT tools available to be able to address some of these concerns but a concerted effort with funding will be required for a comprehensive audit and remediation to reduce the risk of a release of private personal information.

STRATEGIC INITIATIVES

FOUNDATIONAL IT

Forging a path forward is important for the viability of North Bay Hydro. A coherent and practical IT strategy is needed to make sure that IT can respond to the demands of the business.

Ensuring IT is in a good position to support the overall environment, whether it be enacting cyber security good practice, having proactive and preventative monitoring and self-healing tools in-place, and ensuring the environment does not reach a geriatric state where it no longer can support the business's demands means having a vision of where the business and IT are moving towards, sustaining good communications, and seeking stakeholder support.

With SharePoint as our application foundation, we are better prepared to look for solutions that will be easily deployed. One such example is the Transformer Asset Management Database, which can be deployed as an off-the-shelf SharePoint application without the need for additional infrastructure like a server, database, and licenses (purchase and support/maintenance would still be required). This would also allow the application to be (securely) exposed to the Internet for access by remote/mobile users.

Mobile computing will become more prominent, with smart devices and laptops being required to remotely access internal and external resources. Secure and robust ways to access this data will be important. Connecting to

[7] Zero Trust is an information security framework which states that organizations should not trust any entity inside or outside of their perimeter at any time. It provides the visibility and IT controls needed to secure, manage and monitor every device, user, app and network being used to access any data.

Mindoka MIRS, ArcGIS, SharePoint, and others out in the field will enable outside staff to have greater access to information for immediate consumption.

Opportunities for hosted or Cloud-computing solutions will be disruptive to our business model, as we move away from a capital-based expense through the acquisition of hardware and software to an operating expense via subscriptions. For example, moving our payroll to a Cloud-based provider would provide us with the latest software with ongoing support for the platform, removing this burden from IT. However, IT would transform its on-premise support to vendor management (another change to IT). The move to Cloud-based solutions will help facilitate the disaster recovery plan, with phone systems and Office 365 being considered. Cloud-based systems will also allow for better communication and collaboration (like web conferencing, instant messaging, document sharing) that will enable a remote workforce or disaster protection.

The general direction for software vendors is similar to Cloud-based hosted systems: they are exclusively moving to a subscription-based licensing model, which allows them to better control and account for installations and use of their products. Therefore, the move of phone systems, productivity suites (like Microsoft Office), email, collaboration, industry-specific tools (Spida, AutoCAD) are changing how we cost IT services (capital → operating).

To ensure that the physical business systems are safe from a catastrophic event, a disaster recovery site is required and intent is to have all major systems be able to run from that site (or sites). IT has identified those critical systems and, as part of its IT modernization strategy (see Appendix B), where systems will be deployed.

BUSINESS VALUE-ADD

Additionally, business continuity has been discussed and IT will be in a good position to drive this development during this time period. Pandemic planning and enabling remote work are to be addressed with this effort. Laptops for strategic staff, secure and reliable connectivity to the office network, remote support tools, communications (phone/messaging), and privacy all need to be considered and formalized.

Moreover, IT and the business need to prepare for “Digital Transformation” – using new, fast, frequently changing, and often disruptive digital technology to solve operational problems. Artificial intelligence, automation, business intelligence are all areas that can drive innovation to make the business find efficiencies, make better (and quicker) decisions, and have staff focus on value-add tasks (like direct customer engagement). An example is the implementation of a business intelligence platform like Questica that will allow greater depth of analysis and more flexibility and independence to the Finance team. Data mining of existing systems like our meter data, customer data, operational data, etc., will also help identify opportunities for efficiencies. As we need to have flexibility with our workforce, Digital Transformation will help facilitate an easier transition for the remote worker, making documents easier to access through multiple device types, enable collaboration through sharing, and ensure the business can continue through any type of business disruptions such as a pandemic or disaster.

Digital transformation will need to be considered when opportunity arises. IT needs to be prudent in its examination of requests and use all avenues to determine the right solutions. There may be initial investment required to support a solution but the return on investment should easily be within the period of this Cost of Service.

EFFICIENCIES IN IT

Translating strategy into operational effectiveness is the key to the IT plan. Delivering on strategic initiatives and supporting them afterwards is paramount. IT will need to continue to deliver on plans, find efficiencies in reacting to issues, and proactively monitor resources for uptime and reliability. Progressive tools need to be in-place to provide alerts and dashboards to effectively monitor key assets.

Using ITIL processes as a framework, IT can control the environment with less disruptions and impacts to the userbase. However, immediately addressing issues (continuation of the "open door policy") and incidents will continue to be the first priority of the IT department in order to maintain its credibility and system trustworthiness. Incident response plans need to be practiced and updated to ensure that they are current.

Management of assets: ensuring they are properly protected (patched, anti-virus, backed-up), running efficiently, and is current must be an underlying effort of IT. Proper maintenance will ensure the reliability, protection, and integrity of systems and data.

IT/OT Convergence[8]: IT is becoming more involved in maintaining the nontraditional operations networks and systems, namely SCADA (including Wi-Max), HONI, and radio networks, as well as supporting the IT infrastructure at the Co-generation (CoGen), Merrick, and Community Energy Park (CEP) plants. Having in-house expertise allows for quicker turn-around of problem resolution and gives us the ability to challenge our OT providers to create solutions that are for our advantage, not for the convenience of the vendor. Additionally, we can ensure that networks and systems are compliant to best practices, such as the *OEB Cyber Security Framework* and the *North Bay Hydro Cyber Security Framework*. This expands the IT portfolio outside of its traditional scope.

CAPITAL EXPENDITURES

IT assets are generally on a five-year refresh cycle. Therefore, the majority of assets will be renewed within the DSP time period. The main drivers for each of capital expenditure will be described below.

CAPEX	2020	2021	2022	2023	2024	2025	5 Yr Total	5 Yr Avg
**	354,470	244,950	106,600	110,350	269,650	295,620	1,027,170	205,434
Servers	189,350	-	70,000	46,000	194,300	189,350	499,650	99,930
Facilities	70,100	3,600	-	-	4,800	8,000	16,400	3,280
Printers/Office Eq	6,400	-	27,500	16,000	26,100	6,400	76,000	15,200
Workstations	46,200	8,200	6,100	48,350	33,900	49,450	146,000	29,200
Enterprise Software	-	183,350	-	-	8,000	-	191,350	38,270
Networking/Cyber	41,170	7,800	3,000	-	2,550	41,170	54,520	10,904
Licenses	1,250	42,000	-	-	-	1,250	43,250	8,650

SERVERS

In 2020, a major project to build-out a complete disaster recovery site will be undertaken. The site will require similar hardware (hyper-converged infrastructure or HCI), rack, and UPS. Additional stand-alone servers are required for SCADA (x3) and the primary domain controller. In 2024, the main site HCI will be due for renewal. In

[8] IT/OT Convergence is a strategy where IT becomes more involved with the Operational Technology (OT). The trend in OT is that it is embracing more IT-type (convergence of technology) and methodologies to perform its tasks; thus, it makes sense to have IT involvement in projects, design, and support.

the remaining years between, regular hardware renewal is planned including the iSeries Power8 that supports HTE (2022) and an additional HCI server to support anticipated growth (2023).

All assets have a 5-year useful life.

FACILITIES

With the new DR environment (2020), capital will be invested into creating a small secure server room with air conditioning and humidity controls, extending the alarm and video systems, and creating a workspace. As well, the DR plan is to implement a Cloud-based phone system in 2020 that will require new phone hardware. Smaller investments in new ergonomic desks for IT staff (2020) and management (2021), upgraded video surveillance (2020), and replacement UPSs (2021 and 2024) are planned.

Assets in this category will have a useful life of more than 10-years.

PRINTERS/OFFICE EQUIPMENT

Printers include the multi-function workstations (3 in 2024), small workgroup printer (2020), bill printer (2023), cheque printer (2024), and the folder-inserter (to support billing) (2022). Additionally, new message board hardware will be acquired in 2020.

All assets have a 5-year useful life.

WORKSTATIONS

Within this period, all workstations including stand-alone PCs, laptops, and tablets will be refreshed per their asset life of 5-years. Workstation costs will also include new monitors but not new peripherals (as these would be charged as OM&A). Operating system costs would either be included with the cost of the unit or purchased separately. Supporting software like Microsoft Office, AutoCAD, ERSI, etc. are budgeted separately.

Business continuity must be considered as part of the end user device evolution, as disaster and pandemic planning require staff to be flexible with their work arrangements. Laptops, docking stations, and home-based peripherals will be required.

As well, demand for online resources by the mobile workforce (like outside workers) to allow them access to internal and external tools and information will enable them to be more productive. Mobile hardened laptops and tablets will be required.

All assets have a 5-year useful life.

NETWORKING/CYBER SECURITY

All costs related to the security and configuration of the various enterprise networks are included in this category. Firewalls (2022 and 2023) will be refreshed, as well as the smaller site firewalls (2024) and various switches (2020). In 2020, new cyber security software (Cisco ISE) will be implemented, as well as new network devices for the new DR site. Network monitoring software will also be purchased in 2020.

IT has spent much time evolving its cyber-strategy, using the O*EB Cyber Security Framework* and creating its own *North Bay Hydro Cyber Security Framework*. This document describes both the operational and strategic direction for cyber security, which feeds directly into the capital plan.

The requirement for mobile and remote workers will drive much of the spending in networking to ensure our networks and information are safe, secure, and accessible by the right people at the right time.

All assets have a 5-year useful life.

ENTERPRISE SOFTWARE

Per the feedback from the customer engagement effort in 2019, a refresh of the Customer Portal (2021) and the creation of a customer app (2021) would be beneficial for the customer. Development will not be performed in-house so a proper project management exercise is necessary. Additionally, an upgrade of the timekeeping software (2024) will be required.

Other enterprise software platforms such as Exchange, SQL Server, and SharePoint are not required to be upgraded within this five-year time period but new capability may be required due to demand. These platforms are scalable.

Our CIS system (HTE/Naviline) has been running on a complex, difficult to support platform. With the vendor[9] stating that our current product line has a finite life of 2029, we need to set aside some funds to look at alternatives to our current platform, whether it be to remain with Central Square and upgrade to their replacement offering or to look elsewhere. The opportunity to do this is near the end of this CoS.

SOFTWARE LICENSES

A different approach will be taken to the purchase of Microsoft licenses. Currently, we purchase our licenses through capital and, while perpetual, require periodic upgrades. Each device, regardless of who uses it, requires a separate license. This can be difficult to manage and causes issues when upgrading equipment or ensuring all users are using the same version. By taking advantage of using subscription-based Office 365 will allow our products to be Cloud-based, be most recent, and better managed. However, this moves the cost of licenses from a capital to an operating expense. This is being planned for 2021.

Additionally, Remote Desktop Services is being purchased (2020) to help facilitate remote users with limited bandwidth to have access to full desktops (via VDI[10]) or to help securely publish applications to remote users that can only reside on internal servers. Server hardware is being scaled to accommodate this.

SUMMARY

Moving towards 2025 means putting in place the appropriate strategic and operational plans that will keep our systems and people safe while enabling the business to become more efficient. Security will continue to be a priority: protecting our assets to maintain privacy, security, and integrity without compromising reliability, costs, and accessibility is the over-arching goal of IT. Planning initiatives and communications to all levels of the company are now embedded in the IT culture. Operational efficiencies, proactive monitoring, and good ITIL practices will ensure a robust and reliable system.

Ultimately, IT strives to be a world-class organization the help meet the goals of North Bay Hydro.

[9] Central Square, formerly known as Superion

[10] Virtual Desktop Infrastructure such as VMWare Horizon or Citrix XenDesktop/Xenapp

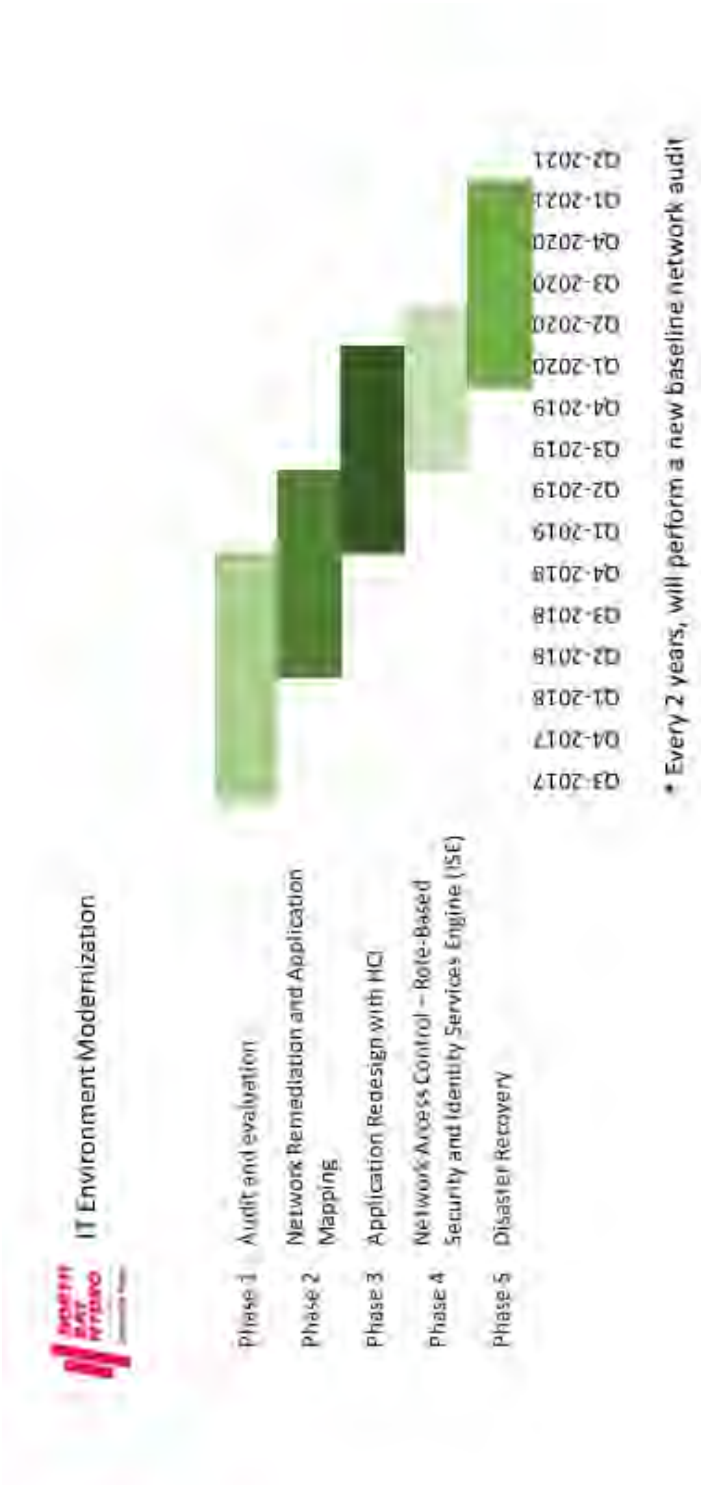
APPENDIX A: IMPROVEMENTS FROM MID-2017 TO END-2019

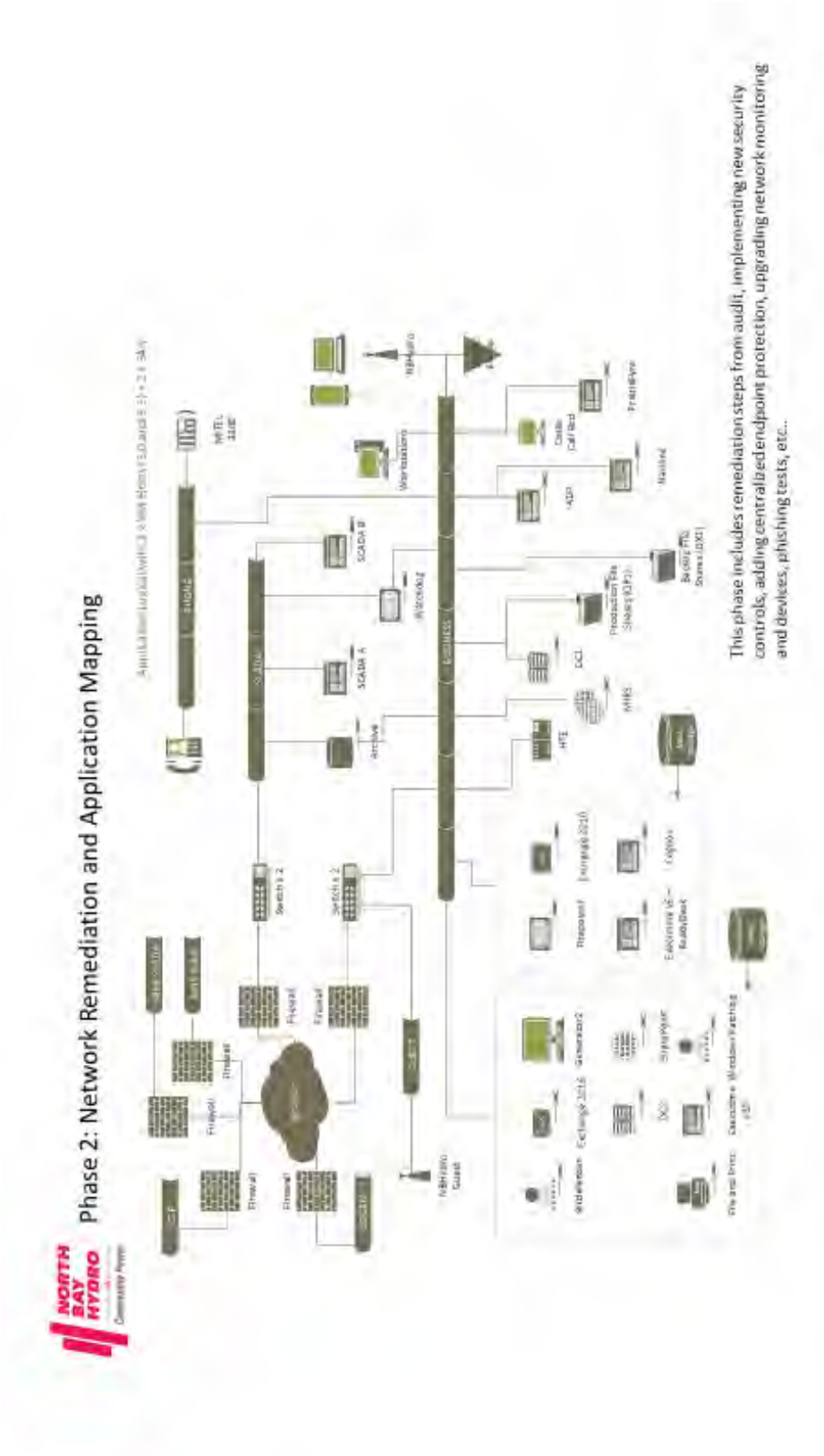
NON-EXHAUSTIVE

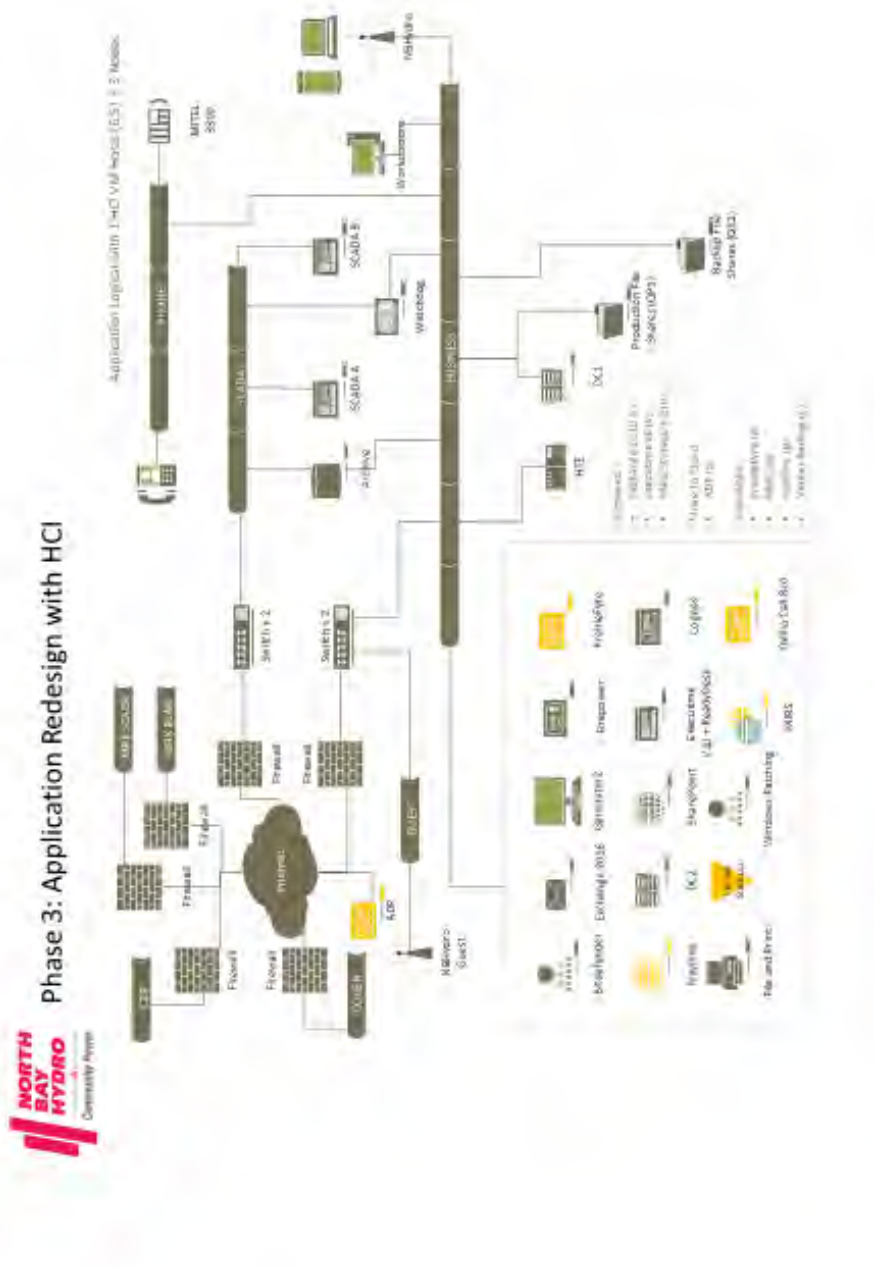
2015 IT Strategy Reference	Initiative
N/A	Ownership and accountability of IT with the IT Sr Manager
Energy Leadership - People	Definition of IT job descriptions
Service Delivery – Standards	Definition of IT Service Catalogue
Asset Management (Field)	Development of an asset database – attributes include: asset tags, life expectancy, configuration, purpose
Enterprise Solutions	Implementation of email spam filter – blocking about 60% of all email traffic coming into NBH
Asset Management (Field)	Deployment of Engineering PCs
Information Security	Implementation of PC lock screen security
Communication	Deployment of message boards, regular IT updates to staff via email
Asset Management (Field)	Identify and remediate improper server configurations (poor RAID, no backups, h/w redundancies)
Information Security	Conduct third-party network risk analysis, including priorities and plan for remediation; remediation of network issues as identified by risk analysis
People / IT Organization	Hire of network analyst (FTE)
Information Security	Implementation of WSUS (Windows OS patching)
Proactive Infrastructure Management	Implementation of simple monitoring + alerting
Information Security	Tightening of firewall rules
Information Security	Introduction of periodic forced password changes; increased password length from 8- to 9-characters (complex passwords)
N/A	Development of Network Usage policy
Information Security	Introduction of end user phishing training, tests, and awareness program
Asset Management (Field) / Planning Culture	Replacement of server asset, including hyper-converged infrastructure to promote redundancy and stability, and to help facilitate replication to a future disaster recovery site
Asset Management (Field) / Planning Culture	Replacement of PC asset – replacing all critical PCs running non-supported OS's or geriatric hardware
Asset Management (Field) / Planning Culture	Replacement of network assets – upgraded firewalls, monitoring and diagnosis, threat protection
Asset Management (Field) / Planning Culture	Performed product upgrades (Oxilio, Exchange, ExecuTime, HTE/Naviline)
Managing Documents / Enterprise Solutions	Implementation of new services: SharePoint
Business Intelligence	Introduction of Excel-based reporting of HTE data (query)

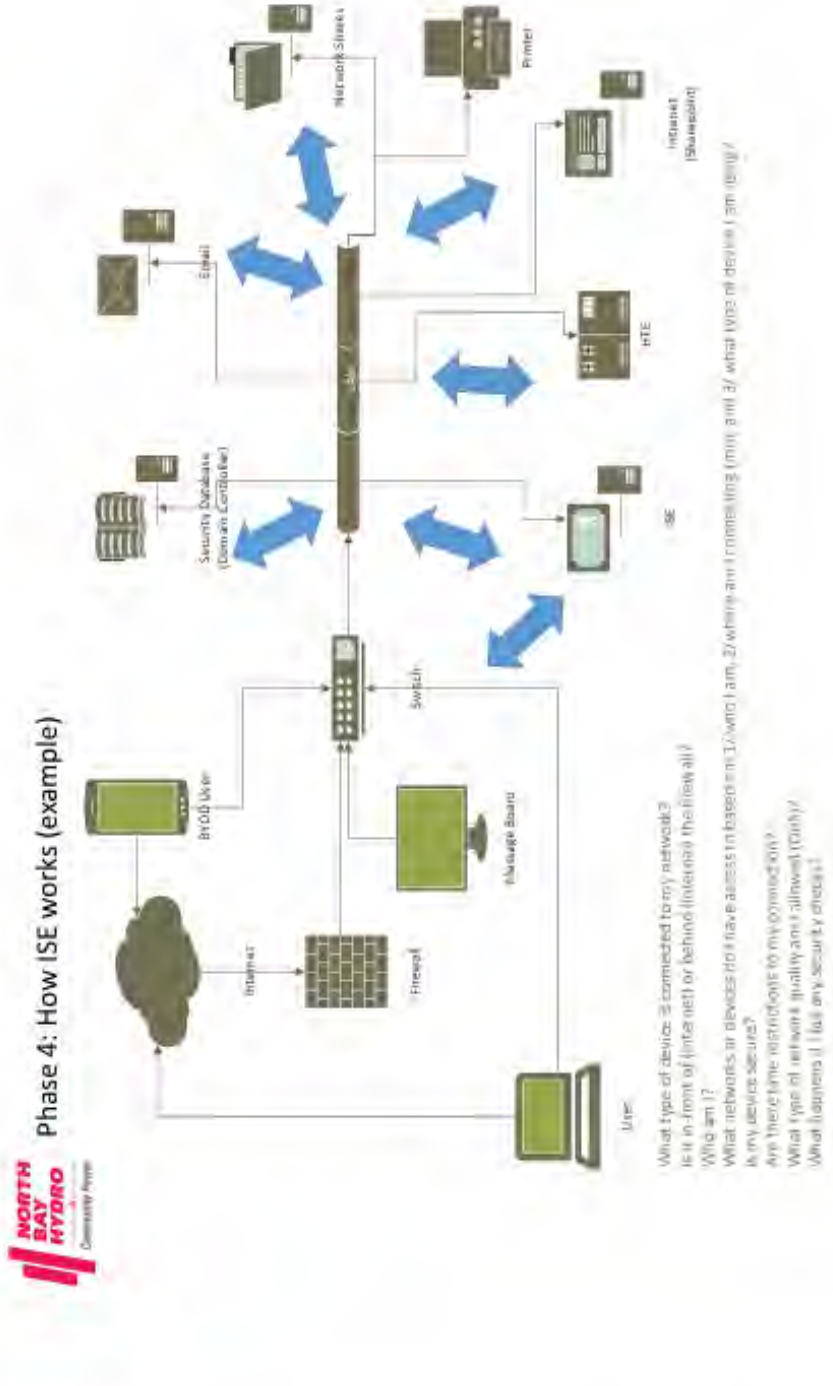
2015 IT Strategy Reference	Initiative
Communication	Regular communication to senior management of IT initiatives and projects; stakeholder input
People / IT Organization	Hire of new IT Specialist; [re-]hire of PT IT Specialist
Asset Management (Field)	Performance of backups and recovery tests of critical infrastructure
Planning Culture	Planned quarterly maintenance
Planning Culture	Development of cyber security framework
Asset Management (Field) / Planning Culture	Incident response plans developed
Managing Workflow	Formalized provisioning and de-provisioning
Managing Workflow / Managing IT Expenditures	Improvements in cost controls and visibility; expenses are approved in a timely fashion
Planning Culture / Managing IT Expenditures	Formalized year-over-year planning and budging
Planning Culture	Development of IT Modernization Plan

APPENDIX B: IT MODERNIZATION PLAN




Phase 2: Network Remediation and Application Mapping
This phase includes remediation steps from audit, implementing new security controls, adding centralized endpoint protection, upgrading network monitoring and devices, phishing tests, etc...


Phase 3: Application Redesign with HCI


Phase 4: How ISE works (example)
NORTH BAY HYDRO
Network Sheets
Printer
Intranet (Sharepoint)
Email
HTE
Security Database (Domain Controller)
ISE
Switch
BYOD Wifi
Message Board
Internet
Firewall
User
What type of device is connected to my network?
Is it in front of (inte net) or behind (inside) the firewall?
Who am I?
What networks or devices do I have access to based on 1/ who I am, 2/ where am I connecting (min) and 3/ what type of device I am using?
Is my device secure?
Are there any restrictions to my connection?
What type of network quality and allowed (QoS)?
What happens if I fail any security checks?

Phase 4: Network Access Control – Role-Based Security and Identity Services Engine (ISE)

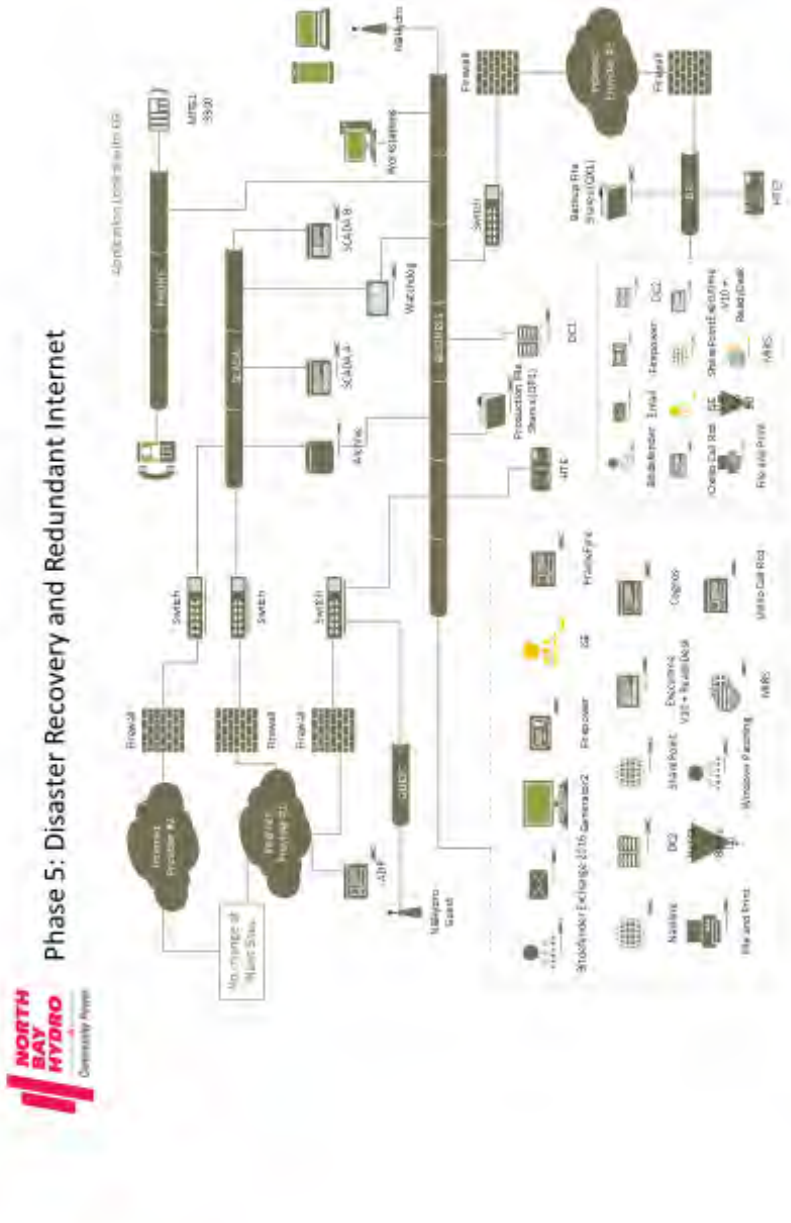


Network controls (Identity Services) to be put in place in conjunction with upgraded switches from Phase 3 (through HCI implementation) that will give users only the access they require.

Access based on:

- Who you are (UID/role)
- Where you are (in office, remote)
- What type of device are you using (NBH device, BYOD)
- What resources do you need (Intranet, file shares, HTE, …)

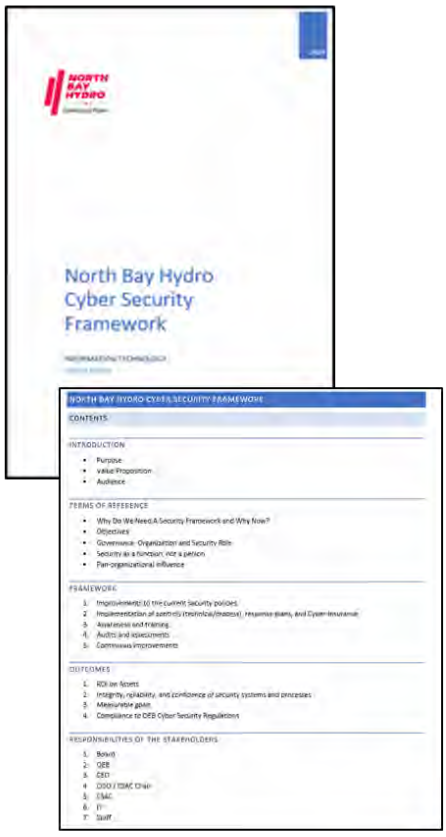
Evaluating Cisco ISE as this will easily integrate with our network infrastructure and Cisco is the leader network security.


Phase 5: Disaster Recovery and Redundant Internet

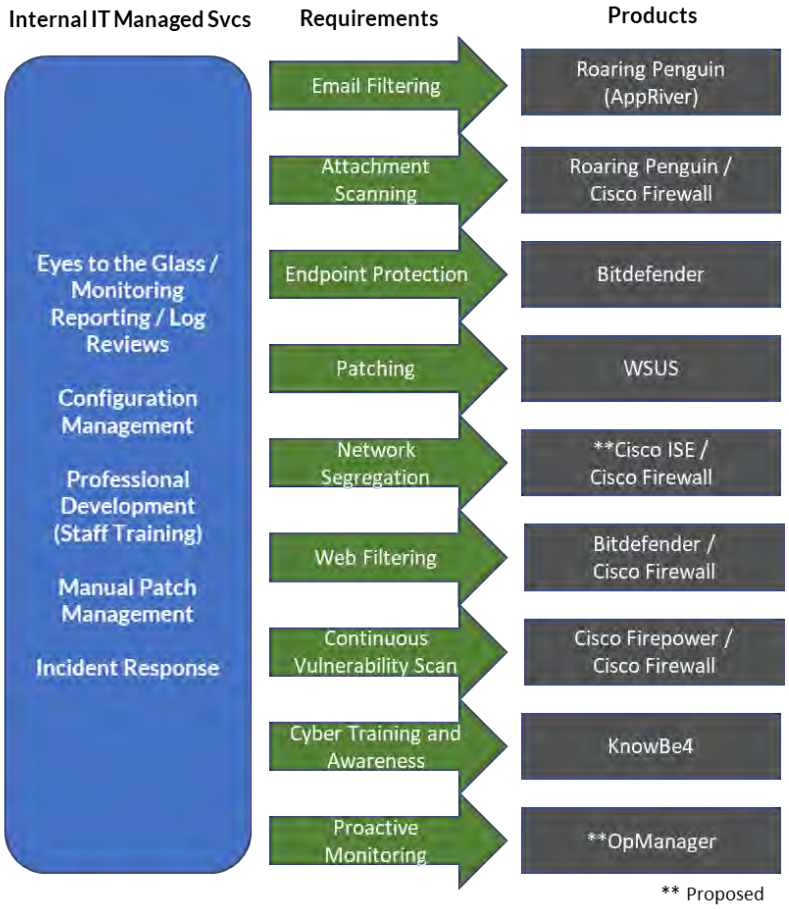
APPENDIX C: CYBER SECURITY COMPONENTS

Cyber-Security Components

Strategic



Operational



** Proposed

APPENDIX D: CRITICAL APPLICATION INVENTORY

Core System	Product	Vendor	Support	Business Owner	Commercial off-the-shelf or Custom	Future Direction
ERP - HR	Naviline	CentralSquare (formally Sungard)	CentralSquare (formally Sungard)	HR	COTS	Naviline will continue to be the ERP for this period. Product timeline shows that Naviline will be retired in 2029 when CentralSquare consolidates their product line. Investigation of product evolution should have budget assigned to it in this COS with option to change in the next COS.
ERP - Finance	Naviline	CentralSquare (formally Sungard)	CentralSquare (formally Sungard)	Finance	COTS	
ERP – Inventory / Purchasing	Naviline	CentralSquare (formally Sungard)	CentralSquare (formally Sungard)	Finance / Operations	COTS	
ERP - CIS	Naviline	CentralSquare (formally Sungard)	CentralSquare (formally Sungard)	Finance	COTS	
ERP - Work Orders	Naviline	CentralSquare (formally Sungard)	CentralSquare (formally Sungard)	Operations	COTS	
ERP - Business Intelligence	Cognos	IBM/CentralSquare	CentralSquare (formally Sungard)	Finance	COTS	Product is under-utilized and not well-developed; will consider changing products in 2021 (ex. Questica)
Time Reporting	ExecuTime	TylerTech	TylerTech	Finance	COTS	Upgraded in 2019; no requirement to change at this time. Integrates with Naviline.
Payroll	Payspecialist	ADP	ADP	Finance	COTS	Propose moving to Cloud-based solution in 2020
CAD	AutoCAD	Autodesk	Autodesk	Engineering	COTS	Autodesk is moving away from licensed products to subscriptions
Locates	Locates	Mindoka	Mindoka	Operations	Custom	Will continue
Disconnects/Reconnects	Disconnects/Reconnects	Mindoka	Mindoka	Operations	Custom	Will continue

Core System	Product	Vendor	Support	Business Owner	Commercial off-the-shelf or Custom	Future Direction
Company Web Site	northbayhydro.com	Mindoka (Host)/WordPress	Mindoka	IT	Custom	Slated to be updated in 2021
Customer Portal	northbayhydro.com/customer	Mindoka	Mindoka	Finance	Custom	Slated to be updated in 2021
eBilling Portal	northbayhydro.com/mirs/nodes	Mindoka	Mindoka	Finance	Custom	Will continue
Bill Generation	northbayhydro.com/mirs/nodes/billing	Mindoka	Mindoka	Finance	Custom	Will continue
SCADA	Worldview	Surveillant	CIMA+/Surveillant	Operations	COTS	Worldview support will be discontinued in 2020; upgrade to SmartVU
GIS	ArcGIS	ESRI	ESRI	Engineering	COTS	Will keep current
Data Broker	AS2	Cleo	Cleo	IT	COTS	Will keep current
Document Management	Mindoka MIRS	Mindoka	Mindoka	IT	COTS	Will continue; opportunity to move to SharePoint (strategic)
Configuration Management	Excel	Microsoft	Microsoft	IT	COTS/Custom	Will continue; no requirement for formal CMDB
Help Desk	None	N/A	N/A	N/A	N/A	No requirement for HD at this time unless business model changes
Metering Infrastructure	AMI	Sensus	Sensus/Util-Assist	Finance / IT	COTS	Will continue
ODS	ODS	Savage Data	Savage Data	Finance / IT	COTS	Will continue
Commercial Billing	MV90	Itron	Itron	Engineering	COTS	Opportunity to move to smart metering will eliminate MV90; may occur before 2025
Central Endpoint Protection	Bitdefender	Bitdefender	Bitdefender	IT	COTS	Will evaluate in 2022 upon completion of 3-yr agreement
Network Scanning	Firepower	Cisco	Cisco	IT	COTS	Will keep current
Email Filtering	RoaringPenguin / Canit	AppRiver	AppRiver	IT	COTS	Will move to AppRiver product when Canadian tenant is established

Core System	Product	Vendor	Support	Business Owner	Commercial off-the-shelf or Custom	Future Direction
NAS	QNAP NAS	QNAP	QNAP	IT	COTS	Will evaluate in 2024 when product is due for refresh
Email	Exchange 2016	Microsoft	Microsoft	IT	COTS	Will keep current / potential to move to O365
Phone System	Mitel 3300	Mitel	Bell/Mitel	IT	COTS	Move to Cloud-based telephony for strategic reasons (D/R)
Collaboration Platform	SharePoint	Microsoft	Microsoft	IT	COTS	Will keep current / potential to move to O365
Backup/Recovery Platform	Backup Exec	Veritas	Veritas	IT	COTS	Will evaluate in 2021 for enterprise-class solution
Services - Finance/Payroll	Sage 50	Sage	Sage	Finance	COTS	Will keep current

Appendix H - HONI Planning Status Letter

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Toronto, ON M5G 2P5
www.HydroOne.com

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Fax: (416) 345-4141
Ajay.Garg@HydroOne.com

May 27, 2020

Mr. Roch Pilon
Vice-President, Engineering
North Bay Hydro Distribution Ltd.
74 Commerce Crescent
North Bay, ON P1A 0B4

Dear Mr. Pilon,

Subject: Regional Planning Status

As per your request, this Planning Status letter is provided to meet one of the requirements of your upcoming Rate Application to the Ontario Energy Board (OEB).

As you are aware, the province of Ontario is divided into 21 Regions for the purpose of Regional Planning (RP), a map of Ontario showing the 21 Regions and the list of Local Distribution Companies (LDCs) in each of the Region are attached as Appendix A and B respectively.

North Bay Hydro Distribution Ltd. is an LDC within the North/East of Sudbury region, where Hydro One Networks Inc. (Hydro One) is the lead transmitter.

This letter confirms that the first cycle of Regional Planning (RP) for North/East of Sudbury region was completed in 2017. The findings and the recommendations stemming out of this process are provided in detail in the North/East of Sudbury Regional Infrastructure Planning Report. The report can be accessed from Hydro One's Regional Planning website for the North/East of Sudbury region.

North/East of Sudbury

The following transmission projects were undertaken and completed by Hydro One to address near-term needs that were recommended in the first Regional Planning cycle.

- Timmins TS / Kirkland TS – Voltage Regulation Issues
- Dymond TS T3/T4 transformers
- Kirkland Lake TS T12/T13 transformers
- Timmins TS T63/T64 with single 83 MVA
- Otto Holden TS T3/T4 autotransformers, and 115kV circuit breakers

There were no other need that require further regional coordination in the first cycle. In summary, no capital contribution is expected from North Bay Hydro Inc. for the projects developed by Hydro One in North/East of

Sudbury region.

Hydro One anticipated that next cycle of regional planning will commence in Q1/Q2 of 2021. North Bay Hydro Distribution Ltd. is an active participating member on the regional Study Teams and Hydro One is looking forward to continue working with North Bay Hydro Distribution Ltd. in executing the regional planning process. Please feel free to contact me if you have any questions.

Sincerely,



Ajay Garg, Manager – Regional Planning Coordination
Hydro One Networks Inc.

Appendix A. Map of Ontario's Planning Regions

Northern Ontario



Southern Ontario



Greater Toronto Area (GTA)



Burlington to Nanticoke	East Lake Superior	Chatham/Lambton/Sarnia
Greater Ottawa	London area	Greater Bruce/Huron
GTA East	Peterborough to Kingston	Niagara
GTA North	South Georgian Bay/Muskoka	North of Moosonee*
GTA West	Sudbury/Algoma	North/East of Sudbury
Kitchener- Waterloo- Cambridge-Guelph ("KWCG")	Northwest Ontario	Renfrew
Toronto	Windsor-Essex	St. Lawrence

*This region is not within Hydro One's territory.

Appendix B. List of LDCs for Each Region

(Hydro One as Upstream Transmitter)

Region	LDCs
1. Burlington to Nanticoke	• Energy+ Inc. • Brantford Power Inc. • Burlington Hydro Inc. • Haldimand County Hydro Inc.** • Alectra Utilities Corporation • Hydro One Networks Inc. • Norfolk Power Distribution Inc.** • Oakville Hydro Electricity Distribution Inc.
2. Greater Ottawa	• Hydro 2000 Inc. • Hydro Hawkesbury Inc. • Hydro One Networks Inc. • Hydro Ottawa Limited • Ottawa River Power Corporation • Renfrew Hydro Inc.
3. GTA North	• Alectra Utilities Corporation • Hydro One Networks Inc. • Newmarket-Tay Power Distribution Ltd. • Toronto Hydro Electric System Limited • Elexicon Energy Inc.
4. GTA West	• Burlington Hydro Inc. • Alectra Utilities Corporation • Halton Hills Hydro Inc. • Hydro One Networks Inc. • Milton Hydro Distribution Inc. • Oakville Hydro Electricity Distribution Inc.
5. Kitchener- Waterloo-Cambridge-Guelph ("KWCG")	• Energy+ Inc. • Centre Wellington Hydro Ltd. • Alectra Utilities Corporation • Halton Hills Hydro Inc. • Hydro One Networks Inc. • Kitchener-Wilmot Hydro Inc. • Milton Hydro Distribution Inc. • Waterloo North Hydro Inc. • Wellington North Power Inc.

6. Toronto	• Alectra Utilities Corporation • Hydro One Networks Inc. • Toronto Hydro Electric System Limited • Elexicon Energy Inc.
7. Northwest Ontario	• Atikokan Hydro Inc. • Chapleau Public Utilities Corporation • Fort Frances Power Corporation • Hydro One Networks Inc. • Kenora Hydro Electric Corporation Ltd. • Sioux Lookout Hydro Inc. • Thunder Bay Hydro Electricity • Distribution Inc.
8. Windsor-Essex	• E.L.K. Energy Inc. • Entegrus Power Lines Inc. [Chatham- Kent] • EnWin Utilities Ltd. • Essex Powerlines Corporation • Hydro One Networks Inc.
9. East Lake Superior* *Hydro One Sault Ste. Marie L.P. is the Lead Transmitter for the region.	• Algoma Power Inc. • Chapleau PUC • Sault Ste. Marie PUC • Hydro One Networks Inc.
10. GTA East	• Hydro One Networks Inc. • Oshawa PUC Networks Inc. • Elexicon Energy Inc.
11. London Area	• Entegrus Power Lines Inc. [Middlesex] • Erie Thames Power Lines Corporation • Hydro One Networks Inc. • London Hydro Inc. • Norfolk Power Distribution Inc.** • St. Thomas Energy Inc. • Tillsonburg Hydro Inc. • Woodstock Hydro Services Inc.**
12. Peterborough to Kingston	• Eastern Ontario Power Inc. • Hydro One Networks Inc. • Kingston Hydro Corporation • Lakefront Utilities Inc. • Peterborough Distribution Inc. • Elexicon Energy Inc.

13. South Georgian Bay/Muskoka	• EPCOR • Hydro One Networks Inc. • InnPower Corporation • Lakeland Power Distribution Ltd. • Midland Power Utility Corporation • Orangeville Hydro Limited • Orillia Power Distribution Corporation • Alectra Utilities Corporation • Elexicon Energy Inc. • Elexicon Energy Inc. • Wasaga Distribution Inc.
14. Sudbury/Algoma	• Espanola Regional Hydro Distribution Corp. • Greater Sudbury Hydro Inc. • Hydro One Networks Inc.
15. Chatham/Lambton/Sarnia	• Bluewater Power Distribution Corporation • Entegrus Power Lines lnc. [Chatham- Kent] • Hydro One Networks Inc.
16. Greater Bruce/Huron	• Entegrus Power Lines lnc. [Middlesex] • Erie Thames Power Lines Corporation • Festival Hydro Inc. • Hydro One Networks Inc. • Wellington North Power Inc. • West Coast Huron Energy lnc. • Westario Power Inc.
17. Niagara	• Canadian Niagara Power Inc. [Port Colborne] • Grimsby Power Inc. • Haldimand County Hydro Inc.** • Alectra Utilities Corporation • Hydro One Networks Inc. • Niagara Peninsula Energy Inc. • Niagara-On-The-Lake Hydro Inc. • Welland Hydro-Electric System Corp. • Niagara West Transformation Corporation* * Changes to the May 17, 2013 OEB Planning Process Working Group Report

19. North/East of Sudbury	• Greater Sudbury Hydro Inc. • Hearst Power Distribution Company Limited • Hydro One Networks Inc. • North Bay Hydro Distribution Ltd. • Northern Ontario Wires Inc.
20. Renfrew	• Hydro One Networks Inc. • Ottawa River Power Corporation • Renfrew Hydro Inc.
21. St. Lawrence	• Cooperative Hydro Embrun Inc. • Hydro One Networks Inc. • Rideau St. Lawrence Distribution Inc.

**This Local Distribution Company (LDC) has been acquired by Hydro One Networks Inc.

Appendix C

Regional Infrastructure Planning (RIP) report – April 2017

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North/East of Sudbury

Regional Infrastructure Plan ("RIP")

April 13, 2017

Northern Ontario Wires Inc.
Hearst Power Ltd.
North Bay Hydro Distribution Ltd.
Hydro One Networks Inc. (Distribution)

North/East of Sudbury Region is the area roughly bordered by Moosonee on the North, Hearst on the North-West, Ferris South and Kirkland Lake on the East.

The Local Planning ("LP") report for the North/East of Sudbury Region was completed on August 8, 2016 (see attached), and identified the following needs in the region:

- Timmins TS/Kirkland Lake TS – Voltage Regulation Issues:

In the LP report, the study team acknowledged that the Timmins TS 115kV bus may experience voltages below ORTAC requirements following a contingency to both Porcupine TS K1K4 and K1K2 breakers. Operating measures are established to control the voltage decline post contingency, and the study team concluded no action is currently required. Hydro One will continue to monitor Timmins area load growth to ensure operating measures outlined in the LP report continue to be effective for voltage regulations.

The LP also report concluded that corrective actions to control voltage violations on the system may be required for any new loads in the Kirkland Lake or Dymond area.

Consistent with a process established by an industry working group[1] created by the OEB the Regional Infrastructure Plan ("RIP") is the last phase of the planning process. In view that no further regional coordination was required, the attached NA and LP reports will be deemed to form the RIP for the North/East of Sudbury Region.

The next planning cycle for the region will take place within five years of the start of this cycle (2021) or earlier, should there be a new need identified in the region.

Sincerely,

Ajay Garg | Manager, Regional Planning Co-ordination
Hydro One Networks Inc.

[1] Planning Process Working Group (PPWG) Report to the Ontario Energy Board available at the OEB website www.ontarioenergyboard.ca

Hydro One Networks Inc.
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Toronto, Ontario
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LOCAL PLANNING REPORT

Timmins / Kirkland Lake Voltage Regulation
Region: North & East of Sudbury

Revision: FINAL
Date: August 8, 2016

Prepared by: Hydro One Networks Inc (Transmission & Distribution)

Study Team

Organization
Hydro One Networks Inc. (Lead Transmitter)
Hydro One Networks Inc. (Distribution)

DISCLAIMER

This Local Planning Report was prepared for the purpose of developing wires-only options and recommending a preferred solution(s) to address the local needs identified in the Needs Assessment (NA) report for the North & East of Sudbury Region that do not require further coordinated regional planning. The preferred solution(s) that have been identified through this Local Planning Report may be reevaluated based on the findings of further analysis. The load forecast and results reported in this Local Planning Report are based on the information and assumptions provided by study team participants.

Study team participants, their respective affiliated organizations, and Hydro One Networks Inc. (collectively, "the Authors") make no representations or warranties (express, implied, statutory or otherwise) as to the Local Planning Report or its contents, including, without limitation, the accuracy or completeness of the information therein and shall not, under any circumstances whatsoever, be liable to each other, or to any third party for whom the Local Planning Report was prepared ("the Intended Third Parties"), or to any other third party reading or receiving the Local Planning Report ("the Other Third Parties"), for any direct, indirect or consequential loss or damages or for any punitive, incidental or special damages or any loss of profit, loss of contract, loss of opportunity or loss of goodwill resulting from or in any way related to the reliance on, acceptance or use of the Local Planning Report or its contents by any person or entity, including, but not limited to, the aforementioned persons and entities.

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LOCAL PLANNING EXECUTIVE SUMMARY

REGION	North & East of Sudbury (the "Region")		
LEAD	Hydro One Networks Inc. ("Hydro One")		
START DATE	May 9, 2016	**END DATE**	November 30, 2016

1. INTRODUCTION

The purpose of this Local Planning (LP) report is to develop wires-only option and recommend a preferred solution that will address the local needs identified in the Needs Assessment (NA) report for the North & East of Sudbury Region dated April 15, 2016. The development of the LP report is in accordance with the regional planning process as set out in the Ontario Energy Board's (OEB) Transmission System Code (TSC) and Distribution System Code (DSC) requirements and the "Planning Process Working Group (PPWG) Report to the Board".

Based on Section 7 of the NA report, the study team recommended that no further coordinated regional planning is required to address the needs in the North & East of Sudbury region. These needs are local in nature and will be addressed by wires options through local planning led by Hydro One with participation of the impacted LDC.

2. LOCAL NEEDS ADDRESSED IN THIS REPORT

The Timmins and Kirkland Lake area voltage regulation are local needs addressed in this report.

3. OPTIONS CONSIDERED

Hydro One (Transmitter) and Hydro One Distribution (LDC) have considered addressing the Timmins TS voltage regulation need with the following options;

Alternative 0 – Status Quo.

Alternative 1 - Implement a Load Rejection Scheme on T61S and P7G

Hydro One (Transmitter) and Hydro One Distribution (LDC) have agreed that Alternative 0 – Status Quo is the only option to be considered for Kirkland Lake TS voltage regulation need.

See Section 3 for further detail.

4. PREFERRED SOLUTION

The preferred solution at this time for both the Timmins TS and Kirkland Lake TS voltage regulation needs are Alternative 0 – Status Quo. See Section 4 for details.

5. NEXT STEPS

The next steps are summarized in section 5

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1 Introduction

The Needs Assessment (NA) for the North & East of Sudbury ("Region") was triggered in response to the Ontario Energy Board's (OEB) Regional Infrastructure Planning process approved in August 2013. Prior to the new regional planning process coming into effect, planning activities were already underway in the Region to address some specific station capacity needs. The NA report can be found on Hydro One's Regional Planning website. The study team identified needs that are emerging in the North & East of Sudbury Region over the next ten years (2016-2026) and recommended whether they should be further assessed through the transmitter-led Local Planning (LP) process or the IESO-led Scoping Assessment (SA) process.

1.1 North & East of Sudbury Region Description and Connection Configuration

The North & East of Sudbury Region are bounded by regions of North Bay, Timmins, Hearst, Moosonee, Kirkland Lake and Dymond. A map of the region is shown below in Figure 1.

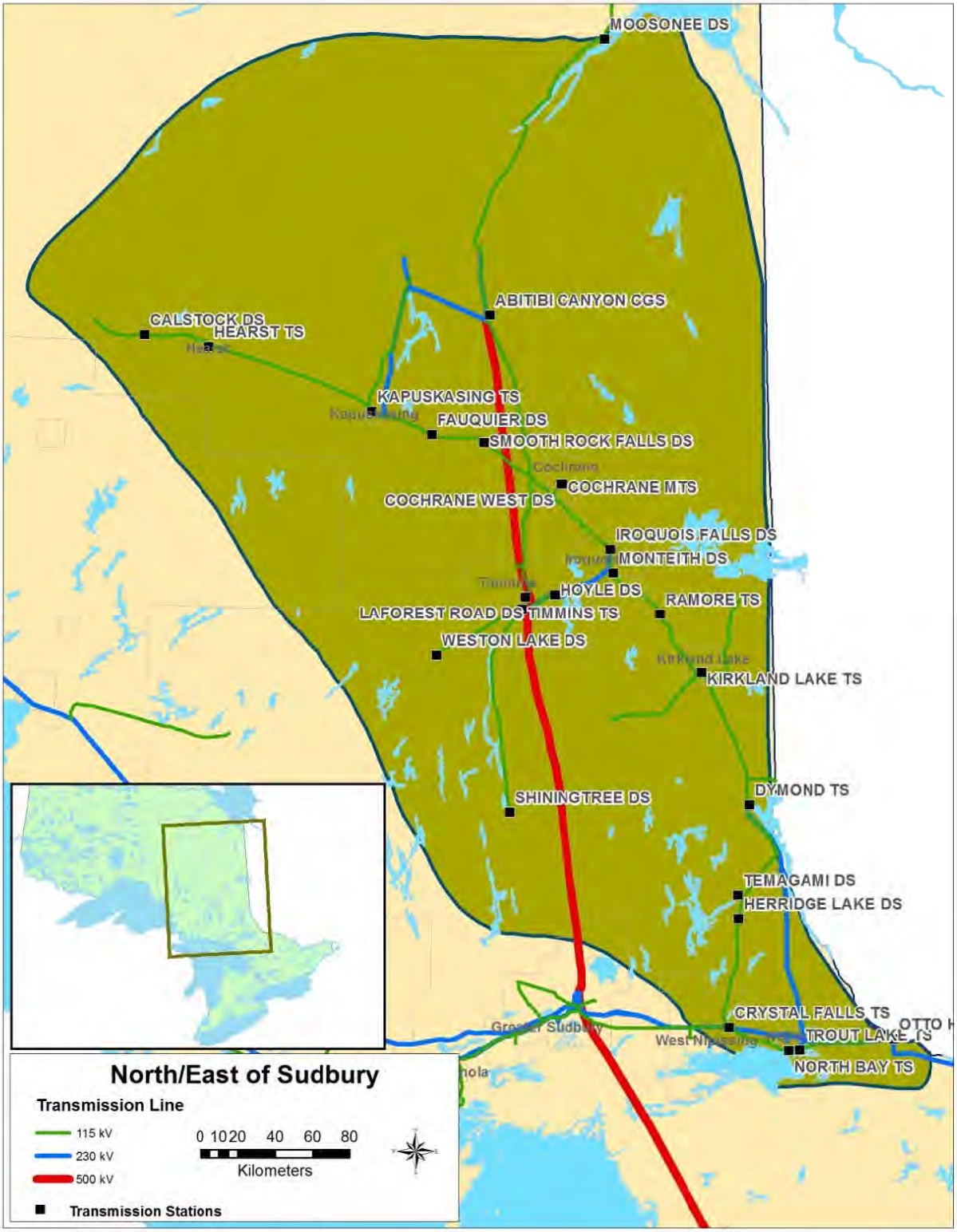


Figure 1: North & East of Sudbury Region Map

Electrical supply for this region is provided through a network of 230kV and 115kV transmission circuits. This area is further reinforced through the 500kV circuits P502X and D501P connecting Pinard TS to Hanmer TS. This region has the following four local distribution companies (LDC):

Hydro One Networks (distribution)
Northern Ontario Wires Inc
Hearst Power Ltd
North Bay Hydro Distribution Ltd.

Table 1: Transmission Lines and Stations in North & East of Sudbury Region

115kV circuits	230kV circuits	500kV circuits	Hydro One Transformer Stations
L5H, L1S D2L, D3K A8K, A9K K2, K4 A4H, A5H D2H, D3H P7G, H9K P13T, P15T T61S, F1E L8L, T7M T8M, H6T H7T, D6T	H23S, H24S W71D, P91G D23G, K38S R21D, L20D L21S, H22D	P502X, D501P	Ansonville TS * Crystal Falls TS Dymond TS * Hearst TS Hunta SS Kapuskasing TS Kirkland Lake TS Little Long SS Moosonee SS North Bay TS Otter Rapids SS Otto Holden TS * Pinard TS * Porcupine TS * Spruce Falls TS* Timmins TS Trout Lake TS Widdifield SS

*Stations with Autotransformers installed

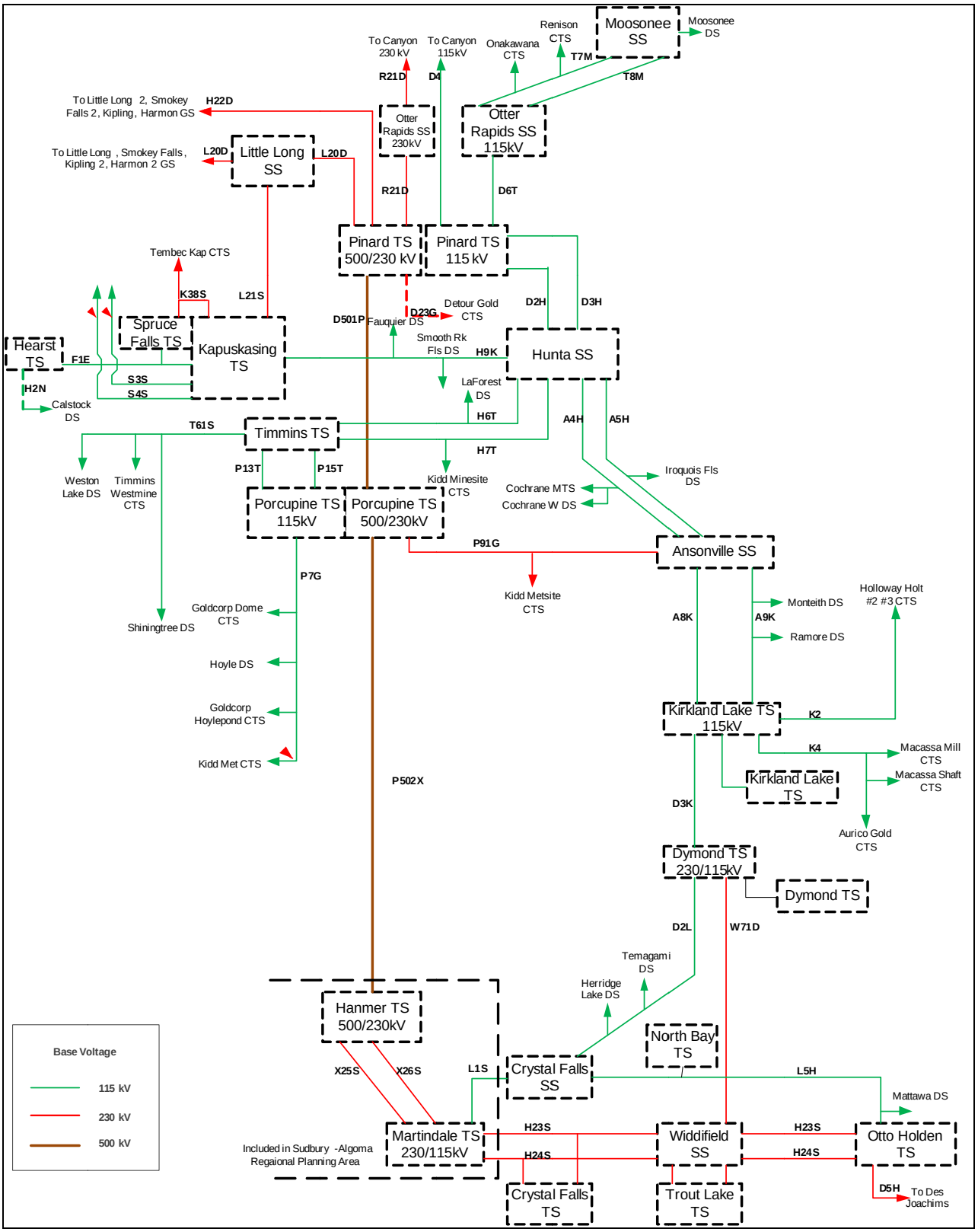


Figure 2: North and East of Sudbury Regional Planning Electrical Diagram

2 Area Needs

2.1 North & East of Sudbury Region Needs

As an outcome of the NA process, the study team identified voltage regulation issues at Timmins TS and Kirkland Lake TS which are addressed in this report. Local planning was recommended, and Hydro One as the transmitter, with the impacted LDC further undertook planning assessments to address the following needs;

- Timmins TS voltage regulation - The loss of Porcupine TS 115kV circuit breakers (K1K4 and K1K2) may result in voltage declines at Timmins TS 115kV bus in excess of 10%. This is considered an n-1-1 contingency and load rejection following the loss of the second element was proposed by IESO to improve post contingency voltage performance. See Figure 3 – Timmins area connection diagram for reference.

- Kirkland Lake TS voltage regulation - The loss of Ansonville T2 and D3K may result in voltage declines at Kirkland Lake TS 115kV bus in excess of 10%. This is considered an n-1-1 contingency and all new loads in the area will be required to participate in a local load rejection scheme to help improve post contingency voltage performance.

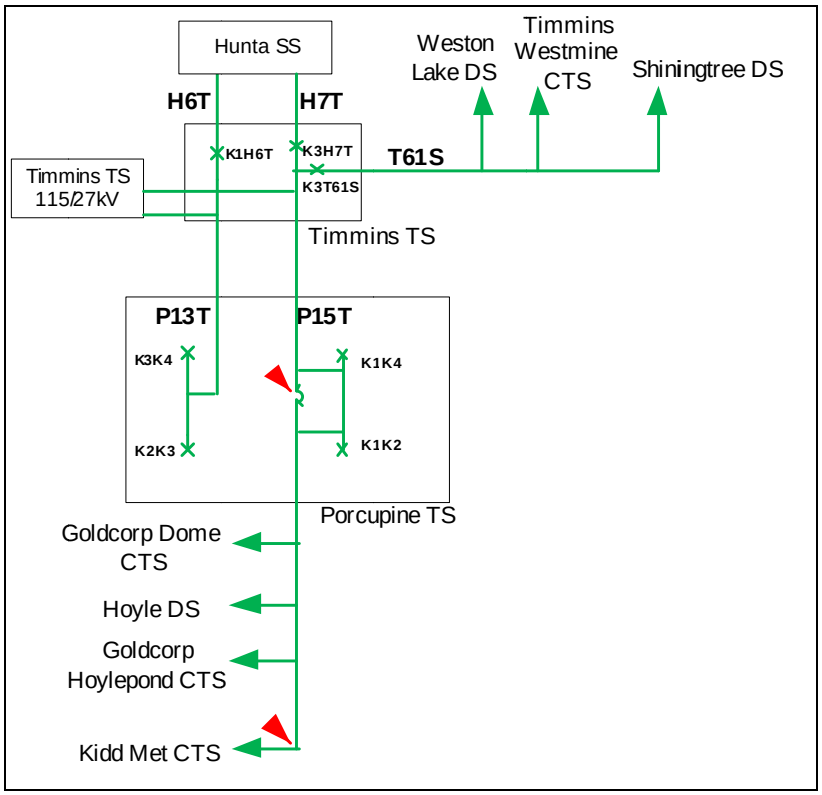


Figure 3: Timmins area connection diagram

3 Alternatives Considered

3.1 Timmins TS Voltage regulation

Alternative 1 – Status Quo.

No further action is required at this time. Hydro One and LDC will monitor the loads and voltages in the area in the upcoming years. Further review of this issue will be undertaken in the next planning cycle or earlier if there is evidence that load cannot be served or system cannot be operated in a safe, secure and reliable manner. Voltage issues can be addressed with operating procedures which are presently in place without any use of load rejection.

Alternative 2 – Implement Load Rejection on T61S, P7G, P15T to control Timmins TS voltages

This option will require expansion of the Northeast LR/GR scheme to include tripping of the Hydro One 115kV T61S, P7G, and P15T circuits upon contingency of both Porcupine TS K1K4 and K1K2 circuit breakers. This will allow for automatic load rejection of approximately 40MW of load.

Table 2: Budgetary Cost for Alternatives

Options Considered	Cost
Alternative 1 – Hydro One to assess voltage performance with no immediate investment.	--
Alternative 2 – Expand Northeast Special Protection Scheme (SPS) to include P15T, P7G, T61S circuits	$2M

3.2 Kirkland Lake TS Voltage regulation

Alternative 1 – Status Quo. See details in section 4 below.

4 Preferred Solution and Reasoning

4.1 Timmins TS Voltage regulation

Hydro One Networks and Hydro One Distribution have reviewed all alternatives and the preferred solution at this time is, Alternative 1 – Status Quo.

The study team acknowledges that Timmins TS 115kV bus may experience voltages below ORTAC requirements following a contingency to both Porcupine TS K1K4 and K1K2 breakers. The possibility of this scenario is remote and there are established operating measures in place should the first Porcupine TS breaker (either K1K4 or K1K2) be placed out of service. The following control measures are taken which help alleviate the voltage decline post contingency.

- Open Timmins TS LV breaker to offload Timmins TS from P15T
- Transfer P7G load to P91G by closing breaker B5L2 at Kidd Creek Metsite and open Porcupine TS switch 30-P7G
- Place one Abitibi Canyon 115kV unit on condenser mode.

Hydro One Networks and Hydro One Distribution have agreed that these operating measures are a preferred alternative to load rejection. In addition, implementing the load rejection scheme will expose the customers in the area to unnecessary interruption due to misoperation of the load rejection scheme.

Hydro One will continue to monitor Timmins area load growth from both LDCs and industrial customers to ensure load growth (if any) does not make voltage situation worse whereby the above operating measures are no longer effective. The next planning cycle will take place within five years and an investment can be triggered at any time should there be a situation where load cannot be served or system cannot be operated safely and reliably.

4.2 Kirkland Lake TS Voltage Regulation

Hydro One Networks and Hydro One Distribution agree that new loads in the Kirkland Lake or Dymond area may be subject to participate in an under voltage load rejection scheme as part to help control voltages in the area post contingency. Presently there is no load growth in the area over the study period. Investments are not required at this time for existing LDC loads and Hydro One will monitor load growth in the area and take corrective action as required or when instructed to do so by the IESO as proponent connection requirements. These will be identified during the load connection process after the connection applications and will be implemented by Hydro One.

5 Next Steps

A summary of the next steps, actions/solutions and timelines required to address the local needs are as follows:

Table 3: Solutions and Timeframe

Need	Action / Recommended Solution	Lead Responsibility	Timeframe
Timmins TS Voltage Regulation	• No Immediate action required • Hydro One and LDC to monitor area load growth	Hydro One Networks	Five years
Kirkland Lake TS Voltage Regulation	• No Immediate action required • Connection requirements for new transmission or distribution connections to be implemented as identified during system studies.	Hydro One Networks	N/A

6 References

[1] Planning Process Working Group (PPWG) Report to the Board: The Process for Regional Infrastructure Planning in Ontario – May 17, 2013

[2] IESO Ontario Resource and Transmission Assessment Criteria (ORTAC)

[3] North & East of Sudbury Needs Assessment Report

Appendix A: Load Forecast for North & East of Sudbury Stations

Transformer Station Name	Customer Data (MW)	Historical Term Forecast (MW)			Near Term Forecast (MW)					Medium Term Forecast (MW)					
		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Kapuskasing TS	Gross Peak Load				13.5	13.6	13.6	13.7	13.8	13.8	13.9	13.9	14.0	14.0	14.0
	Net Load Forecast	26.1	16.1	13.5	13.4	13.3	13.2	13.2	13.1	13.1	13.1	13.0	13.0	13.0	13.0
Trout Lake TS	Gross Peak Load				121.9	122.2	122.7	123.3	123.9	125.3	126.7	127.1	128.4	129.8	131.2
	Net Load Forecast	147.5	124.1	119.4	120.6	120.0	119.1	118.5	118.1	118.7	119.2	119.1	119.7	120.5	121.1
Dymond TS	Gross Peak Load				32.7	32.9	33.1	33.6	34.0	34.2	34.4	34.6	34.8	35.0	35.2
	Net Load Forecast	37.7	34.6	32.4	32.4	32.3	32.2	32.2	32.4	32.4	32.4	32.4	32.4	32.5	32.5
Kirkland Lake TS	Gross Peak Load				32.2	32.3	32.6	32.9	33.3	33.5	33.7	33.8	34.0	34.1	34.3
	Net Load Forecast	43.8	35.7	31.9	31.9	31.7	31.6	31.7	31.7	31.7	31.7	31.7	31.7	31.7	31.6
Timmins TS	Gross Peak Load				53.4	53.7	54.2	54.9	55.6	56.0	56.4	56.7	57.0	57.4	57.7
	Net Load Forecast	51.0	51.1	52.9	52.8	52.7	52.6	52.7	53.0	53.0	53.0	53.1	53.2	53.2	53.3
Hearst TS	Gross Peak Load				27.5	27.6	28.8	29.1	29.3	29.5	29.7	29.9	30.0	30.2	30.4
	Net Load Forecast	27.8	27.3	27.2	27.2	27.1	28.0	27.9	28.0	28.0	28.0	28.0	28.0	28.0	28.0
Herridge Lake DS	Gross Peak Load				3.0	3.1	3.1	3.2	3.2	3.3	3.3	3.4	3.4	3.5	3.5
	Net Load Forecast	3.5	3.8	3.0	3.0	3.0	3.0	3.1	3.1	3.1	3.1	3.2	3.2	3.2	3.2
Temagami DS	Gross Peak Load				2.4	2.4	2.4	2.5	2.5	2.5	2.5	2.5	2.6	2.6	2.6
	Net Load Forecast	2.5	2.6	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
LaForest Rd TS	Gross Peak Load				10.4	10.4	10.5	10.7	10.8	10.9	10.9	11.0	11.1	11.1	11.2
	Net Load Forecast	12.8	9.7	10.3	10.3	10.2	10.2	10.2	10.3	10.3	10.3	10.3	10.3	10.3	10.3
Hoyle TS	Gross Peak Load				8.9	8.9	9.0	9.2	9.3	9.4	9.5	9.5	9.6	9.7	9.7
	Net Load Forecast	9.3	10.4	8.8	8.8	8.8	8.8	8.8	8.9	8.9	8.9	8.9	8.9	9.0	9.0
Monteith DS	Gross Peak Load				2.8	2.8	2.8	2.8	2.9	2.9	2.9	3.0	3.0	3.0	3.0
	Net Load Forecast	3.1	2.9	2.7	2.7	2.7	2.7	2.7	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Ramore TS	Gross Peak Load				9.1	9.2	9.3	9.5	9.7	9.8	9.9	10.1	10.2	10.3	10.4
	Net Load Forecast	8.2	9.1	8.9	9.0	9.0	9.1	9.1	9.2	9.3	9.4	9.4	9.5	9.6	9.6
Cochrane West DS	Gross Peak Load				3.8	3.8	3.8	3.9	3.9	3.9	4.0	4.0	4.0	4.0	4.1
	Net Load Forecast	4.1	4.1	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
Smooth Rock Falls DS	Gross Peak Load				2.2	2.2	2.2	2.3	2.3	2.3	2.3	2.3	2.4	2.4	2.4
	Net Load Forecast	2.4	2.4	2.1	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Fauquier DS	Gross Peak Load				2.1	2.1	2.2	2.2	2.2	2.3	2.3	2.3	2.3	2.3	2.4
	Net Load Forecast	2.3	2.3	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.2	2.2	2.2	2.2
Moosonee DS	Gross Peak Load				14.2	14.3	14.4	14.6	14.8	14.9	15.0	15.0	15.1	15.2	15.3
	Net Load Forecast	18.0	13.5	14.1	14.1	14.0	14.0	14.0	14.1	14.1	14.1	14.1	14.1	14.1	14.1
Calstock DS	Gross Peak Load				5.0	5.0	5.1	5.2	5.2	5.3	5.3	5.4	5.4	5.5	5.5
	Net Load Forecast	5.1	4.9	4.9	4.9	4.9	4.9	5.0	5.0	5.0	5.0	5.1	5.1	5.1	5.1
Mattawa DS	Gross Peak Load				5.5	5.5	5.6	5.7	5.7	5.8	5.8	5.8	5.9	5.9	5.9
	Net Load Forecast				5.4	5.4	5.4	5.4	5.5	5.5	5.5	5.5	5.5	5.5	5.5
Iroquois Falls DS	Gross Peak Load				10.8	10.9	10.9	11.0	11.1	11.1	11.2	11.2	11.2	11.3	11.3
	Net Load Forecast	5.1	4.9	4.9	10.7	10.7	10.6	10.6	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Crystal Falls TS	Gross Peak Load				9.9	10.0	10.0	10.2	10.3	10.4	10.4	10.5	10.5	10.6	10.6
	Net Load Forecast	18.7	11.1	9.8	9.8	9.8	9.7	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
Cochrane MTS	Gross Peak Load				11.3	11.4	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6
	Net Load Forecast	10.3	10.9	11.1	11.1	11.2	11.2	11.1	11.0	11.0	10.9	10.8	10.8	10.7	10.7
North Bay	Gross Peak Load				39.0	39.0	39.0	39.0	39.0	39.4	39.8	40.2	40.6	41.0	41.4
	Net Load Forecast	29.0	39.0	25.0	38.6	38.3	37.9	37.5	37.2	37.3	37.4	37.7	37.8	38.0	38.2

Load Forecast for North & East of Sudbury Stations (Continued)

Transformer Station Name	Customer Data (MW)	Historical Term Forecast (MW)			Near Term Forecast (MW)					Medium Term Forecast (MW)					
		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Weston Lake DS	Gross Peak Load				4.1	4.1	4.2	4.2	4.3	4.3	4.3	4.4	4.4	4.4	4.4
	Net Load Forecast	4.1	4.3	4.1	4.0	4.0	4.0	4.1	4.1	4.1	4.1	4.2	4.2	4.2	4.2
Shiningtree DS	Gross Peak Load				4.1	4.1	4.2	4.2	4.3	4.3	4.3	4.4	4.4	4.4	4.4
	Net Load Forecast	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.1	4.1	4.1	4.2	4.2	4.2	4.2

Appendix B: Acronyms

BES	Bulk Electric System
BPS	Bulk Power System
CDM	Conservation and Demand Management
CIA	Customer Impact Assessment
CGS	Customer Generating Station
CTS	Customer Transformer Station
DESN	Dual Element Spot Network
DG	Distributed Generation
DSC	Distribution System Code
GS	Generating Station
GTA	Greater Toronto Area
IESO	Independent Electricity System Operator
IRRP	Integrated Regional Resource Planning
kV	Kilovolt
LDC	Local Distribution Company
LP	Local Planning
LTE	Long Term Emergency
LTR	Limited Time Rating
LV	Low-voltage
MW	Megawatt
MVA	Mega Volt-Ampere
NA	Needs Assessment
NERC	North American Electric Reliability Corporation
NGS	Nuclear Generating Station
NPCC	Northeast Power Coordinating Council Inc.
OEB	Ontario Energy Board
OPA	Ontario Power Authority
ORTAC	Ontario Resource and Transmission Assessment Criteria
PF	Power Factor
PPWG	Planning Process Working Group
RIP	Regional Infrastructure Planning
SIA	System Impact Assessment
SS	Switching Station
TS	Transformer Station
TSC	Transmission System Code
ULTC	Under Load Tap Changer

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NEEDS ASSESSMENT REPORT

Region: North and East of Sudbury

Date: April 15, 2016

Prepared by: North and East of Sudbury Region Working Group

North & East of Sudbury Working Group	
Organization	**Name**
Hydro One Networks Inc. (Lead Transmitter)	Kirpal Bahra Qasim Raza
Independent Electricity System Operator	Chris Reali Philip Woo
Hydro One Networks Inc. (Distribution)	Richard Shannon Daniel Boutros
Northern Ontario Wires Inc	Dan Boucher
Hearst Power Ltd	D Sampson J Richard
North Bay Hydro Distribution Ltd	Matt Payne

Disclaimer

This Needs Assessment Report was prepared for the purpose of identifying potential needs in the North & East of Sudbury region and to assess whether those needs require further coordinated regional planning. The potential needs that have been identified through this Needs Assessment Report may be studied further through subsequent regional planning processes and may be reevaluated based on the findings of further analysis. The load forecast and results reported in this Needs Assessment Report are based on the information and assumptions provided by Working Group participants.

Working Group participants, their respective affiliated organizations, and Hydro One Networks Inc. (collectively, "the Authors") make no representations or warranties (express, implied, statutory or otherwise) as to the Needs Assessment Report or its contents, including, without limitation, the accuracy or completeness of the information therein and shall not, under any circumstances whatsoever, be liable to each other, or to any third party for whom the Needs Assessment Report was prepared ("the Intended Third Parties"), or to any other third party reading or receiving the Needs Assessment Report ("the Other Third Parties"), for any direct, indirect or consequential loss or damages or for any punitive, incidental or special damages or any loss of profit, loss of contract, loss of opportunity or loss of goodwill resulting from or in any way related to the reliance on, acceptance or use of the Needs Assessment Report or its contents by any person or entity, including, but not limited to, the aforementioned persons and entities.

NEEDS ASSESSMENT EXECUTIVE SUMMARY

REGION	North & East of Sudbury (the "Region")		
LEAD	Hydro One Networks Inc. ("Hydro One")		
START DATE	October 15, 2015	**END DATE**	April 15, 2016

1. INTRODUCTION

The purpose of this Needs Assessment (NA) report is to undertake an assessment of the North & East of Sudbury Region and determine if there are regional needs that require coordinated regional planning. Where regional coordination is not required, and a "localized" wires solution is necessary, such needs will be addressed between relevant Local Distribution Companies (LDCs) and Hydro One and other parties as required.

For needs that require further regional planning and coordination, IESO will initiate the Scoping Assessment (SA) process to determine whether an IESO-led Integrated Regional Resource Planning (IRRP) process, or the transmitter-led Regional Infrastructure Plan (RIP) process (wires solution), or whether both are required.

2. REGIONAL ISSUE / TRIGGER

The NA for the North & East of Sudbury Region was triggered in response to the Ontario Energy Board's (OEB) Regional Infrastructure Planning process approved in August 2013. To prioritize and manage the regional planning process, Ontario's 21 regions were assigned to one of three groups. The NA for Group 1 and 2 regions is complete and has been initiated for Group 3 Regions. The North & East of Sudbury Region belongs to Group 3, triggered on October 15, 2015 and completed on April 17, 2016

3. SCOPE OF NEEDS ASSESSMENT

The scope of the NA study was limited to 10 years as per the recommendations of the Planning Process Working Group (PPWG) Report to the Board. As such, relevant data and information was collected up to the year 2026. Needs emerging over the next 10 years and requiring coordinated regional planning may be further assessed as part of the IESO-led SA, which will determine the appropriate regional planning approach: IRRP, RIP, and/or local planning. This NA included a study of transmission system connection facilities capability, which covers station loading, thermal and voltage analysis as well as a review of system reliability, operational issues such as load restoration, and assets approaching end-of-useful-life.

4. INPUTS/DATA

Working Group participants included representatives from LDCs, the Independent Electricity System Operator (IESO), and Hydro One. The information included: historical load, load forecast, conservation and demand management (CDM) and distributed generation (DG) information, load restoration data, and performance information including major equipment approaching end-of-useful life.

5. NEEDS ASSESSMENT METHODOLOGY

The assessment's primary objective is to identify the electrical infrastructure needs and system performance issues in the Region over the study period (2016 to 2026). The assessment reviewed available information, load forecasts and included single contingency analysis to confirm needs, if and when required.

6. RESULTS - TRANSMISSION NEEDS

A. 500/230kV Autotransfomers

The 500/230kV Autotransformers supplying the regional are adequate over the study period for the loss of a single 500/230kV unit.

B. 500/115kV Autotransfomers

The 500/115kV Autotransformers supplying the regional are adequate over the study period for the loss of a single 500/115kV unit

C. 230/115 kV Autotransformers

The 230/115kV Autotransformers supplying the regional are adequate over the study period for the loss of a single 230/115kV unit

D. Transmission Lines & Ratings

The 500kV, 230kV transmission lines are adequate over the study period.

Sections of the 115kV H9K circuit may experience thermal overloads during high generation scenarios. This is a bulk system issue and will be addressed jointly with the IESO outside of regional planning.

E. 230 kV and 115 kV Connection Facilities

The 230kV and 115kV connection facilities in this region are adequate over the study period.

F. Outage Condition resulting in P15T,P7G and T61S radially connected to Timmins TS

The loss of K1K4 and K1K2 circuit breakers at Porcupine TS can result in excessive voltage declines at Timmins TS 115kV bus

G. Ansonville T2 or D3K Outages

With Ansonville T2 or D3K out of service, the loss of the other can result in excessive voltage decline at the Kirkland Lake TS 115kV bus.

System Reliability, Operation and Restoration Review

Circuit reliability in the region is acceptable, and Hydro One will continue to monitor performance of supply stations and circuits to ensure customer delivery performance criteria are met.

Restoration requirements for the loss of one element can be met by Hydro One.
Restoration requirements for the loss of up to two elements can be met by Hydro One.

Aging Infrastructure / Replacement Plan

Within the regional planning time horizon, the following work is part of Hydro One approved sustainment business plan

Dymond TS (T3/T4) transformers (2016)
Kirkland Lake TS (T12/T13) transformers (2017)
Timmins TS (T63/T64) with single 83MVA (2016)
Otto Holden TS (T3/T4) autotransformers, and 115kV circuit breakers (2019)

7. RESULTS – NEEDS ASSESSMENT REPORT

Based on the findings of the Needs Assessment, the Working Group recommends that no further regional coordination is required and following needs identified be further assessed as part of Local Planning:

Timmins TS / Kirkland Lake TS – Voltage Regulation Issues

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1 INTRODUCTION

This Needs Assessment (NA) report provides a summary of needs that are emerging in the North & East of Sudbury Region ("Region") over the next ten years. The development of the NA report is in accordance with the regional planning process as set out in the Ontario Energy Board's (OEB) Transmission System Code (TSC) and Distribution System Code (DSC) requirements and the "Planning Process Working Group (PPWG) Report to the Board".

The purpose of this NA is to undertake an assessment of the North & East of Sudbury Region to identify any near term and/or emerging needs in the area and determine if these needs require a "localized" wires only solution(s) in the near-term and/or a coordinated regional planning assessment. Where a local wires only solution is necessary to address the needs, Hydro One, as transmitter, with Local Distribution Companies (LDC) or other connecting customer(s), will further undertake planning assessments to develop options and recommend a solution(s). For needs that require further regional planning and coordination, the Independent Electricity System Operator (IESO) will initiate the Scoping Assessment (SA) process to determine whether an IESO-led Integrated Regional Resource Planning (IRRP) process, or the transmitter-led Regional Infrastructure Plan (RIP) process (wires solution), or both are required. If localized wires only solutions do not require further coordinated regional planning, the SA may also recommend that local planning between the transmitter and affected LDCs be undertaken to address certain needs.

This report was prepared by Hydro One Inc ("Hydro One") on behalf of the North & East of Sudbury Region NA Working Group (Table 1). The report captures the results of the assessment based on information provided by LDCs, and the Independent Electricity System Operator (IESO).

Table 1: Working Group Participants for North & East of Sudbury Region

No.	Company
1.	Hydro One Networks Inc. (Lead Transmitter)
2.	Independent Electricity System Operator
3.	Northern Ontario Wires Inc
4.	Hydro One Networks Inc. (Distribution)
5.	Hearst Power Ltd
6.	North Bay Hydro Inc.

2 Regional Issue / Trigger

The NA for the North & East of Sudbury Region was triggered in response to the OEB's Regional Infrastructure Planning process approved in August 2013. To prioritize and manage the regional planning process, Ontario's 21 regions were assigned to one of three groups. The North & East of Sudbury Region belongs to Group 3.

3 Scope of Needs Assessment

This NA covers the North & East of Sudbury Region over an assessment period of 2016 to 2026. The scope of the NA includes a review of transmission system connection facility capability which covers transformer station capacity, thermal capacity, and voltage performance. System reliability, operational issues such as load restoration, and asset replacement plans were also briefly reviewed as part of this NA.

North & East of Sudbury Region Description and Connection Configuration
The North & East of Sudbury Region are bounded by regions of North Bay, Timmins, Hearst, Moosonee, Kirkland Lake and Dymond. A map of the region is shown below in Figure 1.

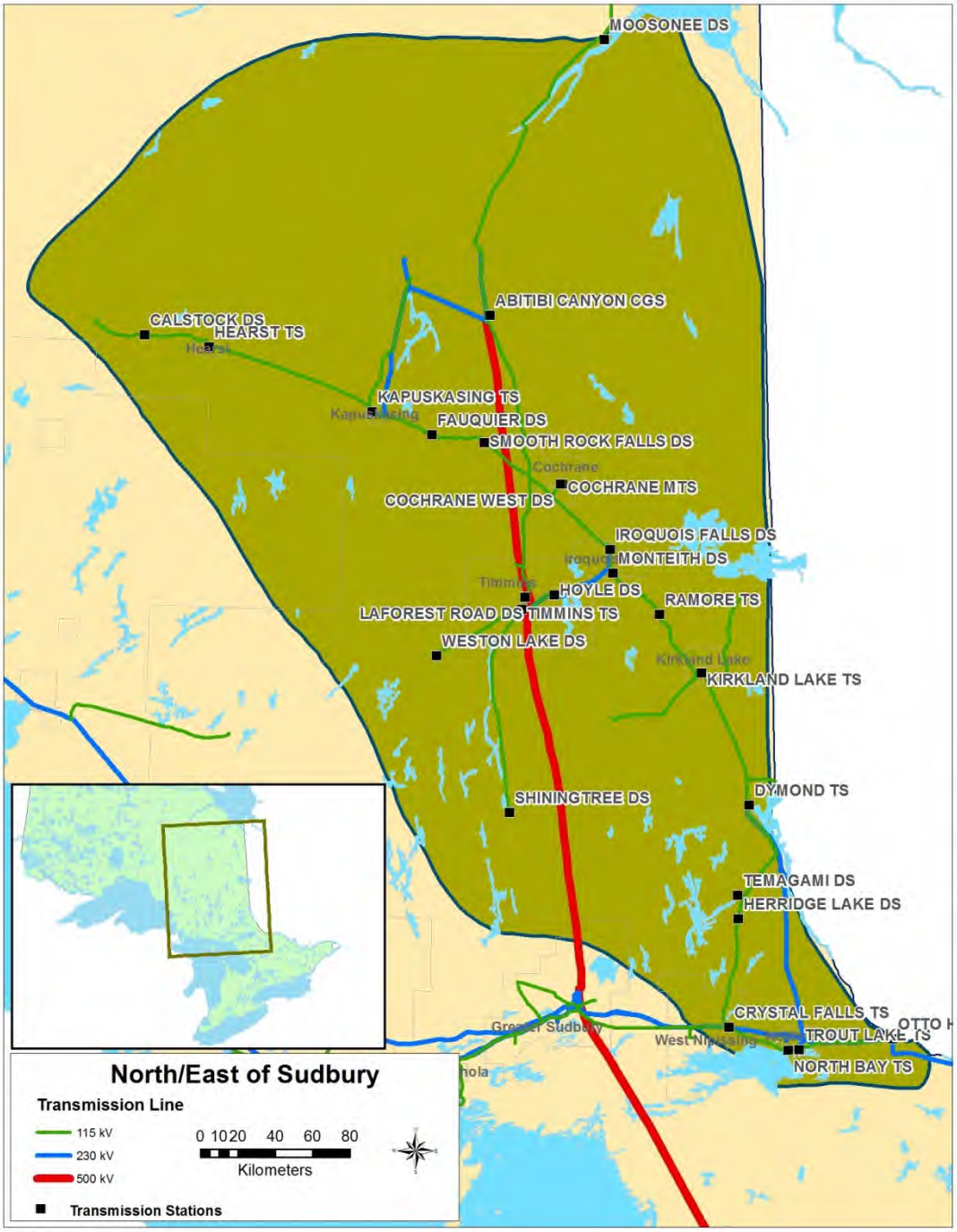


Figure 1: North & East of Sudbury Region Map

Electrical supply for this region is provided through a network of 230kV and 115kV transmission circuits. This area is further reinforced through the 500kV circuits P502X and D501P connecting Pinard TS to Hanmer TS.

This region has the following four local distribution companies (LDC):

- Hydro One Networks (distribution)
- Northern Ontario Wires Inc
- Hearst Power Ltd
- North Bay Hydro Distribution Ltd.

115kV circuits	230kV circuits	500kV circuits	Hydro One Transformer Stations
L5H, L1S D2L, D3K A8K, A9K K2, K4 A4H, A5H D2H, D3H P7G, H9K P13T, P15T T61S, F1E L8L, T7M T8M, H6T H7T, D6T	H23S, H24S W71D, P91G D23G, K38S R21D, L20D L21S, H22D	P502X, D501P	Ansonville TS * Crystal Falls TS Dymond TS * Hearst TS Hunta SS Kapuskasing TS Kirkland Lake TS Little Long SS Moosonee SS North Bay TS Otter Rapids SS Otto Holden TS * Pinard TS * Porcupine TS * Spruce Falls TS * Timmins TS Trout Lake TS Widdifield SS

***Stations with Autotransformers installed**

Table 2: Transmission Lines and Stations in North & East of Sudbury Region

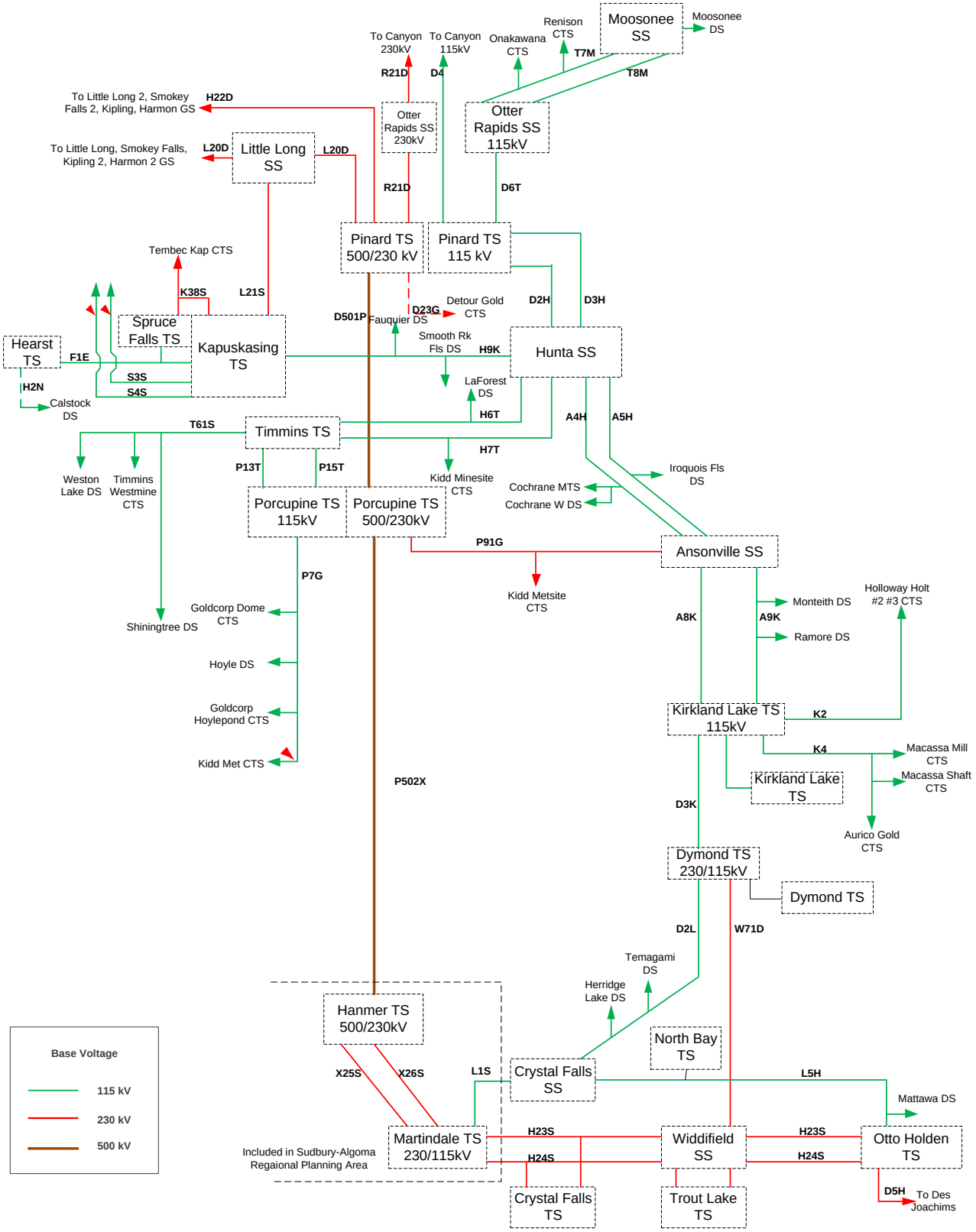


Figure 2 – North and East of Sudbury Regional Planning Electrical Diagram

4 INPUTS AND DATA

In order to conduct this Needs Assessment, Working Group participants provided the following information and data to Hydro One:

- IESO provided:
  i. Historical Ontario and regional coincident load station peaks, as well as individual station peaks.
  ii. List of existing reliability and operational issues
  iii. Conservation and Demand Management (CDM) and Distributed Generation (DG) data
- LDCs provided historical (2013-2015) net load and gross load forecast (2016-2026) Note: 2026 gross load values were extrapolated from 2025 if required.
- Hydro One (Transmission) provided transformer, station, and circuit ratings
- Any relevant planning information, including planned transmission and distribution investments provided by the transmitter and LDCs, etc.

Load Forecast
As per the data provided by the Working Group, the gross load in region is expected to grow at an average rate of approximately 0.7% annually from 2016-2026.

The net load forecast takes the gross load forecast and applies the planned CDM targets and DG contributions. With these factors in place, the total regional load is expected to increase at an average rate of approximately 0.04% annually from 2016-2026.
Note: Extreme weather scenario factor at 1.057 assessed over the study term.

5 NEEDS ASSESSMENT METHODOLOGY

The following methodology and assumptions are made in this Needs Assessment:

1. The Region is winter peaking so this assessment is based on winter peak loads.
2. Forecast loads are provided by the Region's LDCs
3. Load data was provided by industrial customers in the region. Where data was not provided, the load was assumed to be consistent with historical loads.
4. Accounting for (2), (3) above, the gross load forecast and net load forecast were developed. The gross load forecast is used to develop a worst case scenario to identify needs. Where there are issues, the net load forecast which accounts for CDM and DG are analyzed to determine if needs can be deferred. A gross and net non-coincident peak load forecast was used to perform the analysis for this report. A gross and net region-coincident peak load forecast was used to perform the analysis.

5. Review impact of any on-going and/or planned development projects in the Region during the study period.
6. Review and assess impact of any critical/major elements planned/identified to be replaced at the end of their useful life such as autotransformers, cables, and stations.
7. Station capacity adequacy is assessed by comparing the non-coincident peak load with the station's normal planning supply capacity assuming a 90% lagging power factor for stations having no low-voltage capacitor banks or the historical low voltage power factor, whichever is more conservative. For stations having low-voltage capacitor banks, a 95% lagging power factor was assumed or the historical low-voltage power factor, whichever is more conservative. Normal planning supply capacity for transformer stations in this Region is determined by the winter 10-Day Limited Time Rating (LTR). Summer LTR ratings also were reviewed against the station load forecasts over the study period.
8. To identify emerging needs in the Region and determine whether or not further coordinated regional planning should be undertaken, the study was performed observing all elements in service and only one element out of service.
9. Transmission adequacy assessment is primarily based on, but is not limited to, the following criteria:
    - With all elements in service, the system is to be capable of supplying forecast demand with equipment loading within continuous ratings and voltages within normal range.
    - With one element out of service, the system is to be capable of supplying forecast demand with circuit loading within their long-term emergency (LTE) ratings.
    - All voltages must be within pre and post contingency ranges as per Ontario Resource and Transmission Assessment Criteria (ORTAC) criteria.
    - With one element out of service, no more than 150 MW of load is lost by configuration. Note: This criterion was put in place after the 500 kV Northeast system was built and as such, the system was not originally designed to respect this criteria for the loss of the 500 kV circuits P502X or D501P. Currently the loss of either these circuits can result in the loss of more than 150 MW.
    - With two elements out of service, no more than 600 MW of load is lost by configuration.
    - With up to two elements out of service, the system is capable of meeting the load restoration time limits as per ORTAC criteria.

6 RESULTS

6.1 500/230kV Autotransfomers

The 500/230 kV transformers supplying the region are adequate for loss of single 500/230 kV unit.

6.2 500/115kV Autotransfomers

The 500/115kV transformers supplying the region are adequate for loss of single unit.

6.3 230/115kV Autotransfomers

The 230/115kV transformers supplying the region are adequate for loss of single unit.

6.4 Transmission Lines and Ratings

The 500kV and 230 kV circuits supplying the region are adequate over the study period for the loss of a single 500kV or 230 kV circuit in the Region.
As per section 7.2 below – the 115kV H9K circuit may experience thermal overloads and will be addressed as a bulk system issue outside of regional planning.

6.5 230 kV and 115 kV Connection Facilities

A station capacity assessment was performed over the study period for the 230 kV and 115 kV transformer stations in the Region using the station winter peak load forecast provided by the Working Group. All stations in the area have adequate supply capacity for the study period even in the event of extreme weather scenario

7 SYSTEM RELIABILITY, OPERATION AND RESTORATION

7.1 Performance

The areas of Timmins, Dymond and Abitibi Canyon have experienced severe weather patterns over the last 5 years causing periodic increases of both momentary and sustained outages which have been highlighted by the IESO. The region (including the three mentioned above) does not have circuit performance outliers which would fall below customer delivery point performance standards set forth by the Ontario Energy Board.

Hydro One continually monitors performance of supply stations, and high voltage circuits and will make the necessary steps to address the problem should this issue persist.

7.2 Restoration

Depending on system conditions, the loss of P502X may result in the greatest amount of load lost through North East LR/GR special protection schemes. Based on the load levels in the study period of this assessment, load can be restored within the 30 minute, 4 hour and 8 hour time frames as required by IESO ORTAC Section 7.0. The maximum load which may be interrupted by configuration or load rejection due to the loss of two elements is up to 450MW which is below the ORTAC requirement of 600MW. (loss of P502X with D3K out of service, or vice versa)

7.3 Thermal overloading on H9K section

Under high generation scenarios, IESO has identified pre and post contingency overloads on the 115 kV circuit H9K between *Tembec SRF x H9K 127A* junction.
This is a bulk system issue which will be addressed outside of the scope of regional planning.

7.4 Congestion on D3K, A8K, A9K, H6T and H7T

Under high generation scenarios, IESO has identified there may be congestion on D3K, A8K, A9K, H6T and H7T circuits.
This is a bulk system issue which will be addressed outside of the scope of regional planning.

7.5 Kapuskasing and Calstock Area Generation

Non-utility Generator ("NUG") contracts are reaching end of term for the Kapuskasing and Calstock Generating Stations. The NUG Framework Assessment Report [1] indicated that local reliability and congestion issues may require further study as this pertains to contracted generation facilities. This is a bulk system issue which will be addressed outside of the scope of regional planning.

7.6 Outage Condition Resulting in P15/P7G/T61S radially connected to Timmins

The loss of K1K4 and K1K2 circuit breakers at Porcupine TS can result in excessive voltage declines at Timmins TS 115kV bus.
This scenario will be addressed in the next stage of regional planning.

7.7 Ansonville T2 or D3K outages

With Ansonville T2 or D3K out of service, the loss of the other can result in excessive voltage decline at Kirkland Lake TS. This scenario will be addressed in the next stage of regional planning.

8 Aging Infrastructure and Replacement of Major Equipment

Hydro One reviewed the sustainment initiatives that are currently planned for the replacement of any autotransformers, power transformers and high-voltage cables. during the study period. At this time the major committed system investments are;

Dymond TS (T3/T4) transformers (2016)
Kirkland Lake TS (T12/T13) transformers (2017)
Timmins TS (T63/T64) with single 83MVA (2016)
Otto Holden TS (T3/T4) autotransformers, and 115kV circuit breakers (2019)

9 RECOMMENDATIONS

Based on the findings and discussion in Section 6 of the Needs Assessment report, it is further recommended that voltage regulation issues at Timmins TS and Kirkland Lake TS be best addressed by wires options solution thru local planning led by Hydro One:

10 NEXT STEPS

Based on the findings of the Needs Assessment, the Working Group recommends that no further regional coordination is required and the two voltage regulation needs identified in Section 7 be further assessed as part of Local Planning to be entitled:

Timmins TS / Kirkland Lake TS – Voltage Regulation Issues

11 REFERENCES

i) Planning Process Working Group (PPWG) Report to the Board: The Process for Regional Infrastructure Planning in Ontario – May 17, 2013
ii) IESO 18-Month Outlook: March 2014 – August 2015
iii) IESO Ontario Resource and Transmission Assessment Criteria (ORTAC) – Issue 5.0

12 ACRONYMS

BES	Bulk Electric System
BPS	Bulk Power System
CDM	Conservation and Demand Management
CIA	Customer Impact Assessment
CGS	Customer Generating Station
CTS	Customer Transformer Station
DESN	Dual Element Spot Network
DG	Distributed Generation
DSC	Distribution System Code
GS	Generating Station
HVDS	High Voltage Distribution Station
IESO	Independent Electricity System Operator
IRRP	Integrated Regional Resource Planning
kV	Kilovolt
LDC	Local Distribution Company
LTE	Long Term Emergency
LTR	Limited Time Rating
LV	Low-voltage
MW	Megawatt
MVA	Mega Volt-Ampere
NERC	North American Electric Reliability Corporation
NGS	Nuclear Generating Station
NPCC	Northeast Power Coordinating Council Inc.
NA	Needs Assessment
OEB	Ontario Energy Board
ORTAC	Ontario Resource and Transmission Assessment Criteria
PF	Power Factor
PPWG	Planning Process Working Group
RIP	Regional Infrastructure Planning
SIA	System Impact Assessment
SS	Switching Station
TS	Transformer Station
TSC	Transmission System Code
ULTC	Under Load Tap Changer

Appendix I – 2021 Capital Project Summaries

GENERAL INFORMATION ON THE PROJECT/PROGRAM (5.4.3.2.A)

2021 Capital Project Summary

5.4.3.2.A - General Information on the Project / Program

Project Name	Transformers - System Renewal		
Investment Category	System Renewal		
Project Description	This project represents the investment into distribution transformers, both overhead and underground, throughout the given year. All new transformers are brought into inventory and are included in the overall PP&E gross assets, they do not then begin to depreciate until put into service. Transformers are then assigned to different projects as required, some System Renewal, some System Access. This specific summary will deal with the System Renewal assignments. For clarity, the capital expenditures sought in this project are specific to transformers that will be put into service in 2021.		
Capital Investment			
(5.4.3.2.A. First Bullet)	Gross Capital	$229,240	
	O&M Costs (if applicable)	$0	Not applicable
(5.4.3.2.A. Second Bullet)	Capital Contributions	$0.00	
	Net Capital	$229,240	
Customer Attachments/Load (kVA)			
(5.4.3.2.A. Third Bullet)	Customer Attachments (#):	Varies	
	Customer Load (peak KVA)	Varies	
Project Timing			
(5.4.3.2.A. Forth Bullet)	Start Date	January 1, 2021	
	Expected In-Service Date	December 31, 2021	
	Expenditure Timing	Q1:	25% $57,310
		Q2:	25% $57,310
		Q3:	25% $57,310
		Q4:	25% $57,310
Risk and Risk Mitigation			

The timing of transformer purchases is based on inventory levels and the renewal projects that materialize over the given year. In the System Renewal category purchases are made to cover transformer needs for the following demand sub-categories: minor betterments, and major betterments. Risks involve lead times, and the award of transformer purchases to one manufacturer. The risk is mitigated by monthly transformer meetings to discuss inventory levels, inventory levels having set minimums and the fact that NBHDL belongs to a consortium for transformer purchases, making sharing of transformers an option as a last resort. The consortium sends out competitive tenders where they review the costs and confirm the capacity of the manufacturer to provide the necessary transformers to all utilities that are part of it.

(5.4.3.2.A. Fifth Bullet)

Comparative Information

Comparable investments in previous years are as follows:

(5.4.3.2.A. Sixth Bullet)

	Actual						Planned	
	2015	2016	2017	2018	2019	Average	2020	2021
Capital (Gross)	$247,628	$187,250	$289,585	$149,515	$265,374	$227,870	$141,502	$229,240

The voltage conversion project required a significant number of transformers over the last few years and increased the overall transformer requirements. The majority of the transformers required for that project have been purchased and installed.

Total Capital & OM&A Costs Associated with REG Investments

This project is not associated with REG investment; capital and OM&A costs related to REG will not be incurred.

(5.4.3.2.A. Seventh Bullet)

Leave to Construct Approval

This project does not require Leave to Construct approval under Section 92 of the OEB Act and therefore this does not apply.

(5.4.3.2.A. Eigth Bullet)

5.4.3.2.B - Evaluation Criteria and Information Requirements

Efficiency, Customer Value, Reliability (5.4.3.2.B.1)

Section a)

Main Driver (Trigger)	The requirements for transformers in all System Renewal projects
Secondary Drivers	There are no secondary drivers applicable
Related Objectives/Performance Targets	NBHDL Corporate Mission, Vision and Core Values CV2 and CV3 (as identified in Exhibit 1).
Source and Nature of the Information Used to Justify the Investment	Planned and unplanned renewal projects that require transformation.
Section b)	
Reliability Planning and Resilient Distribution System Design	Transformer replacements are critical to maintain the reliability of the overall grid.
Adaptation to Future Challenges	Transformers are sized appropriately to ensure potential future needs. Various aspects are taken in account, including potential development opportunities and planning for increased load requirements some of which can be related to electric vehicle charging stations.
Section c)	
Investment Priority Relative to Other Investments	Transformer acquisition is critical to the operation of the system renewal, irrespective of whether the need is planned or unplanned since they are required to maintain power.
Prioritization Approach	Transformers are replaced on an as needed basis.
Section d) **Analysis of the Project and Project Alternatives**	
Effect on System Operation Efficiency and Cost-Effectiveness (First Bullet)	Transformer purchases alone will not have any material impact on system operation efficiency and cost effectiveness outside of having the correct size transformers readily available should the need to install one arises.
Net Benefits Accruing to Customers (Second Bullet)	Having a stock of transformers allows NBHDL to replace a failed or damaged transformer without the lead time needed to order one. This will benefit the customer in faster restoration times.
Impact on Reliability Performance (Including on the Frequency and Duration of Outages) (Third Bullet)	Not having a transformer available for replacement of a failed one may result in a significantly longer duration of an outage.

Project Alternatives	Transformers are an integral part of the system and investments in them are required in order to facilitate rehabilitation of the system. NBHDL, as a member of the Northeastern District Buying Consortium (NEDBC), tenders the procurement of transformers on a 5-year contract, and therefore purchasing alternatives are basically nonexistent over the contract.

Safety (5.4.3.2.B.2)

The purchase of transformers for renewal work does not directly address safety concerns. The actual installation of the transformers under planned and unplanned capital jobs from time to time will address transformers in poor condition and in turn may eliminate safety issues.

Cyber-Security, Privacy (5.4.3.2.B.3)

Not applicable to the purchase of transformers.

Co-ordination, Interoperability (5.4.3.2.B.4)

Section a)

Co-ordination with Utilities, Regional Planning and/or Links with 3rd Party Providers and/or Industry

Coordination with the successful transformer manufacturer is a daily function, from the administration of the contract, to the actual ordering and receiving of transformers, the relationship with the vendor is very important in ensuring inventory levels are always kept up to meet the demand work. Coordination takes place in the award of the contract by the utilities that make up the NEBDC.

Section b)

Enabling of Future Technological Functionality or Addressing of Future Operational Requirements

Transformer purchases for system renewal projects will not enable future technological functionality or address future operational requirements

Environmental Benefits (5.4.3.2.B.5)

Not applicable

Conservation and Demand Management (5.4.3.2.B.6)

Not applicable

SYSTEM RENEWAL SPECIFIC REQUIREMENTS (5.4.3.2.C.b)

Category-Specific Requirements - System Renewal (5.4.3.2.C.b.)

Relationship Between the Characteristics of Targeted Assets and the Consequences of Asset Performance Deterioration or Failure (5.4.3.2.C.b.First Bullet)

Asset Performance Targets and Asset Lifecycle Optimization Policies and Practices (First Sub-Bullet)

Transformer purchases are made as required. In the case of System Renewal, the transformers purchased are used to replace failed assets and/or assets that are obsolete and therefore the purchases are in line with optimization policies. See section 3.3 of the DSP for more information on Asset Life Cycle Optimization Policies and Practices.

Asset Condition Relative to Typical Life Cycle (Second Sub-Bullet)

All transformers purchased are new and therefore are in very good condition, which is expected as they are in the first year of their useful life. The new transformers will be used to replace failed assets or obsolete assets.

Number of Customers in Each Class Potentially Affected (Third Sub-Bullet)

Number of customers will vary. A transformer may supply anywhere from 1 to 50 customers typically and across all customer classes

Quantitative Customer Impact and Risk (Fourth Sub-Bullet)

The quantitative customer impact varies project by project. The nature of transformer purchases alone does not have a direct quantitative customer impact and risk.

Qualitative Customer Impact and Risk (Fifth Sub-Bullet)

The qualitative customer impact varies project by project. The nature of transformer purchases alone does not have a direct qualitative customer impact

Value of Customer Impact (Sixth Sub-Bullet)

The value of customer impact varies project by project. The nature of transformer purchases alone does not have a direct value to customer impact.

Other Factors Affecting Project Timing (5.4.3.2.C.b.Second Bullet)

Transformers are ordered when required, the purchasing of transformers is not a project, but an investment into equipment to be used as part of the System Renewal projects.

Consequences for System O&M costs (5.4.3.2.C.b.Third Bullet)

- Transformer purchases have no effect on system O&M costs.

Reliability and Safety Factors (5.4.3.2.C.b.Fourth Bullet)

- Transformer purchases do not address reliability or safety factors in a significant way. The replacement of transformers in poor condition may eliminate safety issues.

Analysis of Project Benefits and Timing (5.4.3.2.C.b.Fifth Bullet)

- Transformers are purchased to maintain inventory and as required for system renewal projects. This section is not applicable to transformer purchases.

Like for Like Renewal Analysis (5.4.5.2.C.b.Sixth Bullet)

This is not applicable for transformer purchases.

GENERAL INFORMATION ON THE PROJECT/PROGRAM (5.4.3.2.A)

2021 Capital Project Summary

5.4.3.2.A - General Information on the Project / Program

Project Name

MacBeth Crescent Backlot O/H Elimination - U/G Conversion

Investment Category

System Renewal

Project Description

The MacBeth Cres Backlot project is the second phase of a three phase project initiative to replace the deteriorating backlot overhead infrastructure (50-55 years old) in a residential area of 100 homes. The MacBeth Cres project specifically will re-service 50 of these homes. It will consist of the design and construction of new underground infrastructure (built to 15kV standards) on the public road allowance which will replace the end of life line running along the back lots of the residences. The engineering and electrical construction will be performed by NBHDL's internal resources while the civil component of the projected will be tendered. The construction for this project will involve the installation of 560m of underground primary conductor in duct, 5 pad mounted transformers, and 50 new underground customer services coming from 10 junction boxes.

The existing line has been assessed to be in poor condition and is expected to have its condition decline as it continues to age. The existing poles belong to Bell; however, as per NBHDL and Bell's agreement, NBHDL will be responsible for the installation of the poles as Bell can not install the poles live line (keeping power on for the residents during construction) if NBHDL or Bell deems the poles necessary for replacement. Bell will only provide the poles in this arrangement. All installation labour and NBHDL circuit materials are provided by NBHDL. For all intents and purposes, replacement of a Bell pole line carrying NBHDL's circuits is treated the same as a NBHDL owned pole line replacement project with a cost adjustment for the provided pole. Typically, the pole material contributes to approximately 10-15% of the cost to install a 45 CL3 wood pole with the bulk of the cost being the installation labour and equipment.

Given the current assessment of the line, failures are more likely to occur as the line continues to age. This increase risk is compounded by the fact that NBHDL does not have the ability to adequately access it with its current equipment to perform emergency repairs quickly and efficiently. This will lead to longer outages in this particular residential community. Maintenance activities, such a tree trimming, are also more difficult to conduct and generally cause complaints since it impacts the resident's ability to enjoy trees in their own back yard. It also inconveniences them as NBHDL will require regular access to their property. The existing line was designed using outdated standards that includes insufficient pole height and class, aerial trespasses, and has high voltage conductor running in between houses.

Capital Investment

(5.4.3.2.A. First Bullet)

Gross Capital	$949,317
O&M Costs (if applicable)	$0.00

(5.4.3.2.A. Second Bullet)	Capital Contributions	$0.00			
	Net Capital	$949,317			
Customer Attachments/Load (kVA)					
(5.4.3.2.A. Third Bullet)	Customer Attachments (#):	50 (For this Phase)			
	Customer Load (peak KVA)	100			
Project Timing					
(5.4.3.2.A. Forth Bullet)	Start Date	June 2020 (Engineering)			
		April 2021 (Construction)			
	Expected In-Service Date	October 2021			
	Expenditure Timing	Q1:	0%	$0	
		Q2:	50%	$474,659	
		Q3:	40%	$379,727	
		Q4:	10%	$94,932	

Risk and Risk Mitigation

(5.4.3.2.A. Fifth Bullet)

As with many projects requiring in ground construction (civil work) in colder climates (Northern Ontario), the timeframe for the most efficient construction is typically Mid-May to the End of October where. Asphalt plants do not open until mid-May in the North Bay area, therefore civil work is typically held back until they are open. Any outages required for construction are typically avoided or kept to a minimum during the winter months due to the large presence of electric heating in North Bay. The average temperature for May is 11.2 C which is considered satisfactory for short outages. The average temperature for North Bay in October is 5.9C and -1.4C in November, therefore all work requiring outages should be completed by the end of September and restoration should be completed by the end of October. As such, any delays to the commencement of the construction, or during the construction period puts the project at a risk of carrying over to the following year if it can not be completed before the winter. Since the civil component of the project will be tendered to outside contractors, on-site contract administration is required. NBHDL does not have sufficient internal resources to dedicate staff to monitor contract work, therefore it will retain the services of an engineering consultant firm for the project management and contract administration of the civil work.

As part of the risk mitigation, North Bay Hydro recognizes the large scope of this project and has built a project schedule with key milestone dates to be achieved to keep the project on track. It will be managed by North Bay Hydro's internal project management process which includes update meetings, progress tracking, and developed action plans. The engineering design, customer consultations, and the administrative work for the project is scheduled to be completed in the prior year (2020) and North Bay Hydro has built in its schedule 8 weeks of float time to allow for any unexpected issues which may cause delays in issuing the tender documents or to the construction start date. However, once construction starts, delays caused by equipment breakdowns, severe weather events (climate change), and sudden change in staffing resources can not always be mitigated.

	Comparative Information	
	(5.4.3.2.A. Sixth Bullet)	For underground distribution infrastructure, NBHDL recognizes that the different combinations in the length and size of cables installed, number and types of switching devices installed, number and sizes of transformers installed, number of secondary services installed, as well as other design considerations makes each project unique. Construction methods and equipment may vary depending on location, geography, subterranean conditions, and season as well. All of which affect the cost of a project. NBHDL has determined that each of its past project contains enough variability in their design and construction such that no single project could be used to benchmark the cost of another single project appropriately. For cost comparison purposes, a project that is most similar in scope and design to the proposed MacBeth Cres project is the Sylvan Cres Underground Rebuild, which was a part of the Birchwood Village backlot elimination project (2016 to 2018). It involved the installation of 214m primary cable in duct, 7 pad mounted transformers, and approximately 75 underground secondary services. The total cost of the project was $671,449.
	Total Capital & OM&A Costs Associated with REG Investments	
	(5.4.3.2.A. Seventh Bullet)	This project is not associated with REG investment; Capital and OM&A cost related to REG will not be incurred
	Leave to Construct Approval	
	(5.4.3.2.A. Eight Bullet)	This project does not require Leave to Construct approval under Section 92 of the OEB Act and therefore this does not apply
	5.4.3.2.B - Evaluation Criteria and Information Requirements	
EVALUATION CRITERIA AND INFORMATION REQUIREMENTS	**Efficiency, Customer Value, Reliability (5.4.3.2.B.1)**	
	Section a)	
	Main Driver (Trigger)	Failure risk (associated with the end of life distribution assets) is the main driver of this project. See Section 4.1.2.2 of NBHDL's DSP for pole failure risk description. In line with North Bay Hydro's Asset Lifecycle Optimization Practices (Section 3.3 of the DSP), this System Renewal project is necessary to efficiently sustain the ongoing reliability of electricity to the community. Condition inspections and the assets age have classified this as poor condition. In addition, this line has issues with access (due to it being in the back lot) which creates an issue for potential equipment failures since NBHDL does not own small backlot equipment and therefore, any failures will result in the need to climb the poles manually to perform repairs or to rent a piece of equipment if climbing the pole is not safe due to it being compromised. With these factors considered, a failure at this location will likely result in much longer sustained outages (higher failure consequence) than is typical for a side of road pole line. This project is the second part of an overall larger initiative (to be completed in 3 parts over 3 years) to remove the deteriorating back lot distribution

	assets in this residential area. It must be completed to bring forth the realization of all of the benefits from the previous project in the line (Normal Back Lot Removal Project to be completed in 2020). If this project does not proceed, the Norman Backlot Project would be a waste of resources since the backlot poles of that previous project cannot be removed until the Macbeth project moves forward.
Related Objectives/Performance Targets	NBHDL Corporate Mission, Vision and Core Values CV3 and CV4 (as identified in Exhibit 1).
Source and Nature of the Information Used to Justify the Investment	North Bay Hydro used Pole Inspection Data, the Asset Condition Report, and the Metsco Project Prioritization Tool / Model to justify and prioritize the investment.
Secondary Drivers	This project has two secondary drivers: Safety and Customer Impact. Currently, the existing line was designed with outdated standards that would not meet the rigor of present-day North Bay Hydro safety standards in new construction and given the location of the line in the back yard, there are creates many issues with this. The most significant issue of the existing backlot line is that it runs in between homes as it crosses the road and puts the high voltage conductor (7.2kV) in close proximity of the homes. In multiple cases, a homeowner / contractor can stand on the roof of their home and be within the limits of approach (10ft) to of a high voltage conductor. This creates a hazard and a situation where anyone working on the portion of the roof would require the line to be deenergized (an outage) in order to do so safely, inconveniencing the other residents of the neighborhood. NBDHL considers this a poor design practice and intends to correct it with the proposed project. This line also contains pin type porcelain insulators on the 7.2 kV distribution circuit. A report released by ESA in 2017 titled “Mitigation of Pole Top Fires” shows these insulators as the worst performers when it comes electrical current leakage (references CEA 265 D 748). In order for these insulators to maintain their insulation characteristics, they must not be contaminated or damaged through hairline cracks. However, as they age, there are subject to both electrical and mechanical failures where the pin can break away. This presents a worker and public safety issue. Another issue involves the inability of NBHDL to control home owners’ actions such as the installation of pools, sheds, and the erection of other equipment with out the proper consents / approvals that may put the homeowner at risk of encroaching on the limits of approach to the high voltage conductors unknowingly. It is NBHDL’s position that back lot lines such as the existing one in the MacBeth Cres project is poor distribution system design and will no longer construct new overhead lines in the back lot of residential areas as a standard practice. Aside from the proximity issues mentioned above, the lack of visibility on the line is a disadvantage. This is due to the fact that North Bay Hydro does rely on the public to report issues not detected by its SCADA system or by its feeder patrols. As such, issues created on back lot lines are more likely to remain unreported and remain undiscovered longer than pole lines located along a roadway. Again, this creates a situation of increased risk to homeowners spending time in the backyards.

	The overhead line in the back lot also significantly impacts the customers. Maintenance and replacements are invasive to customers and due to the increase difficulty of access, outages are much longer when equipment does fail. Customers are particularly impacted by vegetative maintenance activities and are restricted on where they can plant tree for privacy and coverage. Customers might not notify NBHDL of trees encroaching on the lines, which can create a fire hazard if left unattended. And since the line is located behind the homes, the line is partially obstructed by the house, therefore NBHDL would not know if there is a hazard. Outages that occur in the middle of the night have required NBHDL staff to walk in people's backyard with flashlights to look at poles in an attempt to identify potentially failed wires. This can frighten a family and a home owner could react aggressively if he believes there is trespassing in his backyard, therefore endangering NBHDL staff. This process is also very slow (has taken about 15-20 min to travel to a backyard and inspect a line which increases outage length, affecting SAIDI and SAIFI numbers. As such, the removal of the backlot line will benefit a customer's ability to enjoy their property.
Related Objectives/Performance Targets	NBHDL Corporate Mission, Vision and Core Values CV2 and CV4 (as identified in Exhibit 1).
Source and Nature of the Information Used to Justify the Investment	North Bay Hydro uses it's GIS (asset data) information along with its operating knowledge and experience as the source of information that identified the secondary drivers.
Section b)	
Reliability Planning and Resilient Distribution System Design	North Bay Hydro adheres to good utility practice in ensuring that all projects are designed to be a part of resilient and reliable distribution system. This project will be built as an underground system that will be resilient to weather events. North Bay Hydro acknowledges climate change and recognizes the possibility of an increase to severe weather events that may result. The existing line is currently a radial feed into the area which means that all customers will remain out during an outage until the cause of the fault is fixed. Once the third phase project is complete, the area will be part of a loop network and power can be restored to the majority of the area (if not the whole area) while isolating the piece of faulted equipment. The underground conductor will be installed in a duct bank providing it some mechanical protection.
Adaptation to Future Challenges	The project will be designed with spare ducts to accommodate additional cables for future load growth. While residentially zoned areas with limited potential for future growth have not historically presented any challenges with load capacity, North Bay does recognize the potential impact that Electric Vehicles may have on the grid.
Section c)	

Investment Priority Relative to Other Investments	Using the Metsco developed Project Planning Optimization Tool, of the 8 system renewal projects planned for 2021, the MacBeth Cres project ranks as **#4 in its prioritization**. Overall, this project is ranked as #7 in NBHDL's prioritization for distribution line projects. While individual projects are ranked according to their benefits, NBHDL will make its selection based on the group of projects that cumulatively offers the greatest benefit while operating within the planned budget and resourcing requirements for a given year. Cumulatively, the 8 projects planned for 2021 offers the greatest net benefit (highest score) compared to any other combination of projects proposed.
Prioritization Approach	See Section 4.2.2 of NBHDL's DSP for project prioritization approach.
Section d) **Analysis of the Project and Project Alternatives**	
Effect on System Operation Efficiency and Cost-Effectiveness (First Bullet)	This project will remove the ongoing requirement for vegetative maintenance (tree trimming), reduce the risk of failure and emergency work (trouble calls), and lead to an increase in system flexibility and reliability (will be designed to be part of loop network rather than a radial). This project will reduce the risk of failure and the associated increase to O&M costs as the line continues to age and deteriorate. See Section 4.1.2.2 of NBHDL's DSP for description on correlation between age of pole and maintenance activities. NBHDL will also save the rental fees charged by Bell to be attached to their poles. This project will also allow NBHDL to get off of Bell poles in the Norman Ave Backlot elimination project as well is required to get off of Bell poles for the Rancier St and Overholt Pl back lot eliminations. At $53.47 per pole attachment charged annually by Bell, NBHDL will save approximately $1,176.34 in fees per year. These fees are expected to increase by inflation rates and through renegotiation when the current agreement expires.

Net Benefits Accruing to Customers (Second Bullet)	This project will have the following benefits: the avoidance of potentially adverse effects on reliability and safety, an avoidance of increased maintenance costs, the removal of the restriction on planting trees on their property as well as the restrictions on any plans that involve working on their property within the limits of approach around the high voltage conductor.
Impact on Reliability Performance (Including on the Frequency and Duration of Outages) (Third Bullet)	This project will avoid an adverse impact to the reliability performance of this line if this project is not implemented.
Project Alternatives	NBHDL has considered the following alternatives to this project but has deemed them to not be viable options. • <u>Alternative #1 – Do Nothing</u> This alternative involves no reconstruction at all and waiting longer to replace or until the poles fail. The benefit of this alternative is that there are no capital costs associated with it. The downside is that all the issues identified above will remain. The Norman Backlot project will not be able to be completed (poles will remain in the front and back of those properties) and there will be no loop feed. • <u>Alternative #2 - Rebuilding the overhead line in the existing back lot location (like for like).</u> This alternative would mitigate the risk of a failure as a system renewal project; however, it would not correct the other issues associated with the location of the line alone (safety, access and tree trimming, etc. (see items above)). It is NBHDL position that this option would be poor distribution system design practice. • <u>Alternative #3 - Constructing a new overhead line in the public road allowance (front lots).</u> An overhead option will be less costly, however the construction of a new overhead line where one does not currently exist will have a significant impact on the residential area. Other than cost savings, an overhead line will offer no advantage over an underground line from a distribution system design perspective for this particular project and is susceptible to damage from storms and foreign interference such as wildlife, car accidents, and vandalisms. Any system advantages an overhead line may offer such as sub transmission feeders and major distribution system ties are not required for this specific project. MacBeth Cres is a crescent shaped road that would require a significant amount of anchoring for the poles into the front lot of the residences. Since there has never been any poles or anchors in the front yards of these people's properties, NBHDL expects that this would cause grievances to residents who now have to deal with a

new anchor / pole in their front lawn. It will change the aesthetics of the area.

An underground line may impact and compromise shallow rooted trees causing the need for their removal, however the impact to the tree canopy will not be as substantial as it would be with an over head line. It is NBHDL's operating experience that overhead construction projects of this nature are typically unwelcomed in residential areas where customers generally value the appearance of their neighborhood. With an underground line, there will be more locational flexibility to planting new trees without the worry of them interfering with overhead lines.

The maintenance activity for tree trimming would not be avoided either with over head lines.

Lastly, it is the City of North Bay's preference that any new infrastructure on the municipal roadway, where overhead infrastructure does not currently exist, is installed as underground in order to maintain community aesthetics. The city of North Bay currently has all its street lighting on Macbeth Cres. fed through underground conductors. Bringing an overhead line would defeat the purpose of the underground conductors installed for the street lighting.

NBHDL will install its infrastructure in a manner that best suits its system design; however, if maintaining alignment with the interests of the city and the customers is achievable while incorporating good system design in a cost-effective manner, that is the preferable option for NBHDL.

Ultimately, the underground design would retain the character of the neighbourhood.

Safety (5.4.3.2.B.2)

This project will eliminate the high voltage line (7.2 kV) that runs in between house as it crosses the road from the back lot. This creates a situation where a new home owner or contractor performing roof top repairs may inadvertently encroach on the safe limits of approach. Back lot lines are less visible to the public, and issues with the equipment are less likely to be reported. Potential vegetative contact with the line will also be eliminated entirely, reducing the risk of fires and the inadvertent energization of the vegetation creating an electrical hazard.

Cyber-Security, Privacy (5.4.3.2.B.3)

Not applicable to this project

Co-ordination, Interoperability (5.4.3.2.B.4)

Section a)

Co-ordination with Utilities, Regional Planning and/or Links with 3rd Party Providers and/or Industry

Coordination with utilities, regional planning, third party providers, or other industries is not applicable to this project as the project is located in the middle of North Bay Hydro's service territory and serves a residential area with no planned requirements for additional capacity. There is a potential opportunity to share the underground trench if other telecommunication utilities are interested, but at this time no agreement is in place

Section b)

Enabling of Future Technological Functionality or Addressing of Future Operational Requirements

The underground duct bank will be installed with additional spare ducts to allow for the future installation of additional conductor. Primary junction boxes will be installed that will allow future feeder lines to be tied in if required. No other future technological functionality has been deemed required for this project

Environmental Benefits (5.4.3.2.B.5)

The nature of this project does not impact the environment in any substantial manner other than the impacts associated with the manufacturing of the materials. It should be mentioned however that as a result of removing the overhead back lot line and rebuilding it as an underground system, the restrictions on tree growth in proximity to the line will be removed. Residents will have more locational flexibility to plant trees who may not have otherwise if the backlot line remains place. Trees act as a carbon sink for greenhouse gas (reference), therefore more trees are better for the environment.

Conservation and Demand Management (5.4.3.2.B.6)

This project is not applicable to any rate funded conservation or demand program

Category-Specific Requirements - System Renewal (5.4.3.2.C.b.)

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SYSTEM RENEWAL SPECIFIC REQUIREMENTS (5.4.3.2.C.b)

Relationship Between the Characteristics of Targeted Assets and the Consequences of Asset Performance Deterioration or Failure (5.4.3.2.C.b.First Bullet)

Asset Performance Targets and Asset Lifecycle Optimization Policies and Practices (First Sub-Bullet)

All assets in the in the existing back lot line are past their useful life with the majority being between the ages of 50 to 55 years old. This project must be completed in order to proceed with the system renewal in the next section of the residential area, with all assets past their useful life as well. **See section 3.3 of the DSP for more information on Asset Life Cycle Optimization Policies and Practices.**

Asset Condition Relative to Typical Life Cycle (Second Sub-Bullet)

Inspection data has shown that the majority of the line is in the category of poor condition (low health index). Condition issues identified on this line such shell rot, pole top deterioration, deep cracks, and footing displacements are characteristic of very old wood pole lines such as this one (50 - 55 years). Wood poles in NBHDL's system are also subjected to a regional condition issue which is damage suffered from wood peckers, more specifically, the Pileated Woodpecker which is particularly destructive and leaves large cavities in poles which shortens their life spans.

Number of Customers in Each Class Potentially Affected (Third Sub-Bullet)

Feeder / Station	Residential Customers	General Service Customers
13F4	304	6

As part of this project, NBHDL conducted preliminary consultation on this project during the week of October 26, 2020. Staff went door-to-door to deliver letters explaining the project and its purpose (see Attachment 1). It identified that the underground work is required to improve our reliability of supply and create better access for maintenance purposes. The letter discusses the work included which involves underground primary and secondary supplies with pad mounted transformers and junction boxes as well as underground services line to each building. A sketch is included with the letter and a notice that the project will start in 2021. It clarifies that NBHDL is preparing detailed plans with sketches on how each property will be fed and that we will return with these sketches to show customers the location of the plant and the specific plans for their property.

Quantitative Customer Impact and Risk (Fourth Sub-Bullet)

North Bay Hydro collects outages statistics to analyze it distribution system performance on a feeder level with a particular focus on interruptions caused by defective equipment and tree contacts. In 2019, the distribution feeder servicing the area (13F4) experienced 6 sustained outages and 5 momentary outages from trees and defective equipment combined. This has increased from the 1 sustained / 1 momentary outages in 2018 and 0 outages recorded in 2017. This information represents the entire feeder, not just the area of the proposed project.

NBHDL does not have a record of an outage caused by a specific issue on this section of line in the last three years.

Qualitative Customer Impact and Risk (Fifth Sub-Bullet)

Outage restoration in this area in particular will be substantially longer as North Bay Hydro does not currently have the specialized equipment necessary to efficiently work on back lot lines. Back lot lines also make it more difficult to identify the cause of the issue initially through feeder patrols. Customer yards would be significantly disturbed by work activities. Long outages lead to customer dissatisfaction and complaints. Customers who work from home also lose productivity from outages.

Value of Customer Impact (Sixth Sub-Bullet)

The customer impact in terms of the potential failure is medium. Typically, the value of customer impact in residential areas would be low; however, due to the layout of the back lot pole line and the challenges with equipment access, restoration times for outages in this area would be longer. Residential customers are more commonly working from home (expected to increase due the recent Covid 19 situation) and longer sustained outage can be particularly detrimental to their ability to do this. Customers who rely on medical equipment (such as oxygen systems) require reliable power and may need to make other arrangements for long sustained outages.

Removing the back lot line will add value by giving the customers more freedom to do what they want in their back yard with out the restrictions put in place due to the high voltage overhead line. It is NBHDL's experience that customers value the sanctuary of their back yards and the intrusive nature of the constant required access for maintaining and replacing back lot assets is unfavourable to the full enjoyment of their private property.

Other Factors Affecting Project Timing (5.4.3.2.C.b.Second Bullet)

This project is the second part of a three phase initiative to remove the back lot lines in a residential area, and while not it is necessarily required, it would be most practical and efficient to complete the first part, the Norman Backlot Elimination, first. As such, the Norman Backlot Elimination construction will be prioritized to be completed in 2020. The design and administration work for the Macbeth Cres project will be scheduled to be completed as well in 2020 to ensure construction can commence in spring 2021. Third phase of this initiative, the Rancier St & Overholt Place project, can not be completed until the Macbeth Cres project is completed (2022 - 2023)

Consequences for System O&M costs (5.4.3.2.C.b.Third Bullet)

By eliminating the deteriorating overhead back lot line and replacing it with underground infrastructure, the cost of vegetative maintenance for the line will be removed in perpetuity. Vegetative maintenance required for this back lot line is more costly than typical tree trimming as restrictions on equipment access makes the work much more labour intensive. All tree trimming in proximity to high voltage primary conducts must be done be a qualified Utility Arborist (specialty trade).

This project will reduce the risk of equipment failure and trouble calls in line with general system renewal projects. Under ground infrastructure is particularly unaffected by severe weather events reducing the potential cost of trouble calls (emergency restorations).

Reliability and Safety Factors (5.4.3.2.C.b.Fourth Bullet)

This project will not have a material impact on improving the system reliability, but there will have a detrimental impact on system reliability if the project is not implemented. The impacts on public safety and the elimination of potential hazards were considered as factors to the importance of the project (See section 5.4.3.2.B.2 above)

Analysis of Project Benefits and Timing (5.4.3.2.C.b.Fifth Bullet)

North Bay Hydro uses a Project Planning Optimization Tool developed by Metsco to assess the benefits of its capital projects and uses that information to organize the most appropriate trimming of its projects (see section 5.4.3.2.B.1.c for prioritization approach). For system renewal projects, the reduction of the risk cost (probability of failure vs the consequence of failure) and the optimization of the total life cycle cost for the asset is the main consideration for project benefits and prioritization. The timing of the proposed projects has been planned in a manner to maximize investment benefits.

North Bay Hydro acknowledges Climate Change and recognizes the potential impacts to its distribution system. As a primarily overhead system, North Bay Hydro must continue to design and operate its system (new projects & investments) to be able to withstand severe weather conditions (adherence to CSA design standards is a minimum). The large amount of existing aging overhead infrastructure (refer to ACA Report) however, through the degradation of the assets, is losing its ability to withstand repeated severe weather events. North Bay Hydro must ensure that its system is not crippled by weather events and as such, the urgency and importance investing in system renewal projects has increased.

Like for Like Renewal Analysis (5.4.5.2.C.b.Sixth Bullet)

Like for like renewal is not being proposed and as such, like for like analysis is not applicable.

Like for like renewal will not correct all of the issues of the existing line which primarily revolve around its location, many of which would be considered not acceptable to present day standards.

It will also not achieve the overarching goal that is to be achieved by NBHDL's back lot elimination initiative. Back lot elimination is not solely driven by need for system renewal and the technical requirements, but also by understanding that there are substantial benefits to the customers from it. It is NBHDL's experience that back lot lines come with a variety of different issues and are generally problematic. It is NBHDL's position that the end goal of eliminating all back-lot lines from its system will improve its distribution system design and operational efficiency while providing intangible benefits to the customers as discussed above.

Attachment 1: Customer Letter

74 Commerce Crescent
P.O. Box 3240
North Bay, Ontario

Tel. (705) 474-8100
Fax: (705) 495-2756 Administration
Fax: (705) 474-3138 Engineering/Purchasing

October, 2020

Dear Sir/Madam:

Re: North Bay Hydro Customer – Macbeth & Rancier Area

North Bay Hydro Distribution Limited (NBHDL) will begin rebuilding our distribution plant supplying the Macbeth & Rancier neighbourhood of the City of North Bay in the spring/summer of 2021 with completion scheduled for 2022. This work is necessary in order to improve our reliability of supply, and create better access for maintenance purposes. This rebuild represents a major improvement to the electrical infrastructure supplying your home or business.

Currently our existing plant is located in backlot easements together with Bell and Cable. It is our intention to relocate our system to the City Street road allowance and to provide a new service from this location.

Our new plant will be designed and constructed to current day standards which will include underground primary and secondary supplies with pad mounted transformers and junction boxes. Service lines to each building will now be underground instead of overhead.

The potential exists for the other utilities that are currently located in the backlots to also be relocated but this has yet to be finalized.

The attached schematic identifies the affected area and the phases of construction that we anticipate. Phase 1 will proceed in 2021, possibly as early as the first week of May, with phase 2 scheduled for 2022.

Due to the size and complexity of the project, it is proposed to perform the work in two stages which includes:

1. Civil Installation – includes the excavation, installation of ducts, transformers and junction boxes and all surface restoration which will be performed by a third party, and

2. Electrical Installation – includes installation of conductors within the ducts, meter base changes or installation of new meter bases, all connections to existing wiring and restoration as required which will be performed by NBHDL together with an approved electrician.

NBHDL is currently in the process of preparing service connection details (SCD) for each affected building and these will include a description of the work to be undertaken as well as a sketch of the proposed location of the new underground service on your property. We will be forwarding these to each property owner and we would request that you review them and acknowledge the work with your signature and date, and return them to our office so that they can be kept on file.

If you have any questions and/or concerns, please do not hesitate to contact one of the undersigned.

Yours truly,

NORTH BAY HYDRO DISTRIBUTION LIMITED

Pat Desjardins

Engineering Technician

North Bay Hydro Distribution Ltd.

T. 705-474-8100 x.308

E. pdesjardins@northbayhydro.com

Roch Pilon, P.Eng. AVS

Vice-President, Engineering

North Bay Hydro Distribution Ltd.

Tel : 705-474-8100 Ext. 400

GENERAL INFORMATION ON THE PROJECT/PROGRAM (5.4.3.2.A)

2021 Capital Project Summary

5.4.3.2.A - General Information on the Project / Program

Project Name

Wallace Rd - Sub Transmission Line Rebuild (44kV)

Investment Category

System Renewal

Project Description

The Wallace Rd Rebuild project consists of the design, construction, and installation of a new over head pole line along the side of Wallace Rd from Trout Lake Rd to Seymour Dr. The length of the line will be approximately 1860m in length and will consist of 31 composite poles. The line will carry two 44kV sub transmission circuits (one owned by Hydro One) and a 12.47kV primary distribution circuit (line will be built to 46kV and 15kV standards). The existing Hydro One Circuit and equipment will be transferred over to the new pole line by Hydro One personnel. Given that this line carries important circuits for both NBHDL and Hydro One, composite poles were chosen as the pole material due to its resistance to wood pecker damage and rot among other benefits.

The new line will replace the existing line which is at the end of its useful life at 45 years old and is fair condition, but on the threshold of poor condition. Condition issues include wood pecker holes, shell rot, pole top deterioration, cracks, and slight footing displacements (leaning poles). Another problematic issue on the existing pole line is that it was built using poles that are under classed by present day standards. As a result, no new equipment or attachments can be installed on the poles with out failing the engineering analysis. The pole analysis using current CSA standards (On. Reg. 22-04 for Electrical Distribution Safety) will always fail and require the existing pole to be replaced. This can be particularly challenging due to the fact that the Hydro One circuit has a large amount of connected generation (20 MW) and an isolation on the 44kV circuit to install the pole safely is a significant disruption to their customers and can not always be accommodated in a timely fashion. This impedes NBHDL's ability to install new equipment on the line necessary for customer servicing or upgrades.

The two 44kV Sub-Transmission circuits are important to both NBHDL and Hydro One's distribution systems. Depending on the operating system configuration, the NBHDL circuit will supply 2 to 3 substations that may be servicing up to approximately 5000 customers combined. It also services some of NBHDL's largest load customers including a mall and a plastics processing plant. The Hydro One owned circuit has embedded generation connected to it. Any failure on the line will cause a major disruption to the customers of both LDCs.

Capital Investment

(5.4.3.2.A. First Bullet)	Gross Capital	$811,240
	O&M Costs (if applicable)	$0.00
(5.4.3.2.A. Second Bullet)	Capital Contributions	$0.00

	Net Capital	$811,240		
Customer Attachments/Load (kVA)				
(5.4.3.2.A. Third Bullet)	Customer Attachments (#):	88		
	Customer Load (peak KVA)	15000 (Load Supplied Through Line)		
Project Timing				
(5.4.3.2.A. Forth Bullet)	Start Date	October 2020 (Engineering)		
		April 2021 (Construction)		
	Expected In-Service Date	September 2021		
	Expenditure Timing	Q1:	0%	$0
		Q2:	50%	$405,620
		Q3:	50%	$405,620
		Q4:	0%	$0

Risk and Risk Mitigation

(5.4.3.2.A. Fifth Bullet)

This project will require coordination with Hydro One to isolate and de-energize their 44kV circuit. Hydro One has a large amount of embedded generation (20 MW from a 2019 CIA Report) connected to this circuit and accommodating an isolation / de-energization may be challenging depending on the time of year. NBHDL will work with Hydro One to coordinate this isolation in a manner such that it will have minimal disruption to their system and their customers. In coordinating with Hydro One, if construction cannot commence and be completed within an agreed upon timeline, a portion of this project may need to be deferred.

NBHDL understands the scope of this project and has built a project schedule with key milestone dates to be achieved to keep the project on track. It will be managed by North Bay Hydro's internal project management process which includes update meetings, progress tracking, and developed action plans. The engineering design and the administrative work (municipal approvals, coordination, etc.) for the project is currently scheduled to be completed by the end the first quarter 2021 with construction to start in the second quarter (spring) of 2021.

NBHDL has built into its project schedule a buffer to allow for any unexpected issues in order to avoid a delay to the construction start date. However, once construction starts, delays caused by equipment breakdowns, severe weather events (climate change), and sudden change in staffing resources can not always be mitigated.

Comparative Information

	(5.4.3.2.A. Sixth Bullet)	NBHDL recognizes that the different combinations in the number of poles installed, length and size of conductors installed, number and type of switching devices installed, number and sizes of transformers installed, number of services, line angles and anchoring installed, as well as other design considerations makes all projects unique. Construction methods and equipment may vary depending on location, geography, subterranean conditions, and season as well. All of which affect the cost of a project. For cost comparison purposes, NBHDL has determined that each of its past project contains enough variability in their design and construction such that no single project could be used to benchmark the cost of another single project appropriately. Instead, for overhead lines, NBHDL uses multiple historic projects (last 10 years) involving the construction of similar infrastructure to determine an average cost per pole installed. The average per pole cost for a 44kV line carrying a 12.47kV circuit as well is $24,676 per pole. At a project cost of $811,240 with 31 poles to be installed, the estimated per pole cost of the Wallace Rd Rebuild project is $26,169, approximately 6% over the average.
	Total Capital & OM&A Costs Associated with REG Investments	
	(5.4.3.2.A. Seventh Bullet)	This project is not associated with REG investment; Capital and OM&A cost related to REG will not be incurred
	Leave to Construct Approval	
	(5.4.3.2.A. Eight Bullet)	This project does not require Leave to Construct approval under Section 92 of the OEB Act and therefore this does not apply
	5.4.3.2.B - Evaluation Criteria and Information Requirements	
EVALUATION CRITERIA AND INFORMATION REQUIREMENTS (5.4.3.2.B)	**Efficiency, Customer Value, Reliability (5.4.3.2.B.1)**	
	Section a)	
	Main Driver (Trigger)	Failure risk (associated with the end of life distribution assets) is the main driver of this project. See Section 4.1.2.2 of NBHDL's DSP for pole failure risk description. The poles in this line are currently 45 years of age; however, they are under-classed meaning that they are weaker than the poles which would be required under present day design standards for an equivalent line construction. This line is particularly important to NBHDL's system as a significant number of customers and large load industrial facilities will be impacted by a failure. One of the large load industrial customers is a plastics manufacturing plant and any interruption of power during their processes may result in entire batch of plastics going to waste. It is also one of only two 44kV Sub Transmission feeder that supplies the entire southern section of the city (West Ferris Area). Hydro One also has a large amount of connected generation (20 MW) on their circuit that would be substantially impacted by a failure. Due to this consequence, the replacement schedule for this line requires a

	conservative approach and is prioritized highly among other system renewal projects of even older lines. It is NBHDL position, that in its objective of maintaining a reliable and resilient distribution system, allowing these poles to fall into a condition of "poor" would pose a risk to NBHDL's performance targets. This line is responsible for supplying three distribution substations and any failure would affect the large number of customers those substations serve.
Related Objectives/Performance Targets	NBHDL Corporate Mission, Vision and Core Values CV3 and CV4 (as identified in Exhibit 1).
Source and Nature of the Information Used to Justify the Investment	North Bay Hydro used Pole Inspection Data, the Asset Condition Report, and the Metsco Project Prioritization Tool / Model to justify and prioritize the investment.
Secondary Drivers	Safety and Functionality are the secondary drivers to this project. Currently, the existing line is built with sub standard classed poles and would not meet the rigor of present-day design and safety standards. As such, all poles on this line will not pass present-day engineering analysis for new equipment or attachments to be installed on them. The structural analysis will always call for the poles to be replaced. Spot replacements however on this line are not practical due to the Hydro 44kV circuits it carries and the amount of coordination and planning required to isolate it. This line also contains pin type porcelain insulators on the Hydro One and the NBHDL 12.47 kV primary circuits. A report released by ESA in 2017 titled "Mitigation of Pole Top Fires" shows these insulators as the worst performers when it comes electrical current leakage (references CEA 265 D 748). In order for these insulators to maintain their insulation characteristics, they must not be contaminated or damaged through hairline cracks. However, as they age, there are subject to both electrical and mechanical failures where the pin can break away. This presents a worker and public safety issue that will be corrected with the construction of the new line.
Related Objectives/Performance Targets	NBHDL Corporate Mission, Vision and Core Values CV2 and CV4 (as identified in Exhibit 1).
Source and Nature of the Information Used to Justify the Investment	North Bay Hydro uses it's GIS (asset data) information, customer loading information, and its operating knowledge and experience as the source of information that identified the secondary drivers.
Section b)	

Reliability Planning and Resilient Distribution System Design

NBHDL adheres to good utility practice in ensuring that all projects are designed to be a part of resilient and reliable distribution system. This project will be built using composite poles (RS Poles) that offer the following benefits over wood poles

- Useful service life of 80 Years (ASTM G154 tested)
- Manufacturer warranty of 43 years
- Engineered product – Quality Control
- Not susceptible to Insect / wood pecker damage
- Not affected by moisture
- Fire resistant (performance tested by RS)
- Cannot be scaled easily by wildlife (squirrels)
- Light weight - Less worker and equipment wear
- Poles are straight, no need to align "hooks"
- Easily cleaned and resistant to staples
- Does not require pole testing program

NBHDL has performed a cost / benefit analysis on using composite poles in rebuilding of the Ski Club Rd (part 1, 2, and 3) in its system. That analysis demonstrated that composite poles offer more benefit and are actually more cost effective compared to wood poles over the life cycle of the asset. Since composite poles last much longer than wood poles, the cost per year of service is less.

Using pole inspection data collected from the field, NBHDL sampled wood poles in areas that have been observed to have a high frequency of wood pecker damage, deemed as wood pecker "hot spots". NBHDL discovered that approximately 43% of wood poles located in wood pecker "hot spots" had some form of wood pecker damage to varying degrees. On average, NBHDL estimates that approximately 8% of service life will be lost on these poles due to early replacement from wood pecker damage. NBHDL as a standard practice will use composite poles for all 44kV sub-transmission lines in wood pecker "hot spots" to protect its assets from this damage. Wallace Rd has been deemed a wood pecker "hot spot" area.

North Bay Hydro acknowledges climate change and recognizes the possibility of an increase to severe weather events that may result. Composite poles a capable of with standing high amounts of elastic strain and are less likely to experience permanent structural damage in violent winds.

Adaptation to Future Challenges

This project will be built with enough conductor capacity to allow for future load growth on both the sub transmission and distribution circuits. The spacing on the poles will allow for the installation of new equipment without the need to re-frame the pole. No other improvements have been deemed necessary for the adaptation to future challenges on this particular project.

Section c)

Investment Priority Relative to Other Investments	Using the Metsco developed Project Planning Optimization Tool, of the 8 system renewal projects proposed for 2021 (Distribution System OH & UG Lines), the Wallace Rd Rebuild project ranks as **#1 in its prioritization**. Overall, this project is ranked as #4 in NBHDL's prioritization for all projects. The prioritization approach for which this rank is determined is outlined in the next section below. While individual projects are ranked according to their benefits, NBHDL will make its selection based on the group of projects that cumulatively offers the greatest benefit while operating within the planned budget and resourcing requirements for a given year. Cumulatively, the 8 projects planned for 2021 offers the greatest net benefit (highest score) compared to any other combination of projects proposed.
Prioritization Approach	See Section 4.2.2 of NBHDL's DSP for project prioritization approach.
Section d) **Analysis of the Project and Project Alternatives**	
Effect on System Operation Efficiency and Cost-Effectiveness (First Bullet)	This project will reduce the risk of failure and the associated increase to O&M costs as the line continues to age and deteriorate. See Section 4.1.2.2 of NBHDL's DSP for description on correlation between age of pole and maintenance activities.
Net Benefits Accruing to Customers (Second Bullet)	NBHDL will be able to accommodate new or upgraded service request from customers that require new equipment to be installed on poles in a timelier fashion. The avoidance of potentially adverse effects on reliability will also benefit customers. An avoidance of increased maintenance costs and the reduction in line losses positively impacts the overall cost for the delivery of electricity.

Impact on Reliability Performance (Including on the Frequency and Duration of Outages) (Third Bullet)	This project will avoid an adverse impact to the reliability performance of this line. If this project is not implemented, there will be an increased risk of outages affecting a high number of customers. 44kV sub transmission lines supply power to multiple substations and large load customer. This 44kV feeder in particular can be providing power up to 5000 customers at a given time based on the current system configuration. It also supplies some of NBHDL's largest industrial load customers. A single interruption that lasts an hour can contribution 0.2 to NBHDL's SAIDI / SAIFI metrics, approximately 10% of its performance target. NBHDL does not have 24-hour staffing of its control room and has a line crew on call for emergencies outside of normal operating hours. As such, response and restoration times outside of normal operating hours take longer if a failure was to occur since switching orders to isolate the affected area can not be completed as quickly. 44kV sub transmission circuits in NBHDL's system are critical components and must be maintained in a manner that minimizes risk to ensure performance targets are met.
Project Alternatives	NBHDL has considered the following alternative to this project but has deemed them not to be viable options: • Alternative #1 – Do Nothing This alternative involves not doing anything at this time and deferring the project or running the line to failure. This option will defer the cost of replacing the asset, however the existing line will continue to be an issue for installing new equipment and the risk of failure will continue to increase until it does actually fail or is reconstructed. Maintenance issues associated with the ageing and deteriorating line would be expected to increase year over year cause the overall life cycle of the asset to be more expensive. See section 3 of the DSP. This line cannot be relocated or eliminated and is a important part of North Bay Hydro's distribution system. • Alternative #2 – Build with Wood Poles This alternative will involves constructing the project with the same design, but using wood poles instead of composite. NBHDL has performed a cost / benefit analysis and composite poles offer greater benefits and are less expensive over the life cycle of the asset. The wood poles would be subjected to wood pecker damage which has been problematic for NBHDL. Wood poles offer no benefit in this project as a building material. Deferring the project in favour for another project will result in overall lost benefit as determined by North Bay Hydro's Project Planning Optimization Tool (see section 5.4.3.2.B.1.c for Prioritization Approach.
Safety (5.4.3.2.B.2)	

This project will eliminate hazards associated with deteriorating pole lines. The existing line does not meet the rigor of North Bay Hydro's present-day safety standards and includes under classed poles. This project will also eliminate pin type porcelain insulators which have been known to perform poorly as they can lead to both electrical and mechanical failure of the insulator.

NBHDL has first hand experience with this when in 2019, an employee suffered an electrical shock while pulling out a nail at the base of the pole in the rain. There was a hail line crack on the insulating that cause the energization of the pole, but the leakage current was to small to be detected as a fault by the protective devices in NBHDL's system.

The degradation of the existing pole lines over time will lead to an increased probability of equipment failure that may result in a situation where live conductor may come into contact with the ground level, presenting a hazard to public safety.

Cyber-Security, Privacy (5.4.3.2.B.3)

Not applicable to this project

Co-ordination, Interoperability (5.4.3.2.B.4)

Section a)

Co-ordination with Utilities, Regional Planning and/or Links with 3rd Party Providers and/or Industry

Coordination with utilities, regional planning, third party providers, or other industries is not applicable to this project as the project is located in the middle of North Bay Hydro's service territory in an area with no future development plans.

Section b)

Enabling of Future Technological Functionality or Addressing of Future Operational Requirements

At this time, the project does not incorporate any future technological functionality (i.e. automated switches) in North Bay Hydro's distribution system. The new construction framing will provide at a minimum 3.2m of pole space between the phase conductors and the neutral to allow for the easy installation of future equipment. This will allow the line to be ready and easily adaptable to future needs if required.

Environmental Benefits (5.4.3.2.B.5)

The nature of this project does not impact the environment in any substantial manner other than the impacts associated with the manufacturing of the materials.

Conservation and Demand Management (5.4.3.2.B.6)

This project is not applicable to any rate funded conservation or demand program

Category-Specific Requirements - System Renewal (5.4.3.2.C.b.)

SYSTEM RENEWAL SPECIFIC REQUIREMENTS (5.4.3.2.C.b.)

Relationship Between the Characteristics of Targeted Assets and the Consequences of Asset Performance Deterioration or Failure (5.4.3.2.C.b.First Bullet)

Asset Performance Targets and Asset Lifecycle Optimization Policies and Practices (First Sub-Bullet)

The existing line assets are at the end of their useful life at 45 years old and will result in an increase of the asset's lifecycle cost as the risk of failure increases. See section 3.3 of the DSP for more information on Asset Life Cycle Optimization Policies and Practices.

Asset Condition Relative to Typical Life Cycle (Second Sub-Bullet)

Inspection data has shown that the majority of the line is in the category of poor condition (low health index). While the age of the pole line is a consideration in the condition assessment, further degradation of the pole line caused by shell rot, pole top deterioration, and holes (caused by insects and wood peckers) puts the effective age of the pole line at a greater age than the actual age. This is to say that the pole line has condition characteristics of a pole line much older and has deteriorated (and will continue to deteriorate) at a faster rate.

Number of Customers in Each Class Potentially Affected (Third Sub-Bullet)

Feeder / Station	Residential Customers	General Service Customers
MS10	1984	116
MS15	657	393
MS22	1358	502
44kV > 1 MVA	0	4

Quantitative Customer Impact and Risk (Fourth Sub-Bullet)

North Bay Hydro collects outages statistics to analyze it distribution system performance on a feeder level with a particular focus on interruptions caused by defective equipment and tree contacts.

In 2019, the 44 kV sub transmission feeder (18M2) experienced no interruptions from defective equipment or tree contacts. In 2018, 3 sustained outages (all part of the same event) occurred due to equipment failure and in 2017, 1 sustained outage from defective equipment. This information represents the entire feeder, not just the area of the proposed project.

In 2019, the 12.47 kV distribution feeder (15F3) carried by the line experienced 0 momentary outages with 1 sustained outage from defective equipment. This has increased from 0 sustained / 0 momentary outages in 2018 and 0 momentary outages recorded in 2017. Again, this information represents the entire feeder, not just the area of the proposed project.

NBHDL does not have a record of a failure on this particular section of line, however in 2018, NBHDL experienced an outage on the same 18M2 feeder on Booth Rd. The outage was caused by a failed insulator on a 34-year-old pole line. The resulting outage left approximately 3000 customers out of power for 45 minutes and approximately 1800 customer out of power for 3.5 hours. Wallace Rd, which is an older section of line at 45 years, would have similar consequences. NBHDL objective with sub transmission lines is to prevent them from failing rather than react to them once they start to fail due to the severity of outages and its impact to NBHDL's performance targets.

Qualitative Customer Impact and Risk (Fifth Sub-Bullet)

This pole line carries two sub transmission (44kV) circuits that supplies a significant number of customers. A failure on this line will be particularly disruptive to Hydro One as their circuit connects generation customers. Long outages lead to customer dissatisfaction and complaints. Business and manufacturing operations can be substantially impacted and customers who work from home also lose productivity from outages. This project will ensure that the line remains reliable and resilient to weather events, maintaining the overall performance of the feeder it carries.

Value of Customer Impact (Sixth Sub-Bullet)

The customer impact in terms of the potential failure is very high. This sub transmission line supplies some of North Bays largest industrial and commercial customers. This includes a mall and a plastics manufacturing plant. The plastics plant in particular may have an entire production batch go to waste depending on when an outage occurs in their process. The planted has communicated to NBHDL the importance of reliable power to its operations. Substantial financial consequences are incurred by these customers when outages occur as a result of failures.

Other Factors Affecting Project Timing (5.4.3.2.C.b.Second Bullet)

This project will involve the isolation of one of the two sub transmission circuits that brings power to the southern part of North Bay. As such, the other circuit must supply the entire load to the area during construction. If the other line were to have an unexpected failure or an unforeseen maintenance issue were to arise, this project may have to be delayed until the issues are corrected.

Consequences for System O&M costs (5.4.3.2.C.b.Third Bullet)

This project will reduce the risk of equipment failure and trouble calls in line with general system renewal projects. The 12.47 kV distribution circuit will be replaced with a larger conductor, reducing lines losses. The existing line with the degradation of its assets may no longer be able to withstand multiple severe weather events with out further damage.

Maintenance actions and associated costs will trend upwards as the pole line continues to age (see section 5.4.3.2.B.1.d).

Reliability and Safety Factors (5.4.3.2.C.b.Fourth Bullet)

This project will not have a material impact on improving the system reliability, but there will have a detrimental impact on system reliability if the project is not implemented. The impacts on public safety and the elimination of potential hazards were considered as factors to the importance of the project (See section 5.4.3.2.B.2 above)

Analysis of Project Benefits and Timing (5.4.3.2.C.b.Fifth Bullet)

North Bay Hydro uses a Project Planning Optimization Tool developed by Metsco to assess the benefits of its capital projects and uses that information to organize the most appropriate timing of its projects (see section 5.4.3.2.B.1.c for prioritization approach). For system renewal projects, the reduction of the risk cost (probability of failure vs the consequence of failure) and the optimization of the total life cycle cost for the asset is the main consideration for project benefits and prioritization. The timing of the proposed projects have been planned in a manner to maximize investment benefits.

North Bay Hydro acknowledges Climate Change and recognizes the potential impacts to its distribution system. As a primarily overhead system, North Bay Hydro must continue to design and operate its system (new projects & investments) to be able to withstand severe weather conditions (adherence to CSA design standards is a minimum). The large amount of existing aging overhead infrastructure (refer to ACA Report) however, through the degradation of the assets, is losing its ability to withstand repeated severe weather events. North Bay Hydro must ensure that its system is not crippled by weather events and as such, the urgency and importance investing in system renewal projects has increased.

Like for Like Renewal Analysis (5.4.5.2.C.b.Sixth Bullet)

Like for like renewal analysis of this project is not applicable as this project has not been configured at an extra cost to address other distributor planning objectives. This project has been configured solely to meet the requirement.

GENERAL INFORMATION ON THE PROJECT/PROGRAM (5.4.3.2.A)

2021 Capital Project Summary

5.4.3.2.A - General Information on the Project / Program

Project Name

MS10 to Hwy 11S - Sub Transmission Off Road O/H Line Rebuild

Investment Category

System Renewal

Project Description

The MS10 to Hwy 11S Rebuild project consists of the design, construction, and installation of a new over head pole line from the end of Marshal Ave Eave (where Municipal Substation #10 is located) to HWY 11 South. The length of the line will be approximately 1100m and will consist of 13 poles. It will be constructed with composite poles which will carry a 44kV Sub Transmission circuit and a 12.47 kV distribution circuit (line will be built to 15kV and 46kV standards) across undeveloped swampy terrain with no existing access road. Composite poles were chosen for this project due to them being more suitable for high moisture / wet areas and will not experience accelerated rot due to these conditions, unlike wood poles. Among other benefits, they are also resistant to wood pecker damage, a problematic issue for NBHDL that causes premature replacement of wood poles.

The new line will replace the existing line which is pass its useful life at 55 years old, contains undersized conductor that is no longer sufficient for present day peak loading, and is in poor overall condition. Condition issues include wood pecker holes, shell rot, pole top deterioration, cracks, and footing displacements (leaning poles).

Given the current condition assessment of the pole line, failures will be more likely to occur as the line continues to age. This increased risk is compounded by the fact that NBHDL has limited available equipment capabilities to efficiently perform off road repairs and restorations times would be longer. NBHDL intends to rent off-road equipment for the construction of this line and it will have a ruggedized design to ensure it can withstand severe weather events and environmental factors.

This line is one of two Sub Transmission circuits that supplies the south end (Ferris Area) of North Bay where some of North Bay Hydro's largest customers (peak demand) are located. It is an important line in NBDHL's distribution system and depending on the operating system configuration, the NBHDL circuit will supply 2 to 3 substations that may be servicing up to approximately 3500 customers combined, including North Bays largest mall and a waste water treatment plant.

Capital Investment

(5.4.3.2.A. First Bullet)	Gross Capital	$629,884
	O&M Costs (if applicable)	$0.00
(5.4.3.2.A. Second Bullet)	Capital Contributions	$0.00

	Net Capital	$629,884		
Customer Attachments/Load (kVA)				
(5.4.3.2.A. Third Bullet)	Customer Attachments (#):	0 on this section		
	Customer Load (peak KVA)	10500 - Load Supplied Through Line		
Project Timing				
(5.4.3.2.A. Forth Bullet)	Start Date	May 2020 (Engineering)		
		February 2021 (Construction)		
	Expected In-Service Date	April 2021		
	Expenditure Timing	Q1:	80%	$503,907
		Q2:	20%	$125,977
		Q3:	0%	$0
		Q4:	0%	$0

Risk and Risk Mitigation

(5.4.3.2.A. Fifth Bullet)

This project will involve aerial crossings of two rail ways and crossing permits / approvals must be obtained. As such, the most significant risk to the project's timeline would be if any issues arise in obtaining the crossing permits. Construction for this project would be optimal to occur in the winter where the wet terrain is frozen and firm; however, it can still be completed in warmer weather if the project timeline was to be extended.

NBHDL understands the scope of this project and has built a project schedule with key milestone dates to be achieved to keep the project on track. It will be managed by North Bay Hydro's internal project management process which includes update meetings, progress tracking, and developed action plans. The engineering design and the administrative work (crossing permits, municipal approvals, etc.) for the project is currently scheduled to be completed by the end of the prior year (2020).

NBHDL has also built into its schedule a buffer to allow for any unexpected issues which may cause delay to the construction start date. However, once construction starts, delays caused by equipment breakdowns, severe weather events (climate change), and sudden change in staffing resources can not always be mitigated.

Comparative Information

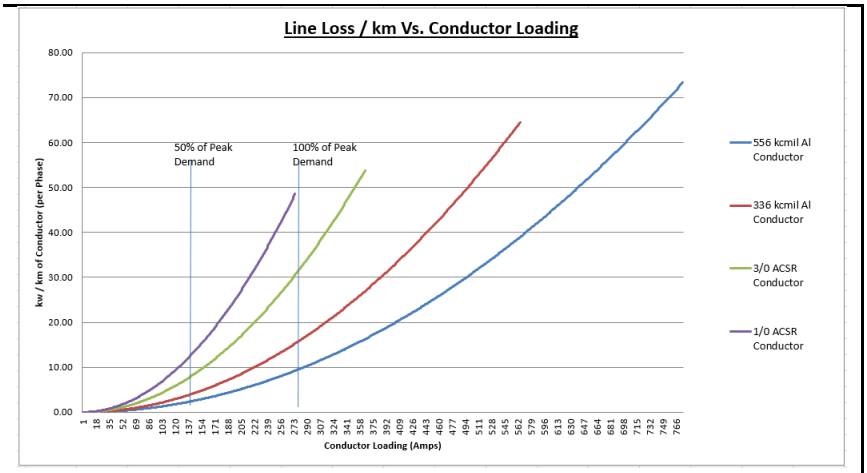
(5.4.3.2.A. Sixth Bullet)

NBHDL recognizes that the different combinations in the number of poles installed, length and size of conductors installed, number and type of switching devices installed, number and sizes of transformers installed, number of services, line angles and anchoring installed, as well as other design considerations makes all projects unique. Construction methods and equipment may vary depending on location, geography, subterranean conditions, and season as well. All of which affect the cost of a project.

For cost comparison purposes, NBHDL has determined that each of its past project contains enough variability in their design and construction such that no single project could be used to benchmark the cost of another single project appropriately. Instead, NBHDL uses multiple historic projects (last 10

		years) involving the construction of similar infrastructure to determine an average cost per pole installed. The average per pole cost for a 44kV line carrying a 12.47kV circuit as well is $24,676 per pole. At a project cost $629,884 with 13 poles to be installed, the estimated per pole cost of the MS10 to HWY 11S Rebuild project is $48,453, approximately 96% higher than the average. This is a significant increase over the historic average; however, there is a few important nontypical aspects of this project that increases the cost: • The line is located in an off-road swampy area inaccessible by NBHDL's current equipment. NBHDL will have to contract out this off-road equipment with an operator for the installation of this pole line. • The line will be constructed with composite poles • The line will be built to be weather resilient with storm guying
	Total Capital & OM&A Costs Associated with REG Investments	
	(5.4.3.2.A. Seventh Bullet)	This project is not associated with REG investment; Capital and OM&A cost related to REG will not be incurred
	Leave to Construct Approval	
	(5.4.3.2.A. Eight Bullet)	This project does not require Leave to Construct approval under Section 92 of the OEB Act and therefore this does not apply
	5.4.3.2.B - Evaluation Criteria and Information Requirements	
EVALUATION CRITERIA AND INFORMATION REQUIREMENTS (5.4.3.2.B)	**Efficiency, Customer Value, Reliability (5.4.3.2.B.1)**	
	Section a)	
	Main Driver (Trigger)	Failure risk (associated with the end of life distribution assets) is the main driver of this project. See Section 4.1.2.2 of NBHDL's DSP for pole failure risk description. The poles in this line are currently 55 years of age and are in poor condition. Condition issues include wood pecker holes, shell rot, pole top deterioration, cracks, and footing displacements (leaning poles). Survival rate or end of life criteria is characterized by when a pole is deemed to no longer able to meet safety or functional requirements and is removed from service. In line with North Bay Hydro's Asset Lifecycle Optimization Practices (Section 3.3 of the DSP), this System Renewal project is necessary to efficiently sustain the ongoing reliability of electricity to the community. Condition assessment which includes the asset's age have classified this as pole line as poor condition. This is a concerning condition assessment because 44kV sub transmission lines are critical components of NBHDL's system as they supply a large number of customers and large load customers with demand requirements over 1MVA. This line in particular is part of a feeder that supplies approximately 3500 customers, North Bay's largest mall, and the waste water treatment plant.

	The off-road location of this line makes it difficult to efficiently perform repairs without off road capable equipment and as such, any equipment failure will result in longer restoration times than roadside equivalent lines. This makes the consequence of failure a significant risk to NBHDL's ability to maintain it reliability performance targets. This line carries one of the only two Sub Transmission circuits which is responsible for bringing power in the southern end (West Ferris area) of the city. Sub transmission circuits which operate at 44kV are isolated for worker safety when maintenance / construction activities are performed on the line, such as load break switch maintenance or replacing a damaged pole. These activities are important in maintaining functional equipment; however, they also create situations in which this line will be the only supply to this area of North Bay. During these times, the consequence of a failure would be devastating as upwards of 5000 customers will be impacted with no alternate way to reroute power to restore the area and these customers will remain out of power until repairs are complete. This consideration is an important driver to ensure that this line remains reliable.
Related Objectives/Performance Targets	NBHDL Corporate Mission, Vision and Core Values CV3 and CV4 (as identified in Exhibit 1).
Source and Nature of the Information Used to Justify the Investment	North Bay Hydro used Pole Inspection Data, the Asset Condition Report, the Metsco Project Prioritization Tool / Model, at its operating experience to justify and prioritize the investment.
Secondary Drivers	Insufficient conductor capacity (undersized conductor) that makes this line inadequate for meeting peak demands is a secondary driver of this project. Currently the Sub Transmission (44kV) conductor on the existing line is substantially undersized at 1/0 ACSR and presents capacity constraints and high line losses (energy dissipated over the resistance of the conductor and lost as heat). As part of North Bay Hydro's distribution system design to ensure resiliency through redundancy, this line must be able to handle a peak load of 21 MVA in present day plus a small growth factor for future considerations. This requirement will ensure that if something was to happen to the other line during peak loading, this line can supply the entire area. This would be greater than 100% of the existing line's ampacity however. Aside from the capacity constraints, the larger conductor size of 556 kcmil Al to be installed in the new rebuild will also save approximately 10 to 40 kW of line losses per conductor during winter peaks (depending on system loading configurations). The relationship between conductor loses and conductor sizes as a function electrical current is represented in the graph below.



NBHDL's system peak loading occurs during winter months and this is attributed to a large amount of electrically heated homes present in North Bay.

As with many old pole lines, the existing line was designed with out of date design standards that use shorter poles and would not be adequate for the clearances required in present day safety standards. Due to the location of the line and the limited need to install any new equipment on the poles, the safety improvement is considered a benefit of the project but not a main driver.

Related Objectives/Performance Targets

NBHDL Corporate Mission, Vision and Core Values CV2 and CV4 (as identified in Exhibit 1).

Source and Nature of the Information Used to Justify the Investment

North Bay Hydro uses it's GIS (asset data) information, customer loading information, and distribution simulation software (DESS) along with its operating knowledge and experience as the source of information that identified the secondary drivers.

Section b)

Reliability Planning and Resilient Distribution System Design

NBHDL adheres to good utility practice in ensuring that all projects are designed to be a part of resilient and reliable distribution system. This project will be built using composite poles (RS Poles) that offer the following benefits over wood poles

- Useful service life of 80 Years (ASTM G154 tested)
- Manufacturer warranty of 43 years
- Engineered product – Quality Control
- Not susceptible to Insect / wood pecker damage
- Not affected by moisture
- Fire resistant (performance tested by RS)
- Cannot be scaled easily by wildlife (squirrels)
- Light weight - Less worker and equipment wear
- Poles are straight, no need to align "hooks"
- Easily cleaned and resistant to staples
- Does not require pole testing program

	NBHDL has performed a cost / benefit analysis on using composite poles in rebuilding of the Ski Club Rd in its system. That analysis demonstrated that composite poles offer more benefit and are actually more cost effective compared to wood poles over the life cycle of the asset. Since composite poles last much longer than wood poles, the cost per year of service is less. Using pole inspection data collected from the field, NBHDL sampled wood poles in areas that have been observed to have a high frequency of wood pecker damage, deemed as wood pecker "hot spots". NBHDL discovered that approximately 43% of wood poles located in wood pecker "hot spots" had some form of wood pecker damage to varying degrees. On average, NBHDL estimates that approximately 8% of service life will be lost on these poles due to early replacement from wood pecker damage. NBHDL as a standard practice will use composite poles for all 44kV sub-transmission lines in wood pecker "hot spots" to protect its assets from this damage. This area has been deemed a wood pecker "hot spot" area. North Bay Hydro acknowledges climate change and recognizes the possibility of an increase to severe weather events that may result. Composite poles a capable of with standing high amounts of elastic strain and are less likely to experience permanent structural damage in violent winds. Storm guying will be utilized to further strengthen the line against high wind loading.
Adaptation to Future Challenges	This project will increase the capacity of the line from 20MVA to 58MVA with the installation of the new conductor. This upgrade with allow for North Bay Hydro's highest projections (simulations) of load growth in the area. The spacing on the poles will allow for the installation of new equipment without the need to re-frame the pole. No other improvements have been deemed necessary for the adaptation to future challenges on this particular project.
Section c)	
Investment Priority Relative to Other Investments	Using the Metsco developed project prioritization tool, of the 10 system renewal projects planned for 2021 (Distribution System), the MS10 to Hwy 11S Rebuild project ranks as **#3 in its prioritization**. Overall, this project is ranked as #6 in NBHDL's prioritization for all projects. The prioritization approach for which this rank is determined is outlined in the next section below. While individual projects are ranked according to their benefits, NBHDL will make its selection based on the group of projects that cumulatively offers the greatest benefit while operating within the planned budget and resourcing requirements for a given year. Cumulatively, the 8 projects planned for 2021 offers the greatest net benefit (highest score) compared to any other combination of projects proposed.

Prioritization Approach	See Section 4.2.2 of NBHDL's DSP for project prioritization approach.
Section d) **Analysis of the Project and Project Alternatives**	
Effect on System Operation Efficiency and Cost-Effectiveness (First Bullet)	This project will involve the installation of a larger conductor on the Sub Transmission circuit which will significantly reducing the losses, saving approximately 10 to 40 kW of system losses over the line (depending on system loading), increasing its efficiency. This project will reduce the risk of failure and the associated increase to O&M costs as the line continues to age and deteriorate. See Section 4.1.2.2 of NBHDL's DSP for description on correlation between age of pole and maintenance activities. This line will also be designed with sufficient space to accommodate a future 44kV sub transmission line to be connected to it without the need to redesign the poles, as part of NBHDL's long term system design planning. In the future, NBHDL will look to rebuild another existing pole line near its end of life with a sub transmission circuit that will connect to this one. Once that is complete, NBHDL can eliminate an older off-road pole line once it reaches its end of life rather than rebuild it, saving the cost of rebuilding it.
Net Benefits Accruing to Customers (Second Bullet)	The avoidance of potentially adverse effects on reliability will also benefit customers. An avoidance of increased maintenance costs and the reduction in line losses positively impacts the overall cost for the delivery of electricity.

Impact on Reliability Performance (Including on the Frequency and Duration of Outages) (Third Bullet)	This project will avoid an adverse impact to the reliability performance of this line. If this project is not implemented, there will be an increased risk of outages affecting a high number of customers. 44kV sub transmission lines supply power to multiple substations and large load customer. This 44kV feeder in particular can be providing power up to 3500 customers at a given time based on the current system configuration. It also supplies some of NBHDL's large load customers including North Bay's largest mall and the waste water treatment plant. A single interruption that lasts an hour can contribution 0.14 to NBHDL's SAIDI / SAIFI metrics, approximately 7% of its performance target. NBHDL does not have 24-hour staffing of its control room and has a line crew on call for emergencies outside of normal operating hours. As such, response and restoration times outside of normal operating hours take longer if a failure was to occur since switching orders to isolate the affected area can not be completed as quickly. 44kV sub transmission circuits in NBHDL's system are critical components and must be maintained in a manner that minimizes risk to ensure performance targets are met.
Project Alternatives	NBHDL has considered the following alternative to this project but has deemed them not to be viable options: • <u>Alternative #1 – Do Nothing</u> This alternative involves not doing anything at this time and deferring the project or running the line to failure. This option will defer the cost of replacing the asset, however the existing line will continue to have undersized conductor (capacity constraints and system vulnerability) and the risk of failure will continue to increase until it does actually fail or is reconstructed. Maintenance issues associated with the ageing and deteriorating line would be expected to increase year over year cause the overall life cycle of the asset to be more expensive. See section 3 of the DSP. This line cannot be relocated or eliminated and is a important part of North Bay Hydro's distribution system. • <u>Alternative #2 – Build with Wood Poles</u> This alternative will involves constructing the project with the same design, but using wood poles instead of composite. NBHDL has performed a cost / benefit analysis and composite poles offer greater benefits and are less expensive over the life cycle of the asset. The wood poles would be subjected to wood pecker damage which has been problematic for NBHDL and would be more susceptible to accelerated rot due to moisture from the wet environment. Wood poles offer no benefit in this project as a building material. Deferring the project in favour for another project will result in overall lost benefit as determined by North Bay Hydro's Project Planning Optimization Tool (see section 5.4.3.2.B.1.c for Prioritization Approach.

Safety (5.4.3.2.B.2)

The line is located in an undeveloped, off road, swampy area where the it is unlikely to be encountered by the public as such, does not present a high risk to safety. It does however not meet the present-day safety standards in which the new line will be constructed to meet.

Despite the low risk due to the location, the degradation of the existing pole line over time will lead to an increased probability of equipment failure that may result in a situation where live conductor may come into contact with the ground level. This is always considered a hazard to public safety.

Cyber-Security, Privacy (5.4.3.2.B.3)

Not applicable to this project

Co-ordination, Interoperability (5.4.3.2.B.4)

Section a)

Co-ordination with Utilities, Regional Planning and/or Links with 3rd Party Providers and/or Industry

Coordination with utilities, regional planning, third party providers, or other industries is not applicable to this project as the project is located in the middle of North Bay Hydro's service territory in an area with no future development plans.

Section b)

Enabling of Future Technological Functionality or Addressing of Future Operational Requirements

At this time, the project does not incorporate any future technological functionality (i.e. automated switches) in North Bay Hydro's distribution system. The new construction framing will provide at a minimum 3.2m of pole space between the phase conductors and the neutral to allow for the easy installation of future equipment.

Environmental Benefits (5.4.3.2.B.5)

The nature of this project does not impact the environment in any substantial manner other than the impacts associated with the manufacturing of the materials.

SYSTEM RENEWAL SPECIFIC REQUIREMENTS (5.4.3.2.C.b)

Conservation and Demand Management (5.4.3.2.B.6)

This project is not applicable to any rate funded conservation or demand program

Category-Specific Requirements - System Renewal (5.4.3.2.C.b.)

Relationship Between the Characteristics of Targeted Assets and the Consequences of Asset Performance Deterioration or Failure (5.4.3.2.C.b.First Bullet)

Asset Performance Targets and Asset Lifecycle Optimization Policies and Practices (First Sub-Bullet)

The existing line assets are at the end of their useful life at 45 years old and will result in an increase of the asset's lifecycle cost as the risk of failure increases

The existing line is highly inefficient due to the line losses of its undersized conductor and currently puts capacity constraints on North Bay Hydro's system. **See section 3.3 of the DSP for more information on Asset Life Cycle Optimization Policies and Practices.**

Asset Condition Relative to Typical Life Cycle (Second Sub-Bullet)

Inspection data has shown that the majority of the line is in the category of poor condition (low health index). While the age of the pole line is a consideration in the condition assessment, further degradation of the pole line caused by shell rot, pole top deterioration, and holes (caused by insects and wood peckers) puts the effective age of the pole line at a much greater age than the actual age. This is to say that the pole line has condition characteristics of a pole line much older and has deteriorated (and it is assumed that it will continue to deteriorate) at a faster rate.

Number of Customers in Each Class Potentially Affected (Third Sub-Bullet)

Feeder / Station	Residential Customers	General Service Customers
MS08	1290	110
MS10	1984	116
MS15	657	393
MS22	1358	502
44kV > 1 MVA	0	4

Quantitative Customer Impact and Risk (Fourth Sub-Bullet)

North Bay Hydro collects outages statistics to analyze it distribution system performance on a feeder level with a particular focus on interruptions caused by defective equipment and tree contacts.

In 2019, the 44 kV sub transmission feeder (18M1) experienced 3 momentary interruption with no sustained outages. This has increased from the 1 momentary interruption in 2018 and 2 momentary outages in 2017. This information represents the entire feeder, not just the area of the proposed project.

In 2019, the distribution feeder (10F4) carried by the line experienced 3 momentary outages with 1 sustained outage. This has increased from 1 sustained / 2 momentary outages in 2018 and 2 momentary outages recorded in 2017. Again, this information represents the entire feeder, not just the area of the proposed project.

NBHDL does not have a record of a failure specific to this particular section of line in the last 5 years, however it is NBHDL's objective with sub transmission lines is to prevent them from failing rather than react to them once they start to fail due to the severity of outages and its impact to NBHDL's performance targets.

Qualitative Customer Impact and Risk (Fifth Sub-Bullet)

Outage restoration in this area in particular will be longer than average due to the location of this line. Since this line carries a sub transmission feeder, a large number of customers will be affected by an outage. It is also more difficult to identify the cause of the issue initially as a large portion of the line must be patrolled on foot due to the swampy area. Long outages lead to customer dissatisfaction and complaints. Business and manufacturing operations can be substantially impacted and customers who work from home also lose productivity from outages. This project will ensure that the line remains reliable and resilient to weather events, maintaining the overall performance of the feeder it carries.

Value of Customer Impact (Sixth Sub-Bullet)

The customer impact in terms of the potential failure is very high. This sub transmission feeder supplies some of North Bays largest industrial and commercial customers. This includes a large mall and the waste water treatment plant. Substantial financial consequences are incurred by these customers when outages occur as a result of failures.

NBHDL acknowledges that there may be a cultural shift of working from the office to working from home due to the current Covid 19 situation. This means that residential areas and home may be impacted similar to business in a lost of productivity.

Other Factors Affecting Project Timing (5.4.3.2.C.b.Second Bullet)

This project will involve the isolation of one of the two sub transmission lines that brings power to the southern part of North Bay. As such, the other circuit must supply the entire load to the area during construction. If the other line were to have an unexpected failure or an unforeseen maintenance issue were to arise, this project may have to be delayed until the issues are corrected.

Consequences for System O&M costs (5.4.3.2.C.b.Third Bullet)

This project will reduce the risk of equipment failure and trouble calls in line with general system renewal projects. The existing conductor will be replaced with a larger conductor, reducing lines losses (lost energy). The existing line with the degradation of its assets may no longer be able to withstand multiple severe weather events with out further damage.

Maintenance actions and associated costs will trend upwards as the pole line continues to age (see section 5.4.3.2.B.1.d).

Reliability and Safety Factors (5.4.3.2.C.b.Fourth Bullet)

This project will not have a material impact on improving the system reliability, but there will have a detrimental impact on system reliability if the project is not implemented. The impacts on public safety and the elimination of potential hazards were considered as small factors to this project (See section 5.4.3.2.B.2 above)

Analysis of Project Benefits and Timing (5.4.3.2.C.b.Fifth Bullet)

North Bay Hydro uses a Project Planning Optimization Tool developed by Metsco to assess the benefits of its capital projects and uses that information to organize the most appropriate timing of its projects (see section 5.4.3.2.B.1.c for prioritization approach). For system renewal projects, the reduction of the risk cost (probability of failure vs the consequence of failure) and the optimization of the total life cycle cost for the asset is the main consideration for project benefits and prioritization. The timing of the proposed projects have been planned in a manner to maximize investment benefits.

North Bay Hydro acknowledges Climate Change and recognizes the potential impacts to its distribution system. As a primarily overhead system, North Bay Hydro must continue to design and operate its system (new projects & investments) to be able to withstand severe weather conditions (adherence to CSA design standards is a minimum). The large amount of existing aging overhead infrastructure (refer to ACA Report) however, through the degradation of the assets, is losing its ability to withstand repeated severe weather events. North Bay Hydro must ensure that its system is not crippled by weather events and as such, the urgency and importance investing in system renewal projects has increased.

Like for Like Renewal Analysis (5.4.5.2.C.b.Sixth Bullet)

Like for like renewal analysis of this project is not applicable as this project has not been configured at an extra cost to address other distributor planning objectives. This project has been configured solely to meet the requirement.

GENERAL INFORMATION ON THE PROJECT/PROGRAM (5.4.3.2.A)

2021 Capital Project Summary

5.4.3.2.A - General Information on the Project / Program

Project Name

Hwy 11 North (Sunshine Ln to Berkley Blvd) - Overhead Line Rebuild

Investment Category

System Renewal

Project Description

The Hwy 11 North (Sunshine Ln to Berkley Blvd) Rebuild project consists of the design, construction and installation of a new overhead pole line along the side of Hwy 11 North from Sunshine Ln to approximately 200m north of Berkley Blvd. The length of the line will be approximately 1200m and will consist of 24 poles. It will carry two 12.47kV distribution circuits (built to 15kV standards) and will replace two existing pole lines that currently run on both sides of the highway (40 poles) carrying an individual circuit. This will eliminate one 1200m pole line and the need to rebuild it, essentially given this project "two for one" value.

Both of the existing pole lines that will be addressed in this project are well past their useful life at 60 years old and have been assessed to be in poor condition. Condition issues include wood pecker holes, shell rot, pole top deterioration, rotten cross arms, cracks, and footing displacements (leaning poles). As with many older pole lines, the design standards in the existing lines would be considered out dated and would not meet the rigorous safety standards that are in place today. The poles are undersized and under classed (weaker) and contain old porcelain insulators which are more prone to electrical and mechanical failures as they age.

The two distribution feeder circuits on these lines supply 930 customers combined with a mix of residential and commercial customers. The Merrick Landfill Generation Station with 1.2 MVA capacity is also connected through the circuit (14F3) that this pole line carries (an important connection). Any interruption on the line, including a momentary interruption, will trip the generating station off line, resulting in lost revenue. The generation station is typically un manned an will require operator intervention to reconnect it back onto the grid.

Capital Investment

(5.4.3.2.A. First Bullet)	Gross Capital	$337,164
	O&M Costs (if applicable)	$0.00
(5.4.3.2.A. Second Bullet)	Capital Contributions	$0.00
	Net Capital	$337,164

Customer Attachments/Load (kVA)

(5.4.3.2.A. Third Bullet)	Customer Attachments (#):	0
	Customer Load (peak KVA)	700 (Load Supplied Through Line by the Feeders)

Project Timing

(5.4.3.2.A. Forth Bullet)

Start Date	March 2020 (Engineering)		
	March 2021 (Construction)		
Expected In-Service Date	October 2021		
Expenditure Timing	Q1:	0%	$0
	Q2:	50%	$168,582
	Q3:	50%	$168,582
	Q4:	0%	$0

Risk and Risk Mitigation

(5.4.3.2.A. Fifth Bullet)

This project will involve installations on the MTO right of way and will require crossing permits / approvals for the construction. As such, the most significant risk to the project's would be if any issues arise in obtaining the crossing permits / approvals.

North Bay Hydro understands the scope of this project and has built a project schedule with key milestone dates to be achieved to keep the project on track. It will be managed by North Bay Hydro's internal project management process which includes update meetings, progress tracking, and developed action plans. The engineering design and the administrative work (crossing permits, municipal approvals, etc.) for the project is currently scheduled to be completed by the end of the prior year (2020).

North Bay Hydro has also built into its schedule a buffer to allow for any unexpected issues which may cause delay to the construction start date. However, once construction starts, delays caused by equipment breakdowns, severe weather events (climate change), and sudden change in staffing resources can not always be mitigated.

Comparative Information

(5.4.3.2.A. Sixth Bullet)

NBHDL recognizes that the different combinations in the number of poles installed, length and size of conductors installed, number and type of switching devices installed, number and sizes of transformers installed, number of services, line angles and anchoring installed, as well as other design considerations makes all projects unique. Construction methods and equipment may vary depending on location, geography, subterranean conditions, and season as well. All of which affect the cost of a project.

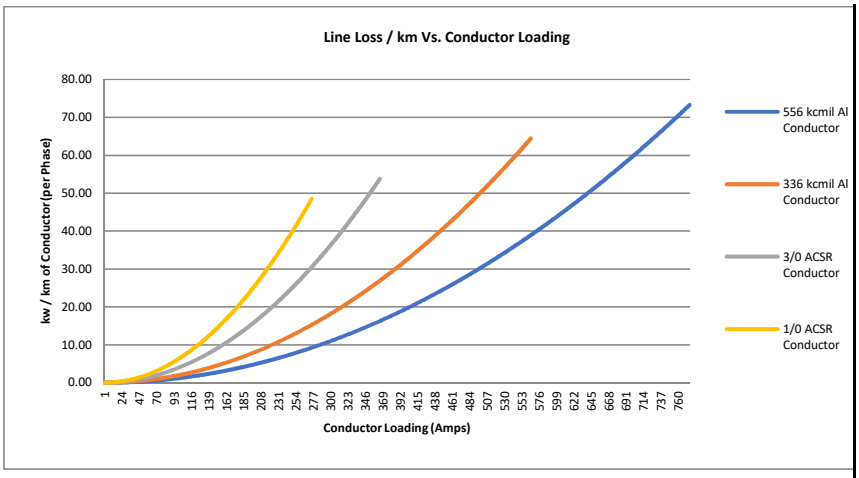
For cost comparison purposes, NBHDL has determined that each of its past project contains enough variability in their design and construction such that no single project could be used to benchmark the cost of another single project appropriately. Instead, for overhead lines, NBHDL uses multiple historic projects (last 10 years) involving the construction of similar infrastructure to determine an average cost per pole installed.

NBHDL however, has only completed a single project in recent history that consisted of the construction of a double circuit 12.47kV distribution line. This would be the 2010 Worthington St Line Rebuild which consisted of 29 poles of double circuit 12.47kV with a double underbuilt circuit of 4.16kV. It also included the installation of nine 44kV sub transmission poles. This

		project was constructed at a cost of $900,508. The scope of this project is so significantly different such that a comparison would not be appropriate for the purposes of this section.
	Total Capital & OM&A Costs Associated with REG Investments	
	(5.4.3.2.A. Seventh Bullet)	This project is not associated with REG investment; Capital and OM&A cost related to REG will not be incurred
	Leave to Construct Approval	
	(5.4.3.2.A. Eight Bullet)	This project does not require Leave to Construct approval under Section 92 of the OEB Act and therefore this does not apply
	5.4.3.2.B - Evaluation Criteria and Information Requirements	
EVALUATION CRITERIA AND INFORMATION REQUIREMENTS (5.4.3.2.B)	**Efficiency, Customer Value, Reliability (5.4.3.2.B.1)**	
	Section a)	
	Main Driver (Trigger)	Failure risk (associated with the end-of-life distribution assets) is the main driver of this project. See Section 4.1.2.2 of NBHDL's DSP for pole failure risk description. The poles in this line are currently 60 years of age and are in poor condition. Condition issues include wood pecker holes, shell rot, pole top deterioration, cracks, and footing displacements (leaning poles). Survival rate or end of life criteria is characterized by when a pole is deemed to no longer able to meet safety or functional requirements and is removed from service. In line with North Bay Hydro's Asset Lifecycle Optimization Practices (Section 3.3 of the DSP), this System Renewal project is necessary to efficiently sustain the ongoing reliability of electricity to customer on these feeders. Condition assessments which include the asset's age have classified these pole lines as poor condition. This is a concerning assessment because the distribution circuits on this line are the only feeders capable of carrying power to the north part of North Bay. As such, power can not be rerouted the restore the affected area in the event of a sustained interruption. This causes the over all reliability performance of these feeders to be amongst the worst in NBHDL's system with only the rural feeders (11F1, 17F1 & 17F2) performing worse. However, unlike those other rural feeders, these ones have more commercial customers. This line is also important to the Merrick Landfill Generation Facility as it is the sole feeder in which it can connect to NBHDL's distribution system.

Related Objectives/Performance Targets	NBHDL Corporate Mission, Vision and Core Values CV3 and CV4 (as identified in Exhibit 1).
Source and Nature of the Information Used to Justify the Investment	North Bay Hydro used Pole Inspection Data, the Asset Condition Report, GIS data, NBHDL's operating experience, and the Metsco Project Prioritization Tool / Model to justify and prioritize the investment.
Secondary Drivers	This project has two secondary drivers: Safety and Elimination of Maintaining Redundant Assets. The existing lines were designed with outdated standards that would not meet the rigor of present-day NBHDL safety standards in new construction. Poles are short and are under classed (weaker) These lines also contain old tie top type porcelain insulators on the 12.47 kV distribution circuit. A report released by ESA in 2017 titled "Mitigation of Pole Top Fires" shows porcelain insulators as the worst performers when it comes electrical current leakage (references CEA 265 D 748). In order for these insulators to maintain their insulation characteristics, they must not must not be contaminated or damaged through hairline cracks. However, as they age, there are subject to both electrical and mechanical failures where the tie can break away. This presents a worker and public safety issue. This project will take two circuits currently carried by two separate pole lines and combine them into one new pole line. This will eliminate the need to maintain a 1200m pole line that would otherwise provide no benefit to NBHDL's distribution system. This action will eliminate perpetual O&M costs associated with maintaining a line asset, increasing the operating efficiency of the system.
Related Objectives/Performance Targets	NBHDL Corporate Mission, Vision and Core Values CV2 and CV4 (as identified in Exhibit 1).
Source and Nature of the Information Used to Justify the Investment	North Bay Hydro uses it's GIS (asset data) information and experience as the source of information that identified the secondary drivers.
Section b)	
Reliability Planning and Resilient Distribution System Design	NBHDL adheres to good utility practice in ensuring that all projects are designed to be a part of resilient and reliable distribution system. This project will reduce the probability of equipment failure and will be built to far exceed the existing lines ability to withstand severe weather events. NBHDL acknowledges climate change and recognizes the possibility of an increase to severe weather events that may result. While these events can not be treated any degree of certainty, NBHDL's aging infrastructure would be potentially vulnerable if these events were to be realized.

Adaptation to Future Challenges	This project will be built with enough conductor ampacity to allow for future load growth. The spacing on the poles will allow for the installation of new equipment without the need to re-frame the pole. No other improvements have been deemed necessary for the adaptation to future challenges on this particular project.
Section c)	
Investment Priority Relative to Other Investments	Using the Metsco developed Project Planning Optimization Tool, of the 8 system renewal projects proposed for 2021 (Distribution System OH & UG Lines), the Hwy 11 North (Sunshine Ln to Berkley Blvd) Rebuild project ranks as **#2 in its prioritization**. Overall, this project is ranked as #5 in NBHDL's prioritization for all projects. The prioritization approach for which this rank is determined is outlined in the next section below. While individual projects are ranked according to their benefits, NBHDL will make its selection based on the group of projects that cumulatively offers the greatest benefit while operating within the planned budget and resourcing requirements for a given year. Cumulatively, the 8 projects planned for 2021 offers the greatest net benefit (highest score) compared to any other combination of projects proposed. See Section 4.2.2 of NBHDL's DSP for project prioritization approach.
Prioritization Approach	
Section d) **Analysis of the Project and Project Alternatives**	
Effect on System Operation Efficiency and Cost-Effectiveness (First Bullet)	This project will remove the need for an existing 1200m pole line, eliminating all perpetual O&M costs associated with that line and the need to rebuild once it reaches its end of life. There will also be a small reduction in line losses with larger conductor installed with the 3/0 ACSR conductor being replace with 336 kcmil Al.



This project will reduce the risk of failure and the associated increase to O&M costs as the line continues to age and deteriorate. See Section 4.1.2.2 of NBHDL's DSP for description on correlation between age of pole and maintenance activities.

Net Benefits Accruing to Customers (Second Bullet)

The avoidance of potentially adverse effects on reliability will also benefit customers. NBHDL expects that more customers will continue to work from given the current Covid 19 situation and outages can be a major inconvenience and a loss to productivity. It is NBHDL's position that reliable electricity to residential areas must be treated with greater significance due to the potential cultural shift of work from the office to the home. The same may apply to students and learning from home

This line also connects the Merrick Landfill Generating Station to NBHDL's system. Any outage on the 14F3 feeder will result in lost generating revenue.

An avoidance of increased maintenance costs and the reduction in line losses positively impacts the overall cost for the delivery of electricity.

Impact on Reliability Performance (Including on the Frequency and Duration of Outages) (Third Bullet)

A single interruption that lasts an hour on the 14F2 and 14F3 can contribute 0.024 & 0.014 to NBHDL's SAIDI / SAIFI metrics respectively. NBHDL does not have 24-hour staffing of its control room and has a line crew on call for emergencies outside of normal operating hours. As such, response and restoration times outside of normal operating hours take longer if a failure was to occur since switching orders to isolate the affected area can not be completed as quickly.

Project Alternatives

NBHDL has considered the following alternative to this project but has deemed them not to be viable options:

- Alternative #1 – Do Nothing
  This alternative involves not doing anything at this time and deferring the project or running the line to failure. This option will defer the cost of replacing the asset, however the existing line will continue to have its condition issues and the risk of failure will continue to increase every year it ages until it does actually fail or is reconstructed. Maintenance issues associated with the ageing and deteriorating line would be expected to increase year over year and cause the overall life cycle of the asset to be more expensive. See section 3 of the DSP. This line cannot be eliminated and is an important part of NBHDL's distribution system.

- Alternative #2 – Rebuild Both Existing Lines on Both Sides of the Highway
  This alternative involves treating both lines as separate projects and rebuilding each one individually in the same location as the existing lines. This would result in NBHDL continuing to have a line on both sides of the Highway. This would come with an overall increased cost as rebuilding two lines is more expensive than one and NBHDL will have to continue to maintain two lines, losing out on any savings realized from avoiding O&M costs of maintaining a line.

Deferring the project in favour for another project will result in overall lost benefit as determined by North Bay Hydro's Project Planning Optimization Tool (see section 5.4.3.2.B.1.c for Prioritization Approach.

Safety (5.4.3.2.B.2)

This project will eliminate hazards associated with deteriorating pole lines. The existing line does not meet the rigor of North Bay Hydro's present-day safety standards and includes under classed poles and inadequate conductor spacing and clearances. This project will also eliminate old porcelain insulators which have been known to perform poorly as they can lead to both electrical and mechanical failure of the insulator.

NBHDL has first hand experience with this when in 2019, an employee suffered an electrical shock while pulling out a nail at the base of the pole in the rain. There was a hair line crack on the insulator that cause the energization of the pole, but the leakage current was too small to be detected as a fault by the protective devices in NBHDL's system.

The degradation of the existing pole lines over time will lead to an increased probability of equipment failure that may result in a situation where live conductor may come into contact with the ground level, presenting a hazard to public safety.

Cyber-Security, Privacy (5.4.3.2.B.3)

Not applicable to this project

Co-ordination, Interoperability (5.4.3.2.B.4)

Section a)

Co-ordination with Utilities, Regional Planning and/or Links with 3rd Party Providers and/or Industry

SYSTEM RENEWAL SPECIFIC REQUIREMENTS (5.4.3.2.C.b)

Coordination with utilities, regional planning, third party providers, or other industries is not applicable to this project as the project is located in an area with no near future development plans.

Section b)

Enabling of Future Technological Functionality or Addressing of Future Operational Requirements

At this time, the project does not incorporate any future technological functionality (i.e. automated switches) in North Bay Hydro's distribution system. The new construction framing will provide at a minimum 3.2m of pole space between the phase conductors and the neutral to allow for the easy installation of future equipment.

Environmental Benefits (5.4.3.2.B.5)

The nature of this project does not impact the environment in any substantial manner other than the impacts associated with the manufacturing of the materials.

Conservation and Demand Management (5.4.3.2.B.6)

This project is not applicable to any rate funded conservation or demand program

Category-Specific Requirements - System Renewal (5.4.3.2.C.b.)

Relationship Between the Characteristics of Targeted Assets and the Consequences of Asset Performance Deterioration or Failure (5.4.3.2.C.b.First Bullet)

Asset Performance Targets and Asset Lifecycle Optimization Policies and Practices (First Sub-Bullet)

The existing line assets are at the end of their useful life at 60 years old and will result in an increase of the asset's lifecycle cost as the risk of failure increases. **See section 3.3 of the DSP for more information on Asset Life Cycle Optimization Policies and Practices.**

Asset Condition Relative to Typical Life Cycle (Second Sub-Bullet)

Inspection data has shown that the majority of the line is in the category of poor condition (low health index). Condition issues of this line are characteristic of a pole line of its age (60 years).

Number of Customers in Each Class Potentially Affected (Third Sub-Bullet)

Feeder / Station	Residential Customers	General Service Customers	Generation
14F2	530	60	
14F3	265	75	1 (Merrick Landfill GS)

Quantitative Customer Impact and Risk (Fourth Sub-Bullet)

North Bay Hydro collects outages statistics to analyze it distribution system performance on a feeder level with a particular focus on interruptions caused by defective equipment and tree contacts.

In 2019, the 14F2 distribution feeder experienced 1 momentary interruption and 5 sustained interruptions from equipment failure and tree contacts combined. This has increased from the 1 momentary interruption and 4 sustained interruptions in 2018 and 1 momentary interruption and 4 sustained interruptions in 2017. This information represents the entire feeder, not just the area of the proposed project.

In 2019, the 14F3 distribution feeder experienced 1 momentary interruption and 6 sustained interruptions from equipment failure and tree contacts combined. This has increased from the 5 momentary interruption and 4 sustained interruptions in 2018 and 1 momentary interruption and 3 sustained interruptions in 2017. This information represents the entire feeder, not just the area of the proposed project.

The most recent outage on this specific section of line occurred in June 2018 on the 14F3 circuit. An old lightning arrester failed and caused an outage affecting 350 customers for 1.5 hours.

Qualitative Customer Impact and Risk (Fifth Sub-Bullet)

The feeders on this line are lengthy and run up Highway 11 North for approximately 12km. NBHDL relies on information reported by customer call-ins to help identify issues on the line or locations where a fault may have occurred. Due to the location of this line which runs along a highway, it is less likely the public will be able to assist NBHDL is locating the cause of an outage. This means that NBHDL must often patrol this long feeder with out the assistance of street lights to find an issue. This can lead to longer outages as it often more difficult to find the issue.

Long outages lead to customer dissatisfaction and complaints. Business operations can be substantially impacted and customers who work from home also lose productivity from outages. This project will work towards ensuring that the line remains reliable and resilient to weather events, maintaining the overall performance of the feeder it carries.

Value of Customer Impact (Sixth Sub-Bullet)

The customer impact in terms of the potential failure is medium. These two lines supply residential and commercial properties. Financial consequences can potentially be incurred by these customers when outages occur as a result of failures.

The 14F3 circuit is also what connects the Merrick Landfill GS to NBHDL's distribution system. Any momentary or sustained interruption will cause it to trip off and requires an operator to make a trip to the site before it can be reconnected.

NBHDL acknowledges that there may be a cultural shift of working from the office to working from home due to the current Covid 19 situation. This means that residential areas and home may be impacted similar to business in a lost of productivity.

Other Factors Affecting Project Timing (5.4.3.2.C.b.Second Bullet)

Proposed developments that are made known to NBHDL before the commencement of construction may impact the project timing such as a need to have the line redesigned for a 44kV line extension or other demand considerations. NBHDL does not currently have any information to suggest this is a likely scenario, however NBHDL acknowledges that it may be a possibility solely based on the availability of land for development in this area.

Consequences for System O&M costs (5.4.3.2.C.b.Third Bullet)

This project will reduce the risk of equipment failure and trouble calls in line with general system renewal projects. The 12.47 kV distribution circuits will be replaced with a larger conductor, reducing lines losses. The existing line with the degradation of its assets may no longer be able to withstand multiple severe weather events with out further damage.

It will also remove a 1200m pole line and eliminate the need for perpetual O&M cost associated with it.

Maintenance actions and associated costs will trend upwards as the pole line continues to age (see section 5.4.3.2.B.1.d).

Reliability and Safety Factors (5.4.3.2.C.b.Fourth Bullet)

This project will not have a material impact on improving the system reliability, but there will have a detrimental impact on system reliability if the project is not implemented. The impacts on public safety and the elimination of potential hazards were considered as factors to the importance of the project (See section 5.4.3.2.B.2 above)

Analysis of Project Benefits and Timing (5.4.3.2.C.b.Fifth Bullet)

North Bay Hydro uses a Project Planning Optimization Tool developed by Metsco to assess the benefits of its capital projects and uses that information to organize the most appropriate timing of its projects (see section 5.4.3.2.B.1.c for prioritization approach). For system renewal projects, the reduction of the risk cost (probability of failure vs the consequence of failure) and the optimization of the total life cycle cost for the asset is the main consideration for project benefits and prioritization. The timing of the proposed projects has been planned in a manner to maximize investment benefits.

North Bay Hydro acknowledges Climate Change and recognizes the potential impacts to its distribution system. As a primarily overhead system, North Bay Hydro must continue to design and operate its system (new projects & investments) to be able to withstand severe weather conditions (adherence to CSA design standards is a minimum). The large amount of existing aging overhead infrastructure (refer to ACA Report) however, through the degradation of the assets, is losing its ability to withstand repeated severe weather events. North Bay Hydro must ensure that its system is not crippled by weather events and as such, the urgency and importance investing in system renewal projects has increased.

Like for Like Renewal Analysis (5.4.5.2.C.b.Sixth Bullet)

Like for like renewal is not being proposed and as such, like for like analysis is not applicable.

GENERAL INFORMATION ON THE PROJECT/PROGRAM (5.4.3.2.A)

2021 Capital Project Summary

5.4.3.2.A - General Information on the Project / Program

Project Name	Ski Club Rd Part 3 (Chapais St to O'Brien St) Line Rebuild	
Investment Category	System Renewal	
Project Description	The Ski Club Rd (Part 3) Line Rebuild project is the final phase of a three-year construction project to rebuild Ski Club Rd. It consists of the design, construction, and installation of a new overhead pole line along Ski Club Rd from Chapais St to O'Brien St. The length of the line will be approximately 1100m and will consist of the installation of 20 new composite poles. It will carry a three phase 12.47kV distribution circuit (built to 15kV standards). Ski Club Rd has a high occurrence of wood pecker damage on poles and as such, composite poles were chosen as the pole material due to its resistance to wood pecker damage among other benefits. The existing pole line that will be replaced is far past its useful life at 65 years old and are in poor condition with sub standard design elements. It is amongst some of the oldest poles in NBHDL's system. Condition issues include wood pecker holes, shell rot, pole top deterioration, cracks, and footing displacements (leaning poles). The poles are undersized and under classed The existing poles are undersized / under classed (weaker) as well with porcelain type insulators. It also contains open bus secondary and neutral conductors on cross arms next to primary conductors which is sub standard design.	
Capital Investment		
(5.4.3.2.A. First Bullet)	Gross Capital	$201,271
	O&M Costs (if applicable)	$0.00
(5.4.3.2.A. Second Bullet)	Capital Contributions	$0.00
	Net Capital	$201,271
Customer Attachments/Load (kVA)		
(5.4.3.2.A. Third Bullet)	Customer Attachments (#):	72
	Customer Load (peak KVA)	500 Load Supplied Through Line
Project Timing		
(5.4.3.2.A. Forth Bullet)	Start Date	January 2020 (Engineering) November 2020 (Construction)

Expected In-Service Date	April 2021		
Expenditure Timing	Q1:	100%	$201,271
	Q2:	0%	$0
	Q3:	0%	$0
	Q4:	0%	$0

Risk and Risk Mitigation

(5.4.3.2.A. Fifth Bullet)

This project has minimal risk that may affect the implementation of it as planned. The most significant risk to the project's would be if any issues arise in obtaining the municipal approvals. North Bay Hydro understands the scope of this project and has built a project schedule with key milestone dates to be achieved to keep the project on track. It will be managed by North Bay Hydro's internal project management process which includes update meetings, progress tracking, and developed action plans.

The engineering design, customer consultations, and the administrative work (municipal approvals, etc.) for the project is currently scheduled to be completed by the end of the third quarter of 2020 with construction starting in the fourth quarter of 2020. It is expected that this project will only have the poles installed by the end of 2020 and the remaining portion of the project will carry over into 2021.

North Bay Hydro has also built into its schedule a buffer to allow for any unexpected issues which may cause delay to the construction start date. However, once construction starts, delays caused by equipment breakdowns, severe weather events (climate change), and sudden change in staffing resources can not always be mitigated.

Comparative Information

(5.4.3.2.A. Sixth Bullet)

NBHDL recognizes that the different combinations in the number of poles installed, length and size of conductors installed, number and type of switching devices installed, number and sizes of transformers installed, number of services, line angles and anchoring installed, as well as other design considerations makes all projects unique. Construction methods and equipment may vary depending on location, geography, subterranean conditions, and season as well. All of which affect the cost of a project.

For cost comparison purposes, NBHDL has determined that each of its past project contains enough variability in their design and construction such that no single project could be used to benchmark the cost of another single project appropriately. Instead, for overhead lines, NBHDL uses multiple historic projects (last 10 years) involving the construction of similar infrastructure to determine an average cost per pole installed. The average per pole cost for a three phase 12.47kV distribution line is $19,800.

At a total project cost of $405,466 with 20 poles to be installed, the estimated per pole cost of the Ski Club Part 3 Rebuild project is $20,273, approximately 2% higher than the average.

	Total Capital & OM&A Costs Associated with REG Investments	
	(5.4.3.2.A. Seventh Bullet)	This project is not associated with REG investment; Capital and OM&A cost related to REG will not be incurred
	Leave to Construct Approval	
	(5.4.3.2.A. Eight Bullet)	This project does not require Leave to Construct approval under Section 92 of the OEB Act and therefore this does not apply
	5.4.3.2.B - Evaluation Criteria and Information Requirements	
EVALUATION CRITERIA AND INFORMATION REQUIREMENTS (5.4.3.2.B)	**Efficiency, Customer Value, Reliability (5.4.3.2.B.1)**	
	Section a)	
	Main Driver (Trigger)	Failure risk (associated with the end of life distribution assets) is the main driver of this project. See Section 4.1.2.2 of NBHDL's DSP for pole failure risk description. The poles in this line are currently 65 years of age and are in poor condition. Condition issues include wood pecker holes, shell rot, pole top deterioration, cracks, and footing displacements (leaning poles). In line with North Bay Hydro's Asset Lifecycle Optimization Practices (Section 3.3 of the DSP), this System Renewal project is necessary to efficiently sustain the ongoing reliability of electricity to customer on these feeders. Condition assessments which includes the asset's age have classified these pole lines as poor condition.
	Related Objectives/Performance Targets	NBHDL Corporate Mission, Vision and Core Values CV3 and CV4 (as identified in Exhibit 1).
	Source and Nature of the Information Used to Justify the Investment	North Bay Hydro used Pole Inspection Data, the Asset Condition Report, and the Metsco Project Prioritization Tool / Model to justify and prioritize the investment.

Secondary Drivers	The secondary driver for this project is safety. As with many older pole lines, the existing line was designed with outdated standards that would not meet the rigor of present-day NBHDL safety standards in new construction. Poles are short, which leads to less than adequate equipment spacing and clearances and are under classed (weaker). This line also has the neutral conductor mounted on the cross arms next to the high voltage distribution conductors. Not only is the spacing inadequate, but it also creates a situation where workers must come into close proximity of these conductors when accessing the neutral. Although NBHDL workers are trained and qualified to work in proximity to high voltage conductors, its preferable to keep a safe distance when working in risk mitigation. These lines also contain old tie top type porcelain insulators on the 12.47 kV distribution circuit. A report released by ESA in 2017 titled "Mitigation of Pole Top Fires" shows porcelain insulators as the worst performers when it comes electrical current leakage (references CEA 265 D 748). In order for these insulators to maintain their insulation characteristics, they must not must not be contaminated or damaged through hairline cracks. However, as they age, there are subject to both electrical and mechanical failures where the tie can break away. This presents a worker and public safety issue. The project will also correct aerial trespassing of secondary services. An aerial trespass is when a secondary service wire crosses over the private property of a customer to reach another customer. NBHDL as a standard practice will correct these trespasses when encountered, however, the condition of the existing lines open wire secondary bus makes this infeasible and services are limited to coming off a pole. This project will install a spun bus secondary which is an aesthetical improvement and will allow services to be attached directly to the bus.
Related Objectives/Performance Targets	NBHDL Corporate Mission, Vision and Core Values CV2 and CV4 (as identified in Exhibit 1).
Source and Nature of the Information Used to Justify the Investment	North Bay Hydro uses it's GIS (asset data) information and experience as the source of information that identified the secondary drivers.

Section b)

Reliability Planning and Resilient Distribution System Design

NBHDL adheres to good utility practice in ensuring that all projects are designed to be a part of resilient and reliable distribution system. This project will reduce the probability of equipment failure and will be built to exceed the existing lines ability to withstand severe weather events.

NBHDL acknowledges climate change and recognizes the possibility of an increase to severe weather events that may result. While these events can not be treated any degree of certainty, NBHDL's aging infrastructure would be potentially vulnerable if these events were to be realized.

This project will also be built using composite poles (RS Poles) that offer the following benefits over wood poles

- Useful service life of 80 Years (ASTM G154 tested)
- Manufacturer warranty of 43 years
- Engineered product – Quality Control
- Not susceptible to Insect / wood pecker damage
- Not affected by moisture
- Fire resistant (performance tested by RS)
- Cannot be scaled easily by wildlife (squirrels)
- Light weight - Less worker and equipment wear
- Poles are straight, no need to align "hooks"
- Easily cleaned and resistant to staples
- Does not require pole testing program

NBHDL has performed a cost / benefit analysis on using composite poles in rebuilding of the Ski Club Rd (Part 1, 2, and 3) in its system. That analysis demonstrated that composite poles offer more benefit and are actually more cost effective compared to wood poles over the life cycle of the asset. Since composite poles last much longer than wood poles, the cost per year of service is less.

Using pole inspection data collected from the field, NBHDL sampled wood poles in areas that have been observed to have a high frequency of wood pecker damage, deemed as wood pecker "hot spots". NBHDL discovered that approximately 43% of wood poles located in wood pecker "hot spots" had some form of wood pecker damage to varying degrees. On average, NBHDL estimates that approximately 8% of service life will be lost on these poles due to early replacement from wood pecker damage. NBHDL as a standard practice will use composite poles for all 44kV sub-transmission lines in wood pecker "hot spots" to protect its assets from this damage, however, it will also use composite poles on 12.47 kV distribution circuits where the existing line has shown substantial wood pecker damage or in a environment where poles have excessive rot due to high moisture. Ski Club Rd has been deemed a wood pecker "hot spot" area.

Adaptation to Future Challenges	This project will be built with enough conductor ampacity to allow for future load growth. The spacing on the poles will allow for the installation of new equipment without the need to re-frame the pole. The poles will tall enough that the line can be three phased if required with out replacing the poles. This line services a residential area with limited potential for further development and as such, NBHDL does not anticipate any substantial load growth; however, NBHDL does consider the potential impact of electric vehicles and recognizes that residential areas may see higher peak demands as a result.
Section c)	
Investment Priority Relative to Other Investments	Using the Metsco developed Project Planning Optimization Tool, of the 8 system renewal projects proposed for 2021 (Distribution System OH & UG Lines), the Ski Club Rd Part 3 Rebuild project ranks as **#5 in its prioritization**. Overall, this project is ranked as #8 in NBHDL's prioritization for distribution line projects. However, since this project is part of a three phase rebuild of Ski Club Rd, commencement of this project will start upon completion of phase two in 2020 to avoid the community being subjected to prolonged construction activities. Phase 2 of the Ski Club Rd Rebuild was ranked as #1 in 2020 overall. While individual projects are ranked according to their benefits, NBHDL will make its selection based on the group of projects that cumulatively offers the greatest benefit while operating within the planned budget and resourcing requirements for a given year. Cumulatively, the 8 projects planned for 2021 offers the greatest net benefit (highest score) compared to any other combination of projects proposed.
Prioritization Approach	Prioritization Approach See Section 4.2.2 of NBHDL's DSP for project prioritization approach.
Section d) **Analysis of the Project and Project Alternatives**	

Effect on System Operation Efficiency and Cost-Effectiveness (First Bullet)	This project will reduce the risk of failure and the associated increase to O&M costs as the line continues to age and deteriorate. See Section 4.1.2.2 of NBHDL's DSP for description on correlation between age of pole and maintenance activities. There will also be a small reduction in line losses with larger conductor installed with the 3/0 ACSR conductor being replace with 336 kcmil Al.
Net Benefits Accruing to Customers (Second Bullet)	The avoidance of potentially adverse effects on reliability will also benefit customers. An avoidance of increased maintenance costs and the reduction in line losses positively impacts the overall cost for the delivery of electricity.
Impact on Reliability Performance (Including on the Frequency and Duration of Outages) (Third Bullet)	This project will avoid an adverse impact to the reliability performance of this line. This line is serves as a tie (open point) in between two feeders, the 13F3 and 14F1. A single interruption that lasts an hour on the 13F3 and 14F1 feeder can contribute 0.031 and 0.024 to NBHDL's SAIDI / SAIFI metrics respectively. NBHDL does not have 24-hour staffing of its control room and has a line crew on call for emergencies outside of normal operating hours. As such, response and restoration times outside of normal operating hours take longer if a failure was to occur since switching orders to isolate the affected area can not be completed as quickly.
Project Alternatives	NBHDL has considered the following alternative to this project but has deemed them not to be viable options: • <u>Alternative #1 – Do Nothing</u> This alternative involves not doing anything at this time and deferring the project or running the line to failure. This option will defer the cost of replacing the asset, however the existing line will continue to have its condition issues and the risk of failure will continue to increase every year it ages until it does actually fail or is reconstructed. Maintenance issues associated with the ageing and deteriorating line would be expected to increase year over year and cause the overall life cycle of the asset to be more expensive. See section 3 of the DSP. This line cannot be eliminated and is an important part of NBHDL's distribution system. • <u>Alternative #2 – Build with Wood Poles</u> This alternative will involves constructing the project with the same design, but using wood poles instead of composite. NBHDL has performed a cost / benefit analysis and composite poles offer greater benefits and are less expensive over the life

cycle of the asset. The wood poles would be subjected to wood pecker damage which has been problematic for NBHDL. Wood poles offer no benefit in this project as a building material.

Deferring the project in favour for another project will result in overall lost benefit as determined by North Bay Hydro's Project Planning Optimization Tool (see section 5.4.3.2.B.1.c for Prioritization Approach.

Safety (5.4.3.2.B.2)

This project will eliminate hazards associated with deteriorating pole lines. The existing line does not meet the rigor of North Bay Hydro's present-day safety standards and includes under classed poles and inadequate conductor spacing and clearances. This project will also eliminate old porcelain insulators which have been known to perform poorly as they can lead to both electrical and mechanical failure of the insulator.

NBHDL has first hand experience with this when in 2019, an employee suffered an electrical shock while pulling out a nail at the base of the pole in the rain. There was a hair line crack on the insulator that caused the energization of the pole, but the leakage current was too small to be detected as a fault by the protective devices in NBHDL's system.

This project will also eliminate the neutral on the cross arm which places workers needlessly close to the high voltage conductors when they require access to it, mitigating the worker safety risk.

The degradation of the existing pole lines over time will lead to an increased probability of equipment failure that may result in a situation where live conductor may come into contact with the ground level, presenting a hazard to public safety.

Cyber-Security, Privacy (5.4.3.2.B.3)

Not applicable to this project

Co-ordination, Interoperability (5.4.3.2.B.4)

Section a)

Co-ordination with Utilities, Regional Planning and/or Links with 3rd Party Providers and/or Industry

Coordination with utilities, regional planning, third party providers, or other industries is not applicable to this project as the project is located in the middle of North Bay Hydro's service territory and is in an area with no future development plans.

Section b)

Enabling of Future Technological Functionality or Addressing of Future Operational Requirements

At this time, the project does not incorporate any future technological functionality (i.e. automated switches) in North Bay Hydro's distribution system. The new construction framing will provide at a minimum 3.2m of pole space between the phase conductor and the neutral to allow for the easy installation of future equipment.

Environmental Benefits (5.4.3.2.B.5)

The nature of this project does not impact the environment in any substantial manner other than the impacts associated with the manufacturing of the materials.

Conservation and Demand Management (5.4.3.2.B.6)

This project is not applicable to any rate funded conservation or demand program

SYSTEM RENEWAL SPECIFIC REQUIREMENTS (5.4.3.2.C.b)

Category-Specific Requirements - System Renewal (5.4.3.2.C.b.)

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Relationship Between the Characteristics of Targeted Assets and the Consequences of Asset Performance Deterioration or Failure (5.4.3.2.C.b.First Bullet)

Asset Performance Targets and Asset Lifecycle Optimization Policies and Practices (First Sub-Bullet)

The existing line assets are at the end of their useful life at 65 years old and will result in an increase of the asset's lifecycle cost as the risk of failure increases. **See section 3.3 of the DSP for more information on Asset Life Cycle Optimization Policies and Practices.**

Asset Condition Relative to Typical Life Cycle (Second Sub-Bullet)

Inspection data has shown that the majority of the line is in the category of poor condition (low health index). Condition issues identified on this line such shell rot, pole top deterioration, deep cracks, and footing displacements are characteristic of very old wood pole lines such as this one (60 years). Wood poles in NBHDL's system are also subjected to a regional condition issue which is damage suffered from wood peckers, more specifically, the Pileated Woodpecker which is particularly destructive and leaves large cavities in poles which shortens their life spans.

Number of Customers in Each Class Potentially Affected (Third Sub-Bullet)

Feeder / Station	Residential Customers	General Service Customers
13F3	684	76
14F1	530	60

Quantitative Customer Impact and Risk (Fourth Sub-Bullet)

North Bay Hydro collects outages statistics to analyze it distribution system performance on a feeder level with a particular focus on interruptions caused by defective equipment and tree contacts.

In 2019, the 13F3 distribution feeder experienced 5 momentary interruption and 3 sustained interruptions from equipment failure and tree contacts combined. This has increased from the 0 momentary interruptions and 0 sustained interruptions in 2018 and 0 momentary interruption and 0 sustained interruption in 2017. This information represents the entire feeder, not just the area of the proposed project.

In 2019, the 14F1 distribution feeder experienced 1 momentary interruption and 1 sustained interruption from equipment failure and tree contacts combined. There were 3 momentary interruptions and 1 sustained interruption in 2018 and 1 momentary interruption and 3 sustained interruption in 2017. This information represents the entire feeder, not just the area of the proposed project.

NBHDL does not have a record of an outage on this particular line in the last 3 years other than 2 under ground service faults (cable burn offs).

Qualitative Customer Impact and Risk (Fifth Sub-Bullet)

Long outages lead to customer dissatisfaction and complaints. Customers who work from home also lose productivity from outages, which may be more common due to the current Covid 19 situation. This project will work towards ensuring that the line remains reliable and resilient to weather events, maintaining the overall performance of the feeder it carries.

The 14F1 feeder services traffic lights were an outage could cause a significate traffic disruption. Police often must be dispatch to direct traffic in these events.

This line also services a high school where long outages may cause a school closure; however, the school may potentially be closed down for the 2021 school year.

Value of Customer Impact (Sixth Sub-Bullet)

The customer impact in terms of the potential failure is low. This line services a residential area where outages may not be majorly disruptive. However, the reliable of service is still important to these customer and outages can be major inconveniences depending on the time in which they occur. NBHDL acknowledges that there may be a cultural shift of working from the office to working from home due to the current Covid 19 situation. This means that residential areas and home may be impacted similar to business in a lost of productivity.

NBHDL does not keep track of residential customers who rely on medical equipment (such as oxygen systems), however in NBHDL's operating experience when scheduling outages and communicating with customers, NBHDL has encountered some customers who have expressed an important reliance on power for this reason.

Other Factors Affecting Project Timing (5.4.3.2.C.b.Second Bullet)

At this time, there are no other factors affect this projects timing.

Consequences for System O&M costs (5.4.3.2.C.b.Third Bullet)

This project will reduce the risk of equipment failure and trouble calls in line with general system renewal projects. The 12.47 kV distribution circuits will be replaced with a larger conductor, slightly reducing line losses. The existing line with the degradation of its assets may no longer be able to withstand multiple severe weather events with out further damage.

Maintenance actions and associated costs will trend upwards as the pole line continues to age (see section 5.4.3.2.B.1.d).

Reliability and Safety Factors (5.4.3.2.C.b.Fourth Bullet)

This project will not have a material impact on improving the system reliability, but there will have a detrimental impact on system reliability if the project is not implemented. The impacts on public safety and the elimination of potential hazards were considered as factors to the importance of the project (See section 5.4.3.2.B.2 above)

Analysis of Project Benefits and Timing (5.4.3.2.C.b.Fifth Bullet)

North Bay Hydro uses a Project Planning Optimization Tool developed by Metsco to assess the benefits of its capital projects and uses that information to organize the most appropriate timing of its projects (see section 5.4.3.2.B.1.c for prioritization approach). For system renewal projects, the reduction of the risk cost (probability of failure vs the consequence of failure) and the optimization of the total life cycle cost for the asset is the main consideration for project benefits and prioritization. The timing of the proposed projects have been planned in a manner to maximize investment benefits.

North Bay Hydro acknowledges Climate Change and recognizes the potential impacts to its distribution system. As a primarily overhead system, North Bay Hydro must continue to design and operate its system (new projects & investments) to be able to withstand severe weather conditions (adherence to CSA design standards is a minimum). The large amount of existing aging overhead infrastructure (refer to ACA Report) however, through the degradation of the assets, is losing its ability to withstand repeated severe weather events. North Bay Hydro must ensure that its system is not crippled by weather events and as such, the urgency and importance investing in system renewal projects has increased.

Like for Like Renewal Analysis (5.4.5.2.C.b.Sixth Bullet)

Like for like renewal analysis of this project is not applicable as this project has not been configured at an extra cost to address other distributor planning objectives. This project has been configured solely to meet the requirement.

2021 Capital Project Summary

5.4.3.2.A - General Information on the Project / Program

GENERAL INFORMATION ON THE PROJECT/PROGRAM (5.4.3.2.A)

Project Name

Dane Ave - Line Rebuild

Investment Category

System Renewal

Project Description

The Dane Ave Line Rebuild project consists of the design, construction, and installation of a new overhead pole line along Dane Ave from Chapais St to Frost St. The length of the line will be approximately 450m and will consist of the installation of 10 new poles. It will carry a single phase 7.2kV distribution circuit (built to 15kV standards)

The existing pole line that will be replaced is far past its useful life at 65 years old and are in poor condition with sub standard design elements. It is amongst some of the oldest poles in NBHDL's system. Condition issues include wood pecker holes, shell rot, pole top deterioration, cracks, and footing displacements (leaning poles). The poles are undersized and under classed as well with porcelain type insulators.

This project will fix 17 servicing issues of "Alley Jumped" services in which an over head service hits a building and then another over head service comes off the building to hit the adjacent building from it (jumps from building to building). This creates aerial trespasses and presents challenges to accommodate service upgrade requests with out NBHDL having to initiate work on the adjacent owner's customer owned servicing equipment. This turns what would normally be a simple request into a project that requires coordination with multiple customers and electrical contractors. Correcting these issues all at once with this project will be more efficient and save on engineering service resources.

It will also involve fixing 4 underground services which are "T" spliced which causes all customers being disconnected if one customer needs a disconnect to work on their servicing equipment.

Capital Investment

(5.4.3.2.A. First Bullet)

Gross Capital	$177,414
O&M Costs (if applicable)	$0.00

(5.4.3.2.A. Second Bullet)

Capital Contributions	$0.00
Net Capital	$177,414

Customer Attachments/Load (kVA)

(5.4.3.2.A. Third Bullet)

Customer Attachments (#):	45
Customer Load (peak KVA)	160 (Load Supplied Through Line)

Project Timing

(5.4.3.2.A. Forth Bullet)

Start Date	February 2020 (Engineering)		
	April 2021 (Construction)		
Expected In-Service Date	September 2021		
Expenditure Timing	Q1:	0%	$0
	Q2:	80%	$141,931
	Q3:	20%	$35,483
	Q4:	0%	$0

Risk and Risk Mitigation

(5.4.3.2.A. Fifth Bullet)

This project has minimal risk that may affect the implementation of it as planned. The most significant risk to the project's would be if any issues arise in obtaining the municipal approvals. NBHDL understands the scope of this project and has built a project schedule with key milestone dates to be achieved to keep the project on track.

It will be managed by North Bay Hydro's internal project management process which includes update meetings, progress tracking, and developed action plans. The engineering design, customer consultations, and the administrative work (municipal approvals, etc.) for the project is currently scheduled to be completed by the end of the prior year (2020).

North Bay Hydro has also built into its schedule a buffer to allow for any unexpected issues which may cause delay to the construction start date. However, once construction starts, delays caused by equipment breakdowns, severe weather events (climate change), and sudden change in staffing resources can not always be mitigated.

Comparative Information

(5.4.3.2.A. Sixth Bullet)

NBHDL recognizes that the different combinations in the number of poles installed, length and size of conductors installed, number and type of switching devices installed, number and sizes of transformers installed, number of services, line angles and anchoring installed, as well as other design considerations makes all projects unique. Construction methods and equipment may vary depending on location, geography, subterranean conditions, and season as well. All of which affect the cost of a project.

For cost comparison purposes, NBHDL has determined that each of its past project contains enough variability in their design and construction such that no single project could be used to benchmark the cost of another single project appropriately. Instead, for overhead lines, NBHDL uses multiple historic projects (last 10 years) involving the construction of similar infrastructure to determine an average cost per pole installed. The average per pole cost for a single-phase distribution pole is $14,341 per pole.

At a project cost $177,414 with 10 poles to be installed, the estimated per pole cost of the Dane Ave Rebuild project is $17,741, approximately 24% higher than the average. This increased cost over the average is attributed to the following reasons:

		• The fixing of "alley jumped" services, which is not typical in the average line rebuild and comes with addition cost • The redesign of the underground secondary to correct the "T-Splicing" issue, which again is not typical in the average rebuild.
	Total Capital & OM&A Costs Associated with REG Investments	
	(5.4.3.2.A. Seventh Bullet)	This project is not associated with REG investment; Capital and OM&A cost related to REG will not be incurred
	Leave to Construct Approval	
	(5.4.3.2.A. Eight Bullet)	This project does not require Leave to Construct approval under Section 92 of the OEB Act and therefore this does not apply
	5.4.3.2.B - Evaluation Criteria and Information Requirements	
EVALUATION CRITERIA AND INFORMATION REQUIREMENTS (5.4.3.2.B)	**Efficiency, Customer Value, Reliability (5.4.3.2.B.1)**	
	Section a)	
	Main Driver (Trigger)	Failure risk (associated with the end of life distribution assets) is the main driver of this project. See Section 4.1.2.2 of NBHDL's DSP for pole failure risk description. The poles in this line are currently 65 years of age and are in poor condition. Condition issues include wood pecker holes, shell rot, pole top deterioration, cracks, and footing displacements (leaning poles). In line with North Bay Hydro's Asset Lifecycle Optimization Practices (Section 3.3 of the DSP), this System Renewal project is necessary to efficiently sustain the ongoing reliability of electricity to customer on these feeders. Condition assessments which includes the asset's age have classified these pole lines as poor condition.
	Related Objectives/Performance Targets	NBHDL Corporate Mission, Vision and Core Values CV3 and CV4 (as identified in Exhibit 1).
	Source and Nature of the Information Used to Justify the Investment	North Bay Hydro used Pole Inspection Data, the Asset Condition Report, it's operating experience, and the Metsco Project Prioritization Tool / Model to justify and prioritize the investment.

Secondary Drivers	This project has two secondary drivers: Safety and Servicing Issues. As with many older pole lines, the existing lines were designed with outdated standards that would not meet the rigor of present-day NBHDL safety standards in new construction. Poles are short which leads to less than adequate equipment spacing and clearances and are under classed (weaker). These lines also contain old tie top type porcelain insulators on the 7.2 kV distribution circuit. A report released by ESA in 2017 titled "Mitigation of Pole Top Fires" shows porcelain insulators as the worst performers when it comes electrical current leakage (references CEA 265 D 748). In order for these insulators to maintain their insulation characteristics, they must not must not be contaminated or damaged through hairline cracks. However, as they age, there are subject to both electrical and mechanical failures where the tie can break away. This presents a worker and public safety issue. The project will also fix servicing issues presented by 17 "Alley Jumped" over head services and 4 "T - Spliced" underground services. T-Spliced under ground services are secondary conductors that are direct buried and have services going to meter bases that are connected directly to the main cable. This creates an issue which ties all the services that have been to "T-Spliced" to the cable to have a single connection point to the secondary system. This is an issue for two reasons. 1. Customers cannot upgrade their services due to the limited capacity of the main cable and 2. when one service needs to be disconnected to isolate service equipment, all customers have to be disconnected. This puts NBHDL in a position where customer will have an outage forced on them or the service requests must be denied until the servicing can be redone. Alley Jumped services are services in which an over head service hits a building and then another over head service comes off the building to hit the adjacent building from it (jumps from building to building). This creates aerial trespasses and presents challenges to accommodate service upgrade requests with out NBHDL having to initiate work on the adjacent owner's customer owned servicing equipment. This turns what would normally be a simple request into a project that requires coordination with multiple customers and electrical contractors. Correcting these issues all at once with this project will be more efficient and save on engineering service resources. Upgrading a service from 100A to 200A is typically a requirement to accommodate electric vehicle chargers which are becoming more common.
Related Objectives/Performance Targets	NBHDL Corporate Mission, Vision and Core Values CV2 and CV4 (as identified in Exhibit 1).
Source and Nature of the Information Used to Justify the Investment	North Bay Hydro uses it's GIS (asset data) information and experience as the source of information that identified the secondary drivers.
Section b)	

Reliability Planning and Resilient Distribution System Design	NBHDL adheres to good utility practice in ensuring that all projects are designed to be a part of resilient and reliable distribution system. This project will reduce the probability of equipment failure and will be built to far exceed the existing lines ability to withstand severe weather events. This project will also correct poor design element such a "T-Spliced" and "Alley Jumped" secondary servicing that challenges to accommodated service request such as upgrades and disconnects. NBHDL acknowledges climate change and recognizes the possibility of an increase to severe weather events that may result. While these events can not be treated any degree of certainty, NBHDL's aging infrastructure would be potentially vulnerable if these events were to be realized.
Adaptation to Future Challenges	This project will be built with enough conductor ampacity to allow for future load growth. The spacing on the poles will allow for the installation of new equipment without the need to re-frame the pole. The poles will be tall enough that the line can be three phased if required with out replacing the poles. This line services a residential area with limited potential for further development and as such, NBHDL does not anticipate any substantial load growth; however, NBHDL does consider the potential impact of electric vehicles and recognizes that residential areas may see higher peak demands as a result.
Section c)	
	Using the Metsco developed Project Planning Optimization Tool, of the 8 system renewal projects proposed for 2021 (Distribution System OH & UG Lines), the Dane Ave Rebuild project ranks as **#7 in its prioritization**. Overall, this project is ranked as #11 in NBHDL's prioritization for distribution line projects.
Investment Priority Relative to Other Investments	While individual projects are ranked according to their benefits, NBHDL will make its selection based on the group of projects that cumulatively offers the greatest benefit while operating within the planned budget and resourcing requirements for a given year. Cumulatively, the 8 projects planned for 2021 offers the greatest net benefit (highest score) compared to any other combination of projects proposed.

Prioritization Approach	See Section 4.2.2 of NBHDL's DSP for project prioritization approach.
Section d) **Analysis of the Project and Project Alternatives**	
Effect on System Operation Efficiency and Cost-Effectiveness (First Bullet)	This project will reduce the risk of failure and the associated increase to O&M costs as the line continues to age and deteriorate. See Section 4.1.2.2 of NBHDL's DSP for description on correlation between age of pole and maintenance activities. There will also be a small reduction in line losses with larger conductor installed
Net Benefits Accruing to Customers (Second Bullet)	Customers on this line will see benefit in NBHDL's ability to effectively accommodate servicing requests such as upgrades and disconnects. Customers will be also unaffected by servicing work required by their neighbors. An avoidance of increased maintenance costs and the reduction in line losses positively impacts the overall cost for the delivery of electricity.
Impact on Reliability Performance (Including on the Frequency and Duration of Outages) (Third Bullet)	This project will avoid an adverse impact to the reliability performance of this line. This line is part of the 20F2 feeder. A single interruption that lasts an hour on this feeder can contribute 0.025 to NBHDL's SAIDI / SAIFI metrics respectively. NBHDL does not have 24-hour staffing of its control room and has a line crew on call for emergencies outside of normal operating hours. As such, response and restoration times outside of normal operating hours take longer if a failure was to occur since switching orders to isolate the affected area can not be completed as quickly.

Project Alternatives

NBHDL has considered the following alternative to this project but has deemed them not to be viable options:

- Alternative #1 – Do Nothing
  This alternative involves not doing anything at this time and deferring the project or running the line to failure. This option will defer the cost of replacing the asset, however the existing line will continue to have its condition issues and the risk of failure will continue to increase every year it ages until it does actually fail or is reconstructed. It will also not address and of the servicing issue present in the existing line

  Maintenance issues associated with the ageing and deteriorating line would be expected to increase year over year and cause the overall life cycle of the asset to be more expensive. See section 3 of the DSP. This line cannot be eliminated and is an important part of NBHDL's distribution system.

Deferring the project in favour for another project will result in overall lost benefit as determined by North Bay Hydro's Project Planning Optimization Tool (see section 5.4.3.2.B.1.c for Prioritization Approach.

Safety (5.4.3.2.B.2)

This project will eliminate hazards associated with deteriorating pole lines. The existing line does not meet the rigor of North Bay Hydro's present-day safety standards and includes under classed poles and inadequate conductor spacing and clearances. This project will also eliminate old porcelain insulators which have been known to perform poorly as they can lead to both electrical and mechanical failure of the insulator.

NBHDL has first hand experience with this when in 2019, an employee suffered an electrical shock while pulling out a nail at the base of the pole in the rain. There was a hair line crack on the insulator that caused the energization of the pole, but the leakage current was too small to be detected as a fault by the protective devices in NBHDL's system.

The degradation of the existing pole lines over time will lead to an increased probability of equipment failure that may result in a situation where live conductor may come into contact with the ground level, presenting a hazard to public safety.

Cyber-Security, Privacy (5.4.3.2.B.3)

Not applicable to this project

Co-ordination, Interoperability (5.4.3.2.B.4)

Section a)

Co-ordination with Utilities, Regional Planning and/or Links with 3rd Party Providers and/or Industry

Coordination with utilities, regional planning, third party providers, or other industries is not applicable to this project as the project is located in the middle of North Bay Hydro's service territory and is in an area with no future development plans.

Section b)

Enabling of Future Technological Functionality or Addressing of Future Operational Requirements

SYSTEM RENEWAL SPECIFIC REQUIREMENTS (5.4.3.2.C.b)

At this time, the project does not incorporate any future technological functionality (i.e. automated switches) in North Bay Hydro's distribution system. The new construction framing will provide at a minimum 3.2m of pole space between the phase conductors and the neutral to allow for the easy installation of future equipment.

Environmental Benefits (5.4.3.2.B.5)

The nature of this project does not impact the environment in any substantial manner other than the impacts associated with the manufacturing of the materials.

Conservation and Demand Management (5.4.3.2.B.6)

This project is not applicable to any rate funded conservation or demand program

Category-Specific Requirements - System Renewal (5.4.3.2.C.b.)

Relationship Between the Characteristics of Targeted Assets and the Consequences of Asset Performance Deterioration or Failure (5.4.3.2.C.b.First Bullet)

Asset Performance Targets and Asset Lifecycle Optimization Policies and Practices (First Sub-Bullet)

The existing line assets are at the end of their useful life at 65 years old and will result in an increase of the asset's lifecycle cost as the risk of failure increases. **See section 3.3 of the DSP for more information on Asset Life Cycle Optimization Policies and Practices.**

Asset Condition Relative to Typical Life Cycle (Second Sub-Bullet)

Inspection data has shown that the majority of the line is in the category of poor condition (low health index). Condition issues identified on this line such shell rot, pole top deterioration, deep cracks, and footing displacements are characteristic of very old wood pole lines such as this one (65 years). Wood poles in NBHDL's system are also subjected to a regional condition issue which is damage suffered from wood peckers, more specifically, the Pileated Woodpecker which is particularly destructive and leaves large cavities in pole.

Number of Customers in Each Class Potentially Affected (Third Sub-Bullet)

Feeder / Station	Residential Customers	General Service Customers
20F2	582	28

Quantitative Customer Impact and Risk (Fourth Sub-Bullet)

North Bay Hydro collects outages statistics to analyze it distribution system performance on a feeder level with a particular focus on interruptions caused by defective equipment and tree contacts.

In 2019, the 20F2 distribution feeder experienced 2 momentary interruption and 1 sustained interruption from equipment failure and tree contacts combined. This has increased from the 0 momentary interruption and 0 sustained interruptions in 2018 and 0 momentary interruption and 0 sustained interruptions in 2017. This information represents the entire feeder, not just the area of the proposed project.

NBHDL does not have a record of a failure on this particular section of line, however in the same area (Montrose Ave), NBHDL did experience a transformer failure causing a momentary outage for 610 customers and a sustained outage for 13 customers of over an hour.

Qualitative Customer Impact and Risk (Fifth Sub-Bullet)

Since the circuits carried by the pole line are radial feeders, the area affected can not be restored by a neighboring feeder once the failed equipment has ben isolated. The inability to perform a switching operation to restore sections of the outage area means more customers are interrupted for longer periods of time when a failure occurs.

Long outages lead to customer dissatisfaction and complaints. Customers who work from home also lose productivity from outages, which may be more common due to the current Covid 19 situation. This project will work towards ensuring that the line remains reliable and resilient to weather events, maintaining the overall performance of the feeder it carries.

Value of Customer Impact (Sixth Sub-Bullet)

The customer impact in terms of the potential failure is low. This line services a residential area where outages may not be majorly disruptive. However, the reliable of service is still important to these customer and outages can be major inconveniences depending on the time in which they occur. NBHDL acknowledges that there may be a cultural shift of working from the office to working from home due to the current Covid 19 situation. This means that residential areas and home may be impacted similar to business in a lost of productivity.

NBHDL does not keep track of residential customers who rely on medical equipment (such as oxygen systems), however in NBHDL's operating experience when scheduling outages and communicating with customers, NBHDL has encountered some customers who have expressed an important reliance on power for this reason.

Other Factors Affecting Project Timing (5.4.3.2.C.b.Second Bullet)

At this time, there are no other factors affect this projects timing.

Consequences for System O&M costs (5.4.3.2.C.b.Third Bullet)

This project will reduce the risk of equipment failure and trouble calls in line with general system renewal projects. The 7.2 kV distribution circuits will be replaced with a larger conductor, slightly reducing line losses. The existing line with the degradation of its assets may no longer be able to withstand multiple severe weather events with out further damage.

Maintenance actions and associated costs will trend upwards as the pole line continues to age (see section 5.4.3.2.B.1.d).

Reliability and Safety Factors (5.4.3.2.C.b.Fourth Bullet)

This project will not have a material impact on improving the system reliability, but there will have a detrimental impact on system reliability if the project is not implemented. The impacts on public safety and the elimination of potential hazards were considered as factors to the importance of the project (See section 5.4.3.2.B.2 above)

Analysis of Project Benefits and Timing (5.4.3.2.C.b.Fifth Bullet)

North Bay Hydro uses a Project Planning Optimization Tool developed by Metsco to assess the benefits of its capital projects and uses that information to organize the most appropriate timing of its projects (see section 5.4.3.2.B.1.c for prioritization approach). For system renewal projects, the reduction of the risk cost (probability of failure vs the consequence of failure) and the optimization of the total life cycle cost for the asset is the main consideration for project benefits and prioritization. The timing of the proposed projects has been planned in a manner to maximize investment benefits.

North Bay Hydro acknowledges Climate Change and recognizes the potential impacts to its distribution system. As a primarily overhead system, North Bay Hydro must continue to design and operate its system (new projects & investments) to be able to withstand severe weather conditions (adherence to CSA design standards is a minimum). The large amount of existing aging overhead infrastructure (refer to ACA Report) however, through the degradation of the assets, is losing its ability to withstand repeated severe weather events. North Bay Hydro must ensure that its system is not crippled by weather events and as such, the urgency and importance investing in system renewal projects has increased.

Like for Like Renewal Analysis (5.4.5.2.C.b.Sixth Bullet)

Like for like renewal analysis of this project is not applicable as this project has not been configured at an extra cost to address other distributor planning objectives. This project has been configured solely to meet the requirement.

GENERAL INFORMATION ON THE PROJECT/PROGRAM (5.4.3.2.A)

2021 Capital Project Summary

5.4.3.2.A - General Information on the Project / Program

Project Name	Gertrude St West - Line Rebuild		
Investment Category	System Renewal		
Project Description	The Gertrude St West Line Rebuild project consists of the design, construction, and installation of a new overhead pole line along Gertrude St West from Parsons Ave to Lakeshore Dr. The length of the line will be approximately 300m and will consist of the installation of 12 new poles (10 Primary Distribution Poles, 2 Secondary Poles). It will carry a single phase 7.2kV distribution circuit (built to 15kV standards) The existing pole line that will be replaced is far past its useful life at 60 years old and is in poor condition with sub standard design elements. Other poor design aspects include as 4-way corner pole which is difficult to replace without extensive planning and coordination if the pole was ever to be damaged (e.g. car accident, snow plows, wood peckers holes, etc.). Condition issues include wood pecker holes, shell rot, pole top deterioration, cracks, and footing displacements (leaning poles). The existing poles are undersized / under classed and contains open bus secondary with aerial trespassing of services.		
Capital Investment			
(5.4.3.2.A. First Bullet)	Gross Capital	$106,113	
	O&M Costs (if applicable)	$0.00	
(5.4.3.2.A. Second Bullet)	Capital Contributions	$0.00	
	Net Capital	$106,113	
Customer Attachments/Load (kVA)			
(5.4.3.2.A. Third Bullet)	Customer Attachments (#):	21 (46 downstream customers in total)	
	Customer Load (peak KVA)	161 Load Supplied Through Line	
Project Timing			
(5.4.3.2.A. Forth Bullet)	Start Date	November 2020 (Engineering) March 2021 (Construction)	
	Expected In-Service Date	November 2021	
	Expenditure Timing	Q1:	10% $10,611

Q2:	90%	$95,502
Q3:	0%	$0
Q4:	0%	$0

Risk and Risk Mitigation

(5.4.3.2.A. Fifth Bullet)

This project has minimal risk that may affect the implementation of it as planned. The most significant risk to the project's would be if any issues arise in obtaining the municipal approvals. NBHDL understands the scope of this project and has built a project schedule with key milestone dates to be achieved to keep the project on track.

It will be managed by North Bay Hydro's internal project management process which includes update meetings, progress tracking, and developed action plans. **The engineering design, customer consultations, and the administrative work (municipal approvals, etc.) for the project is currently scheduled to be completed by the end of the prior year (2020).**

North Bay Hydro has also built into its schedule a buffer to allow for any unexpected issues which may cause delay to the construction start date. However, once construction starts, delays caused by equipment breakdowns, severe weather events (climate change), and sudden change in staffing resources can not always be mitigated.

Comparative Information

(5.4.3.2.A. Sixth Bullet)

NBHDL recognizes that the different combinations in the number of poles installed, length and size of conductors installed, number and type of switching devices installed, number and sizes of transformers installed, number of services, line angles and anchoring installed, as well as other design considerations makes all projects unique. Construction methods and equipment may vary depending on location, geography, subterranean conditions, and season as well. All of which affect the cost of a project.

For cost comparison purposes, NBHDL has determined that each of its past project contains enough variability in their design and construction such that no single project could be used to benchmark the cost of another single project appropriately. Instead, for overhead lines, NBHDL uses multiple historic projects (last 10 years) involving the construction of similar infrastructure to determine an average cost per pole installed. The average per pole cost for a single-phase distribution pole is $14,341 per pole.

At a project cost $106,113 with 10 primary poles to be installed, the estimated per pole cost of the Gertrude St West Rebuild project is $10,611, approximately 26% lower than the average. This lower cost is due to this project having only overhead servicing with no underground (civil) component. It is a very straight forward project in terms of construction complexity.

Total Capital & OM&A Costs Associated with REG Investments

	(5.4.3.2.A. Seventh Bullet)	This project is not associated with REG investment; Capital and OM&A cost related to REG will not be incurred
	Leave to Construct Approval	
	(5.4.3.2.A. Eight Bullet)	This project does not require Leave to Construct approval under Section 92 of the OEB Act and therefore this does not apply
	5.4.3.2.B - Evaluation Criteria and Information Requirements	
EVALUATION CRITERIA AND INFORMATION REQUIREMENTS (5.4.3.2.B)	**Efficiency, Customer Value, Reliability (5.4.3.2.B.1)**	
	Section a)	
	Main Driver (Trigger)	Failure risk (associated with the end of life distribution assets) is the main driver of this project. See Section 4.1.2.2 of NBHDL's DSP for pole failure risk description. The poles in this line are currently 60 years of age and are in poor condition. Condition issues include wood pecker holes, shell rot, pole top deterioration, cracks, and footing displacements (leaning poles). In line with North Bay Hydro's Asset Lifecycle Optimization Practices (Section 3.3 of the DSP), this System Renewal project is necessary to efficiently sustain the ongoing reliability of electricity to customer on these feeders. Condition assessments which includes the asset's age have classified these pole lines as poor condition.
	Related Objectives/Performance Targets	NBHDL Corporate Mission, Vision and Core Values CV3 and CV4 (as identified in Exhibit 1).
	Source and Nature of the Information Used to Justify the Investment	North Bay Hydro used Pole Inspection Data, the Asset Condition Report, its operating experience and the Metsco Project Prioritization Tool / Model to justify and prioritize the investment.
	Secondary Drivers	The secondary driver for this project is safety and aerial trespass correction. As with many older pole lines, the existing line was designed with outdated standards that would not meet the rigor of present-day NBHDL safety standards in new construction. Poles are short, which leads to less than adequate equipment spacing and clearances and are under classed (weaker). These lines also contain old tie top type porcelain insulators on the 7.2 kV distribution circuit. A report released by ESA in 2017 titled "Mitigation of Pole Top Fires" shows porcelain insulators as the worst performers when it comes electrical current leakage (references CEA 265 D 748). In order for these insulators to maintain their insulation characteristics, they must not must not be contaminated or damaged through hairline cracks. However, as they age, there are subject to both electrical and mechanical failures where the tie can break away. This presents a worker and public safety issue.

	The project will also correct aerial trespassing of secondary services. An aerial trespass is when a secondary service wire crosses over the private property of a customer to reach another customer. NBHDL as a standard practice will correct these trespasses when encountered, however, the condition of the existing lines open wire secondary buses makes this infeasible and services are limited to coming off a pole. This project will install a spun bus secondary which is an aesthetical improvement and will allow services to be attached directly to the bus. This project will also eliminate a 4-Way corner pole. A 4-way corner pole is a pole where the attached conductors travel in all four directions of an intersecting line. These poles are often located on the corner of a road intersection where they are more likely to be struck by a vehicle or snow plow turning the corner (in NBHDL's experience). While a 4-Way corner pole isn't an issue in itself, it does create a situation where the pole is difficult to replace if it were to be unexpectedly damaged (i.e. car accident, snow plow, wood peck holes). The new pole must always be installed in the existing pole location (rather than beside it) to maintain alignment. This typically requires an outage to perform safely as conductors must be "floated" (unsecured from the pole) in air during the installation. The nature of this work turns these pole replacements into costly projects that inconvenience customers. The preferable design for intersecting lines is "two pole corners" where the intersecting conductors are connected through a mid span tap. In this design, the poles are placed further back from the road intersection and replacements can be perform with relatively low effort as new poles do not need to be installed in the same location as existing.
Related Objectives/Performance Targets	NBHDL Corporate Mission, Vision and Core Values CV2 and CV4 (as identified in Exhibit 1).
Source and Nature of the Information Used to Justify the Investment	North Bay Hydro uses it's GIS (asset data) information and experience as the source of information that identified the secondary drivers.
Section b)	
Reliability Planning and Resilient Distribution System Design	NBHDL adheres to good utility practice in ensuring that all projects are designed to be a part of resilient and reliable distribution system. This project will reduce the probability of equipment failure and will be built to exceed the existing lines ability to withstand severe weather events. This project will incorporate the better design practice of using in span taps, rather than 4-way corner poles. It will also be designed to change the area supply from a radial feed to a loop (network) feed for a more flexible and resilient grid design. NBHDL acknowledges climate change and recognizes the possibility of an increase to severe weather events that may result. While these events can not be treated any degree of certainty, NBHDL's aging infrastructure would be potentially vulnerable if these events were to be realized.

Adaptation to Future Challenges	This project will be built with enough conductor ampacity to allow for future load growth. The spacing on the poles will allow for the installation of new equipment without the need to re-frame the pole. The poles will tall enough that the line can be three phased if required with out replacing the poles. This line services a residential area with limited potential for further development and as such, NBHDL does not anticipate any substantial load growth; however, NBHDL does consider the potential impact of electric vehicles and recognizes that residential areas may see higher peak demands as a result.
Section c)	
Investment Priority Relative to Other Investments	Using the Metsco developed Project Planning Optimization Tool, of the 8 system renewal projects proposed for 2021 (Distribution System OH & UG Lines), the Gertrude St West Rebuild project ranks as **#6 in its prioritization**. Overall, this project is ranked as #10 in NBHDL's prioritization for distribution line projects. While individual projects are ranked according to their benefits, NBHDL will make its selection based on the group of projects that cumulatively offers the greatest benefit while operating within the planned budget and resourcing requirements for a given year. Cumulatively, the 8 projects planned for 2021 offers the greatest net benefit (highest score) compared to any other combination of projects proposed.
Prioritization Approach	See Section 4.2.2 of NBHDL's DSP for project prioritization approach.
Section d)	
Analysis of the Project and Project Alternatives	

Effect on System Operation Efficiency and Cost-Effectiveness (First Bullet)	This project will reduce the risk of failure and the associated increase to O&M costs as the line continues to age and deteriorate. See Section 4.1.2.2 of NBHDL's DSP for description on correlation between age of pole and maintenance activities. There will also be a small reduction in line losses with larger conductor installed
Net Benefits Accruing to Customers (Second Bullet)	The avoidance of potentially adverse effects on reliability will also benefit customers. NBHDL expects that more customers will continue to work from given the current Covid 19 situation and outages can be a major inconvenience and a loss to productivity. An avoidance of increased maintenance costs and the reduction in line losses positively impacts the overall cost for the delivery of electricity.
Impact on Reliability Performance (Including on the Frequency and Duration of Outages) (Third Bullet)	This project will avoid an adverse impact to the reliability performance of this line. This line is part of the 8F2 feeder. A single interruption that lasts an hour on this feeder can contribute 0.027 to NBHDL's SAIDI / SAIFI metrics respectively. NBHDL does not have 24-hour staffing of its control room and has a line crew on call for emergencies outside of normal operating hours. As such, response and restoration times outside of normal operating hours take longer if a failure was to occur since switching orders to isolate the affected area can not be completed as quickly.
Project Alternatives	NBHDL has considered the following alternative to this project but has deemed them not to be viable options: • <u>Alternative #1 – Do Nothing</u> This alternative involves not doing anything at this time and deferring the project or running the line to failure. This option will defer the cost of replacing the asset, however the existing line will continue to have its condition issues and the risk of failure will continue to increase every year it ages until it does actually fail or is reconstructed. It will also not address and of the servicing issue present in the existing line Maintenance issues associated with the ageing and deteriorating line would be expected to increase year over year and cause the overall life cycle of the asset to be more expensive. See section 3 of the DSP. This line cannot be eliminated and is an important part of NBHDL's distribution system. Deferring the project in favour for another project will result in overall lost benefit as determined by North Bay Hydro's Project Planning Optimization Tool (see section 5.4.3.2.B.1.c for Prioritization Approach.
<u>Safety (5.4.3.2.B.2)</u>	

This project will eliminate hazards associated with deteriorating pole lines. The existing line does not meet the rigor of North Bay Hydro's present-day safety standards and includes under classed poles and inadequate conductor spacing and clearances. This project will also eliminate old porcelain insulators which have been known to perform poorly as they can lead to both electrical and mechanical failure of the insulator.

NBHDL has first hand experience with this when in 2019, an employee suffered an electrical shock while pulling out a nail at the base of the pole in the rain. There was a hair line crack on the insulator that caused the energization of the pole, but the leakage current was too small to be detected as a fault by the protective devices in NBHDL's system.

The degradation of the existing pole lines over time will lead to an increased probability of equipment failure that may result in a situation where live conductor may come into contact with the ground level, presenting a hazard to public safety.

Cyber-Security, Privacy (5.4.3.2.B.3)

Not applicable to this project

Co-ordination, Interoperability (5.4.3.2.B.4)

Section a)

Co-ordination with Utilities, Regional Planning and/or Links with 3rd Party Providers and/or Industry

Coordination with utilities, regional planning, third party providers, or other industries is not applicable to this project as the project is located in the middle of North Bay Hydro's service territory and is in an area with no future development plans.

Section b)

Enabling of Future Technological Functionality or Addressing of Future Operational Requirements

At this time, the project does not incorporate any future technological functionality (i.e. automated switches) in North Bay Hydro's distribution system. The new construction framing will provide at a minimum 3.2m of pole space between the phase conductor and the neutral to allow for the easy installation of future equipment.

Environmental Benefits (5.4.3.2.B.5)

The nature of this project does not impact the environment in any substantial manner other than the impacts associated with the manufacturing of the materials.

Conservation and Demand Management (5.4.3.2.B.6)

This project is not applicable to any rate funded conservation or demand program

Category-Specific Requirements - System Renewal (5.4.3.2.C.b.)

SYSTEM RENEWAL SPECIFIC REQUIREMENTS (5.4.3.2.C.b.)

Relationship Between the Characteristics of Targeted Assets and the Consequences of Asset Performance Deterioration or Failure (5.4.3.2.C.b.First Bullet)

Asset Performance Targets and Asset Lifecycle Optimization Policies and Practices (First Sub-Bullet)

The existing line assets are at the end of their useful life at 60 years old and will result in an increase of the asset's lifecycle cost as the risk of failure increases. **See section 3.3 of the DSP for more information on Asset Life Cycle Optimization Policies and Practices.**

Asset Condition Relative to Typical Life Cycle (Second Sub-Bullet)

Inspection data has shown that the majority of the line is in the category of poor condition (low health index). Condition issues identified on this line such shell rot, pole top deterioration, deep cracks, and footing displacements are characteristic of very old wood pole lines such as this one (60 years). Wood poles in NBHDL's system are also subjected to a regional condition issue which is damage suffered from wood peckers, more specifically, the Pileated Woodpecker which is particularly destructive and leaves large cavities in poles which shortens their life spans.

Number of Customers in Each Class Potentially Affected (Third Sub-Bullet)

Feeder / Station	Residential Customers	General Service Customers
8F2	599	51

Quantitative Customer Impact and Risk (Fourth Sub-Bullet)

North Bay Hydro collects outages statistics to analyze it distribution system performance on a feeder level with a particular focus on interruptions caused by defective equipment and tree contacts.

In 2019, the 8F2 distribution feeder experienced 0 momentary interruption and 0 sustained interruptions from equipment failure and tree contacts combined. This has not changed from the 0 momentary interruptions and 0 sustained interruptions in 2018, but there was 1 momentary interruption and 1 sustained interruption in 2017. This information represents the entire feeder, not just the area of the proposed project.

NBHDL does not have a record of an outage caused by this section of line in the last three years.

Qualitative Customer Impact and Risk (Fifth Sub-Bullet)

Since the circuits carried by the pole line are radial feeders, the area affected can not be restored by a neighboring feeder once the failed equipment has ben isolated. The inability to perform a switching operation to restore sections of the outage area means more customers are interrupted for longer periods of time when a failure occurs.

Long outages lead to customer dissatisfaction and complaints. Customers who work from home also lose productivity from outages, which may be more common due to the current Covid 19 situation. This project will work towards ensuring that the line remains reliable and resilient to weather events, maintaining the overall performance of the feeder it carries.

Value of Customer Impact (Sixth Sub-Bullet)

The customer impact in terms of the potential failure is low. This line services a residential area where outages may not be majorly disruptive. However, the reliable of service is still important to these customer and outages can be major inconveniences depending on the time in which they occur. NBHDL acknowledges that there may be a cultural shift of working from the office to working from home due to the current Covid 19 situation. This means that residential areas and home may be impacted similar to business in a lost of productivity.

NBHDL does not keep track of residential customers who rely on medical equipment (such as oxygen systems), however in NBHDL's operating experience when scheduling outages and communicating with customers, NBHDL has encountered some customers who have expressed an important reliance on power for this reason.

Other Factors Affecting Project Timing (5.4.3.2.C.b.Second Bullet)

At this time, there are no other factors affect this projects timing.

Consequences for System O&M costs (5.4.3.2.C.b.Third Bullet)

This project will reduce the risk of equipment failure and trouble calls in line with general system renewal projects. The 7.2 kV distribution circuits will be replaced with a larger conductor, slightly reducing line losses. The existing line with the degradation of its assets may no longer be able to withstand multiple severe weather events with out further damage.

Maintenance actions and associated costs will trend upwards as the pole line continues to age (see section 5.4.3.2.B.1.d).

Reliability and Safety Factors (5.4.3.2.C.b.Fourth Bullet)

This project will not have a material impact on improving the system reliability, but there will have a detrimental impact on system reliability if the project is not implemented. The impacts on public safety and the elimination of potential hazards were considered as factors to the importance of the project (See section 5.4.3.2.B.2 above).

Analysis of Project Benefits and Timing (5.4.3.2.C.b.Fifth Bullet)

North Bay Hydro uses a Project Planning Optimization Tool developed by Metsco to assess the benefits of its capital projects and uses that information to organize the most appropriate timing of its projects (see section 5.4.3.2.B.1.c for prioritization approach). For system renewal projects, the reduction of the risk cost (probability of failure vs the consequence of failure) and the optimization of the total life cycle cost for the asset is the main consideration for project benefits and prioritization. The timing of the proposed projects have been planned in a manner to maximize investment benefits.

North Bay Hydro acknowledges Climate Change and recognizes the potential impacts to its distribution system. As a primarily overhead system, North Bay Hydro must continue to design and operate its system (new projects & investments) to be able to withstand severe weather conditions (adherence to CSA design standards is a minimum). The large amount of existing aging overhead infrastructure (refer to ACA Report) however, through the degradation of the assets, is losing its ability to withstand repeated severe weather events. North Bay Hydro must ensure that its system is not crippled by weather events and as such, the urgency and importance investing in system renewal projects has increased.

Like for Like Renewal Analysis (5.4.5.2.C.b.Sixth Bullet)

Like for like renewal analysis of this project is not applicable as this project has not been configured at an extra cost to address other distributor planning objectives. This project has been configured solely to meet the requirement.

GENERAL INFORMATION ON THE PROJECT/PROGRAM (5.4.3.2.A)

2021 Capital Project Summary

5.4.3.2.A - General Information on the Project / Program

Project Name	Montrose Ave - Line Rebuild			
Investment Category	System Renewal			
Project Description	The Montrose Ave Line Rebuild project consists of the design, construction, and installation of a new overhead pole line along Montrose Ave from Frost St to Carruthers St. The length of the line will be approximately 525m and will consist of the installation of 11 new primary distribution poles. It will carry a single phase 7.2kV distribution circuit (built to 15kV standards) The existing pole line that will be replaced is far past its useful life at 60 years old and are in poor condition with sub standard design elements. It is amongst some of the oldest poles in NBHDL's system. Condition issues include wood pecker holes, shell rot, pole top deterioration, cracks, and footing displacements (leaning poles). The poles are undersized and under classed as well with porcelain type insulators.			
Capital Investment				
(5.4.3.2.A. First Bullet)	Gross Capital	$105,930		
	O&M Costs (if applicable)	$0.00		
(5.4.3.2.A. Second Bullet)	Capital Contributions	$0.00		
	Net Capital	$105,930		
Customer Attachments/Load (kVA)				
(5.4.3.2.A. Third Bullet)	Customer Attachments (#):	51		
	Customer Load (peak KVA)	134 Load Supplied Through Line		
Project Timing				
(5.4.3.2.A. Forth Bullet)	Start Date	August 2020 (Engineering)		
		April 2021		
	Expected In-Service Date	In Service Date		
	Expenditure Timing	Q1:	0%	$0
		Q2:	0%	$0
		Q3:	50%	$52,965
		Q4:	50%	$52,965

Risk and Risk Mitigation	
(5.4.3.2.A. Fifth Bullet)	This project has minimal risk that may affect the implementation of it as planned. The most significant risk to the project's would be if any issues arise in obtaining the municipal approvals. NBHDL understands the scope of this project and has built a project schedule with key milestone dates to be achieved to keep the project on track. It will be managed by North Bay Hydro's internal project management process which includes update meetings, progress tracking, and developed action plans. The engineering design, customer consultations, and the administrative work (municipal approvals, etc.) for the project is currently scheduled to be completed by the end of the prior year (2020). North Bay Hydro has also built into its schedule a buffer to allow for any unexpected issues which may cause delay to the construction start date. However, once construction starts, delays caused by equipment breakdowns, severe weather events (climate change), and sudden change in staffing resources can not always be mitigated.
Comparative Information	
(5.4.3.2.A. Sixth Bullet)	NBHDL recognizes that the different combinations in the number of poles installed, length and size of conductors installed, number and type of switching devices installed, number and sizes of transformers installed, number of services, line angles and anchoring installed, as well as other design considerations makes all projects unique. Construction methods and equipment may vary depending on location, geography, subterranean conditions, and season as well. All of which affect the cost of a project. For cost comparison purposes, NBHDL has determined that each of its past project contains enough variability in their design and construction such that no single project could be used to benchmark the cost of another single project appropriately. Instead, for overhead lines, NBHDL uses multiple historic projects (last 10 years) involving the construction of similar infrastructure to determine an average cost per pole installed. The average per pole cost for a single-phase distribution pole is $14,341 per pole. At a project cost $105,930 with 11 poles to be installed, the estimated per pole cost of the Montrose Ave Rebuild project is $9,630, approximately 33% lower than the average. This lower cost is due to this project having only overhead servicing with no underground (civil) component. It is a very straight forward project in terms of construction complexity.
Total Capital & OM&A Costs Associated with REG Investments	
(5.4.3.2.A. Seventh Bullet)	This project is not associated with REG investment; Capital and OM&A cost related to REG will not be incurred
Leave to Construct Approval	
(5.4.3.2.A. Eight Bullet)	This project does not require Leave to Construct approval under Section 92 of the OEB Act and therefore this does not apply
5.4.3.2.B - Evaluation Criteria and Information Requirements	

EVALUATION CRITERIA AND INFORMATION REQUIREMENTS (5.4.3.2.B)

Efficiency, Customer Value, Reliability (5.4.3.2.B.1)

Section a)

Main Driver (Trigger)	Failure risk (associated with the end of life distribution assets) is the main driver of this project. See Section 4.1.2.2 of NBHDL's DSP for pole failure risk description. The poles in this line are currently 60 years of age and are in poor condition. Condition issues include wood pecker holes, shell rot, pole top deterioration, cracks, and footing displacements (leaning poles). In line with North Bay Hydro's Asset Lifecycle Optimization Practices (Section 3.3 of the DSP), this System Renewal project is necessary to efficiently sustain the ongoing reliability of electricity to customer on these feeders. Condition assessments which includes the asset's age have classified these pole lines as poor condition.
Related Objectives/Performance Targets	NBHDL Corporate Mission, Vision and Core Values CV3 and CV4 (as identified in Exhibit 1).
Source and Nature of the Information Used to Justify the Investment	North Bay Hydro used Pole Inspection Data, the Asset Condition Report, and the Metsco Project Prioritization Tool / Model to justify and prioritize the investment.
Secondary Drivers	The secondary driver for this project is safety. As with many older pole lines, the existing line was designed with outdated standards that would not meet the rigor of present-day NBHDL safety standards in new construction. Poles are short, which leads to less than adequate equipment spacing and clearances and are under classed (weaker). These lines also contain old tie top type porcelain insulators on the 7.2 kV distribution circuit. A report released by ESA in 2017 titled "Mitigation of Pole Top Fires" shows porcelain insulators as the worst performers when it comes electrical current leakage (references CEA 265 D 748). In order for these insulators to maintain their insulation characteristics, they must not must not be contaminated or damaged through hairline cracks. However, as they age, there are subject to both electrical and mechanical failures where the tie can break away. This presents a worker and public safety issue.
Related Objectives/Performance Targets	NBHDL Corporate Mission, Vision and Core Values CV2 and CV4 (as identified in Exhibit 1).
Source and Nature of the Information Used to Justify the Investment	North Bay Hydro uses it's GIS (asset data) information and experience as the source of information that identified the secondary drivers.

Section b)

Reliability Planning and Resilient Distribution System Design	NBHDL adheres to good utility practice in ensuring that all projects are designed to be a part of resilient and reliable distribution system. This project will reduce the probability of equipment failure and will be built to exceed the existing lines ability to withstand severe weather events. NBHDL acknowledges climate change and recognizes the possibility of an increase to severe weather events that may result. While these events can not be treated any degree of certainty, NBHDL's aging infrastructure would be potentially vulnerable if these events were to be realized.
Adaptation to Future Challenges	This project will be built with enough conductor ampacity to allow for future load growth. The spacing on the poles will allow for the installation of new equipment without the need to re-frame the pole. The poles will tall enough that the line can be three phased if required with out replacing the poles. This line services a residential area with limited potential for further development and as such, NBHDL does not anticipate any substantial load growth; however, NBHDL does consider the potential impact of electric vehicles and recognizes that residential areas may see higher peak demands as a result.
Section c)	
Investment Priority Relative to Other Investments	Using the Metsco developed Project Planning Optimization Tool, of the 8 system renewal projects proposed for 2021 (Distribution System OH & UG Lines), the Montrose Ave Rebuild project ranks as **#8 in its prioritization**. Overall, this project is ranked as #15 in NBHDL's prioritization for all projects. The prioritization approach for which this rank is determined is outlined in the next section below. While individual projects are ranked according to their benefits, NBHDL will make its selection based on the group of projects that cumulatively offers the greatest benefit while operating within the planned budget and resourcing requirements for a given year. Cumulatively, the 8 projects planned for 2021 offers the greatest net benefit (highest score) compared to any other combination of projects proposed.

Prioritization Approach	See Section 4.2.2 of NBHDL's DSP for project prioritization approach.
Section d) **Analysis of the Project and Project Alternatives**	
Effect on System Operation Efficiency and Cost-Effectiveness (First Bullet)	This project will reduce the risk of failure and the associated increase to O&M costs as the line continues to age and deteriorate. See Section 4.1.2.2 of NBHDL's DSP for description on correlation between age of pole and maintenance activities. There will also be a small reduction in line losses with larger conductor installed
Net Benefits Accruing to Customers (Second Bullet)	The avoidance of potentially adverse effects on reliability will also benefit customers. NBHDL expects that more customers will continue to work from given the current Covid 19 situation and outages can be a major inconvenience and a loss to productivity. An avoidance of increased maintenance costs and the reduction in line losses positively impacts the overall cost for the delivery of electricity.
Impact on Reliability Performance (Including on the Frequency and Duration of Outages) (Third Bullet)	This project will avoid an adverse impact to the reliability performance of this line. This line is part of the 20F2 feeder. A single interruption that lasts an hour on this feeder can contribute 0.025 to NBHDL's SAIDI / SAIFI metrics respectively. NBHDL does not have 24-hour staffing of its control room and has a line crew on call for emergencies outside of normal operating hours. As such, response and restoration times outside of normal operating hours take longer if a failure was to occur since switching orders to isolate the affected area can not be completed as quickly.

Project Alternatives

NBHDL has considered the following alternative to this project but has deemed them not to be viable options:

- Alternative #1 – Do Nothing
  This alternative involves not doing anything at this time and deferring the project or running the line to failure. This option will defer the cost of replacing the asset, however the existing line will continue to have its condition issues and the risk of failure will continue to increase every year it ages until it does actually fail or is reconstructed. It will also not address and of the servicing issue present in the existing line

  Maintenance issues associated with the ageing and deteriorating line would be expected to increase year over year and cause the overall life cycle of the asset to be more expensive. See section 3 of the DSP. This line cannot be eliminated and is an important part of NBHDL's distribution system.

Deferring the project in favour for another project will result in overall lost benefit as determined by North Bay Hydro's Project Planning Optimization Tool (see section 5.4.3.2.B.1.c for Prioritization Approach.

Safety (5.4.3.2.B.2)

This project will eliminate hazards associated with deteriorating pole lines. The existing line does not meet the rigor of North Bay Hydro's present-day safety standards and includes under classed poles and inadequate conductor spacing and clearances. This project will also eliminate old porcelain insulators which have been known to perform poorly as they can lead to both electrical and mechanical failure of the insulator.

NBHDL has first hand experience with this when in 2019, an employee suffered an electrical shock while pulling out a nail at the base of the pole in the rain. There was a hair line crack on the insulator that caused the energization of the pole, but the leakage current was too small to be detected as a fault by the protective devices in NBHDL's system.

The degradation of the existing pole lines over time will lead to an increased probability of equipment failure that may result in a situation where live conductor may come into contact with the ground level, presenting a hazard to public safety.

Cyber-Security, Privacy (5.4.3.2.B.3)

Not applicable to this project

Co-ordination, Interoperability (5.4.3.2.B.4)

Section a)

Co-ordination with Utilities, Regional Planning and/or Links with 3rd Party Providers and/or Industry

Coordination with utilities, regional planning, third party providers, or other industries is not applicable to this project as the project is located in the middle of North Bay Hydro's service territory and is in an area with no future development plans.

Section b)

Enabling of Future Technological Functionality or Addressing of Future Operational Requirements

At this time, the project does not incorporate any future technological functionality (i.e. automated switches) in North Bay Hydro's distribution system. The new construction framing will provide at a minimum 3.2m of pole space between the phase conductors and the neutral to allow for the easy installation of future equipment.

Environmental Benefits (5.4.3.2.B.5)

SYSTEM RENEWAL SPECIFIC REQUIREMENTS (5.4.3.2.C.b)

The nature of this project does not impact the environment in any substantial manner other than the impacts associated with the manufacturing of the materials.

Conservation and Demand Management (5.4.3.2.B.6)

This project is not applicable to any rate funded conservation or demand program

Category-Specific Requirements - System Renewal (5.4.3.2.C.b.)

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Relationship Between the Characteristics of Targeted Assets and the Consequences of Asset Performance Deterioration or Failure (5.4.3.2.C.b.First Bullet)

Asset Performance Targets and Asset Lifecycle Optimization Policies and Practices (First Sub-Bullet)

The existing line assets are at the end of their useful life at 60 years old and will result in an increase of the asset's lifecycle cost as the risk of failure increases. **See section 3.3 of the DSP for more information on Asset Life Cycle Optimization Policies and Practices.**

Asset Condition Relative to Typical Life Cycle (Second Sub-Bullet)

Inspection data has shown that the majority of the line is in the category of poor condition (low health index). Condition issues identified on this line such shell rot, pole top deterioration, deep cracks, and footing displacements are characteristic of very old wood pole lines such as this one (60 years). Wood poles in NBHDL's system are also subjected to a regional condition issue which is damage suffered from wood peckers, more specifically, the Pileated Woodpecker which is particularly destructive and leaves large cavities in poles which shortens their life spans.

Number of Customers in Each Class Potentially Affected (Third Sub-Bullet)

Feeder / Station	Residential Customers	General Service Customers
20F2	582	28

Quantitative Customer Impact and Risk (Fourth Sub-Bullet)

North Bay Hydro collects outages statistics to analyze it distribution system performance on a feeder level with a particular focus on interruptions caused by defective equipment and tree contacts.

In 2019, the 20F2 distribution feeder experienced 2 momentary interruption and 1 sustained interruption from equipment failure and tree contacts combined. This has increased from the 0 momentary interruption and 0 sustained interruptions in 2018 and 0 momentary interruption and 0 sustained interruptions in 2017. This information represents the entire feeder, not just the area of the proposed project.

The most recent outage for this particular section of line occurred in 2019 where a transformer failure causing a momentary outage for 610 customers and a sustained outage for 13 customers of over an hour.

Qualitative Customer Impact and Risk (Fifth Sub-Bullet)

Since the circuits carried by the pole line are radial feeders, the area affected can not be restored by a neighboring feeder once the failed equipment has ben isolated. The inability to perform a switching operation to restore sections of the outage area means more customers are interrupted for longer periods of time when a failure occurs.

Long outages lead to customer dissatisfaction and complaints. Customers who work from home also lose productivity from outages, which may be more common due to the current Covid 19 situation. This project will work towards ensuring that the line remains reliable and resilient to weather events, maintaining the overall performance of the feeder it carries.

Value of Customer Impact (Sixth Sub-Bullet)

The customer impact in terms of the potential failure is low. This line services a residential area where outages may not be majorly disruptive. However, the reliable of service is still important to these customer and outages can be major inconveniences depending on the time in which they occur. NBHDL acknowledges that there may be a cultural shift of working from the office to working from home due to the current Covid 19 situation. This means that residential areas and home may be impacted similar to business in a lost of productivity.

NBHDL does not keep track of residential customers who rely on medical equipment (such as oxygen systems), however in NBHDL's operating experience when scheduling outages and communicating with customers, NBHDL has encountered some customers who have expressed an important reliance on power for this reason.

Other Factors Affecting Project Timing (5.4.3.2.C.b.Second Bullet)

At this time, there are no other factors affect this projects timing.

Consequences for System O&M costs (5.4.3.2.C.b.Third Bullet)

This project will reduce the risk of equipment failure and trouble calls in line with general system renewal projects. The 7.2 kV distribution circuits will be replaced with a larger conductor, slightly reducing line losses. The existing line with the degradation of its assets may no longer be able to withstand multiple severe weather events with out further damage.

Maintenance actions and associated costs will trend upwards as the pole line continues to age (see section 5.4.3.2.B.1.d).

Reliability and Safety Factors (5.4.3.2.C.b.Fourth Bullet)

This project will not have a material impact on improving the system reliability, but there will have a detrimental impact on system reliability if the project is not implemented. The impacts on public safety and the elimination of potential hazards were considered as factors to the importance of the project (See section 5.4.3.2.B.2 above).

Analysis of Project Benefits and Timing (5.4.3.2.C.b.Fifth Bullet)

North Bay Hydro uses a Project Planning Optimization Tool developed by Metsco to assess the benefits of its capital projects and uses that information to organize the most appropriate timing of its projects (see section 5.4.3.2.B.1.c for prioritization approach). For system renewal projects, the reduction of the risk cost (probability of failure vs the consequence of failure) and the optimization of the total life cycle cost for the asset is the main consideration for project benefits and prioritization. The timing of the proposed projects have been planned in a manner to maximize investment benefits.

North Bay Hydro acknowledges Climate Change and recognizes the potential impacts to its distribution system. As a primarily overhead system, North Bay Hydro must continue to design and operate its system (new projects & investments) to be able to withstand severe weather conditions (adherence to CSA design standards is a minimum). The large amount of existing aging overhead infrastructure (refer to ACA Report) however, through the degradation of the assets, is losing its ability to withstand repeated severe weather events. North Bay Hydro must ensure that its system is not crippled by weather events and as such, the urgency and importance of investing in system renewal projects has increased.

Like for Like Renewal Analysis (5.4.5.2.C.b.Sixth Bullet)

Like for like renewal analysis of this project is not applicable as this project has not been configured at an extra cost to address other distributor planning objectives. This project has been configured solely to meet the requirement.

GENERAL INFORMATION ON THE PROJECT/PROGRAM (5.4.3.2.A)

2021 Capital Project Summary

5.4.3.2.A - General Information on the Project / Program

Project Name

Minor Betterments - System Renewal

Investment Category

System Renewal

Project Description

Minor Betterment projects represent small unplanned projects over the year that fall under one of the following:

1) The rehabilitation or expansion of high voltage and low voltage lines required to service new customers or upgrade existing customers (5 poles or less). This type of project arises from service requests from new or existing customers. (System Access)

2) Small renewal projects to replace assets found in very poor condition and require immediate replacement (5 poles or less). This type of project arises from trouble calls, maintenance programs, and information provided from 3rd parties (ESA, customers, communication companies). **(System Renewal)**

This project summary will detail projects relating to #2

Capital Investment

(5.4.3.2.A. First Bullet)

Gross Capital	$295,359
O&M Costs (if applicable)	N/A

(5.4.3.2.A. Second Bullet)

Capital Contributions	$0.00
Net Capital	$395,359

Customer Attachments/Load (kVA)

(5.4.3.2.A. Third Bullet)

Customer Attachments (#):	N/A
Customer Load (peak KVA)	N/A

Project Timing

(5.4.3.2.A. Forth Bullet)

Start Date	January 1, 2021		
Expected In-Service Date	December 31, 2021		
Expenditure Timing	Q1:	25%	$64,840
	Q2:	25%	$64,840

Q3:	25%	$64,840
Q4:	25%	$64,840

Risk and Risk Mitigation

(5.4.3.2.A. Fifth Bullet)	The circumstances in which minor betterment projects occur often requires the immediate replacement as the asset has failed or is about to fail. The risk to implementation of these projects is typically not applicable as they often involve "like for like" replacements performed under emergency / high priority basis as a response to a trouble call or a field inspection.

Comparative Information (5.4.3.2.A. Sixth Bullet)

Comparable investments in previous years are as follows:

	Actual						Planned	
	2015	2016	2017	2018	2019	Average	2020	2021
Capital (Gross)	$186,255	$281,979	$290,965	$363,998	$347,969	$294,223	$311,490	$295,359

Total Capital & OM&A Costs Associated with REG Investments

(5.4.3.2.A. Seventh Bullet)	This project is not associated with REG investment; Capital and OM&A cost related to REG will not be incurred

Leave to Construct Approval

(5.4.3.2.A. Eight Bullet)	This project does not require Leave to Construct approval under Section 92 of the OEB Act and therefore this does not apply

5.4.3.2.B - Evaluation Criteria and Information Requirements

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Efficiency, Customer Value, Reliability (5.4.3.2.B.1)

Section a)

Main Driver (Trigger)	Failure risk of distribution assets is the main driver for the majority of these projects. These assets are typically not scheduled for replacement as part of NBHDL's system renewal program, but have been discovered to no longer able to meet its safety or functional requirements and must be replaced. These assets present an immediate risk to safety and / or the reliability of NBHDL's distribution system.
Related Objectives/Performance Targets	NBHDL Corporate Mission, Vision and Core Values CV3 and CV4 (as identified in Exhibit 1).
Source and Nature of the Information Used to Justify the Investment	Asset Inspections (NBH Inspection Programs), ESA, Customer Reporting, Communication Companies are all means of discovery to identify these assets. The consequence of not doing anything is used to provide the justification.
Secondary Drivers	Not Applicable
Related Objectives/Performance Targets	Not Applicable
Source and Nature of the Information Used to Justify the Investment	Not Applicable
Section b)	

Reliability Planning and Resilient Distribution System Design	Minor Betterments are small scope projects and do not typically have an impact on the overall distribution system design. However, NBHDL will adhere to good utility practice in ensuring that all projects are designed to be a part of resilient and reliable distribution system when applicable. This includes pole heights being adjusted to align to future needs, and transformer sizing being increased or decreased based on loading information.
Adaptation to Future Challenges	Adaptation to future challenges will vary from project to project; however, the unplanned nature of minor betterment projects may not always present opportunities for this.
Section c)	
Investment Priority Relative to Other Investments	Investments are required in order to ensure continued service to existing customers and eliminate safety issues, regardless of what other investments may have been planned.
Prioritization Approach	These projects will be prioritized according to the risk they present to the safety and reliability of North Bay Hydro's system. This considers the probability of failure and the consequence of the failure. Safety is always the highest priority.
Section d) **Analysis of the Project and Project Alternatives**	
Effect on System Operation Efficiency and Cost-Effectiveness (First Bullet)	The effect on system operation efficiency and cost-effectiveness may vary from project to project; however, the nature of minor betterment projects will typically have no effect on this in most cases

Net Benefits Accruing to Customers (Second Bullet)	All projects ensure the elimination of safety hazards and that reliability is maintained
Impact on Reliability Performance (Including on the Frequency and Duration of Outages) (Third Bullet)	Reliability may be impacted by failed assets involved in projects; however, replacement of failed assets will only help improve reliability in the future
Project Alternatives	Alternatives are rarely considered for these projects as the majority involves like for like replacements. At times, pole heights will be adjusted to align to future needs, and transformer sizing may be increased or decreased based on loading information. Both adjustments are made to avoid future costs.

Safety (5.4.3.2.B.2)

The majority of these projects involve assets that have failed or are about to fail and therefore the work almost always involves eliminating a current or soon to be safety hazard.

Cyber-Security, Privacy (5.4.3.2.B.3)

Not applicable to this project

Co-ordination, Interoperability (5.4.3.2.B.4)

Section a)

Co-ordination with Utilities, Regional Planning and/or Links with 3rd Party Providers and/or Industry

Not applicable to this project

Section b)

Enabling of Future Technological Functionality or Addressing of Future Operational Requirements

The nature of minor betterment projects involves the unplanned replacement of failed or close to failing assets and typically do not provide opportunities of **e**nabling of future technological functionality or addressing of future operational requirements.

Environmental Benefits (5.4.3.2.B.5)

The nature of these projects does not impact the environment in any substantial manner other than the impacts associated with the manufacturing of the materials.

Conservation and Demand Management (5.4.3.2.B.6)

Not applicable to this project

Category-Specific Requirements - System Renewal (5.4.3.2.C.b.)

SYSTEM RENEWAL SPECIFIC REQUIREMENTS (5.4.3.2.C.b)

Relationship Between the Characteristics of Targeted Assets and the Consequences of Asset Performance Deterioration or Failure (5.4.3.2.C.b.First Bullet)

Asset Performance Targets and Asset Lifecycle Optimization Policies and Practices (First Sub-Bullet)

Assets involved with these projects are replaced because they have failed or are close to failure and are usually done under emergency conditions. Lifecycle optimization policies and practices seek to avoid these kinds of circumstances. **See section 3.3 of the DSP for more information on Asset Life Cycle Optimization Policies and Practices.**

Asset Condition Relative to Typical Life Cycle (Second Sub-Bullet)

As stated above, the assets involved with these projects have failed or about to fail and therefore have reached the end of their life. The asset's condition relative to typical life varies from project by project, but the nature of the circumstances under which these projects occurs typically involves the asset exceeding their useful life

Number of Customers in Each Class Potentially Affected (Third Sub-Bullet)

The number of customers varies project by project

Quantitative Customer Impact and Risk (Fourth Sub-Bullet)

The quantitative customer impact varies project by project

Qualitative Customer Impact and Risk (Fifth Sub-Bullet)

The renewal of these assets will ensure future reliability statistics are maintained at or above the target, and eliminate safety issues All of which will maintain or improve customer satisfaction.

Value of Customer Impact (Sixth Sub-Bullet)

The value of customer impact varies project by project.

Other Factors Affecting Project Timing (5.4.3.2.C.b.Second Bullet)

Due to the nature of the projects, they are done immediately or scheduled very quickly. Other projects are deferred if required.

Consequences for System O&M costs (5.4.3.2.C.b.Third Bullet)

These projects do not materially impact system O&M costs

Reliability and Safety Factors (5.4.3.2.C.b.Fourth Bullet)

There will be no material impact on reliability, however spot replacement of end of life assets as a whole will help reduce interruptions related to failed equipment. The elimination of safety hazards are considered as factors to the importance of the project. See section 5.4.5.2.B.2 above.

Analysis of Project Benefits and Timing (5.4.3.2.C.b.Fifth Bullet)

Investments in this category are required immediately and are not subject to project prioritization as they for the most part are non-discretionary.

Like for Like Renewal Analysis (5.4.5.2.C.b.Sixth Bullet)

The majority of the assets replaced in this category fall under the like-for-like renewal but are typically not configured at extra costs. As noted above, sometimes assets are adjusted to align with future needs or to improve operation and/or efficiency all in efforts to save future costs. Due to the nature of the projects, this varies from project to project and when changes are made, the decisions behind them are typically made quickly. Note that these changes do not have significant benefits or costs. [I.e. Replacing a 40' pole with a 45' pole versus a 40' pole, the only difference in cost is the actual material pole cost, which is $60, as installation is the same for a 40' and 45'. Doing this will save the future costs associated with harvesting a new 40' pole that is too short for new construction.]

GENERAL INFORMATION ON THE PROJECT/PROGRAM (5.4.3.2.A)

2021 Capital Project Summary

5.4.3.2.A - General Information on the Project / Program

Project Name	MS15 Substation Rehabilitation - Construction
Investment Category	System Renewal
Project Description	The MS15 Substation Rehabilitation project involves the engineering (completed in 2020), construction, and commissioning of three new reclosers with their relays (including modifications to the supporting structure) as well as new SCADA equipment. MS15 is an outdoor style 44kV / 12.47 kV distribution substation with three feeders and oil filled reclosers servicing approximately 1050 customers. The existing oil filled reclosers are 25 years old and obsolete with spare parts no longer available. The existing relays are also at their end of life at 25 years old and while they may be adequate for overcurrent protection, they lack modern SCADA features and advanced functionality to support embedded distribution and other advanced applications. These relays have become technically obsolete. The same conditions apply to the existing Remote Terminal Unit (RTU) which will be replaced with a modern RTU. This project will also correct deficiencies with the perimeter fencing and layers of insulating stone.

Capital Investment

(5.4.3.2.A. First Bullet)	Gross Capital		$424,402
	O&M Costs (if applicable)		$0.00
(5.4.3.2.A. Second Bullet)	Capital Contributions		$0.00
	Net Capital		$424,402

Customer Attachments/Load (kVA)

(5.4.3.2.A. Third Bullet)	Customer Attachments (#):	1050
	Customer Load (peak KVA)	7860 kVA Peak Station Load

Project Timing

(5.4.3.2.A. Forth Bullet)	Start Date	Engineering Start Date		September 1, 2020
		Construction Start Date		May 15, 2021
	Expected In-Service Date	In Service Date		September 30, 2021
	Expenditure Timing	Q1:	0%	$0
		Q2:	50%	$212,201
		Q3:	50%	$212,201
		Q4:	0%	$0

GENERAL INFORMATION ON THE PROJECT/PROGRAM (5.4.3.2.A)		
	Risk and Risk Mitigation	
	(5.4.3.2.A. Fifth Bullet)	The largest risk will be the successful award of the project to a construction contractor. Within this broader scope of risk, the availability and the ability to complete the project within budget are two items outside of NBHDL's control. These risks will be reduced by the issuance of 2021 Q1 construction tender, that will go out to at least 5 bidders, and NBHDL's internal project management process as described below. The secondary risk to the project will be material delivery. Since the engineering for this will completed in 2020, materials can be ordered in 2020 for delivery in Q1 of 2021 in an effort to mitigate this risk. The project itself will be managed by NBHDL's internal project management process which includes update meetings, progress tracking, and developed action plans. NBHDL has also built into its schedule a buffer to allow for any unexpected issues which may cause delay to the construction start date. However, once construction starts, delays caused by equipment breakdowns, severe weather events (climate change), and sudden change in staffing resources cannot always be mitigated.
	Comparative Information	
	(5.4.3.2.A. Sixth Bullet)	A comparable project to the MS15 Rehabilitation project would be the MS11 Rehabilitation which occurred in 2019. The rehabilitation project involved replacing the relays and reclosers at the station. The equipment at MS11 had reached the end of its typical useful life, was technically obsolete, and had no available spare parts. The main driver for the project was risk of failure, with safety as the secondary driver. Civil works carried out at the same time as the equipment replacement included installing a ground grid, fencing, and additional insulating stone. The civil structures on which the reclosers are installed was also replaced. The structure did not provide clearance to ground in accordance with the current version of ESA Reg 22/04. NBHDL provided and installed new feeder cables for the station. MS11 Total Rehabilitation Cost - $414,750.48
	Total Capital & OM&A Costs Associated with REG Investments	
	(5.4.3.2.A. Seventh Bullet)	This project is not associated with REG investment; Capital and OM&A cost related to REG will not be incurred
	Leave to Construct Approval	
	(5.4.3.2.A. Eighth Bullet)	This project does not require Leave to Construct approval under Section 92 of the OEB Act and therefore this does not apply

EVALUATION CRITERIA AND INFORMATION REQUIREMENTS (5.4.3.2.B)		
	5.4.3.2.B - Evaluation Criteria and Information Requirements	
	Efficiency, Customer Value, Reliability (5.4.3.2.B.1)	
	Section a)	
	Main Driver (Trigger)	The main driver to this project is failure risk. The existing reclosers & relays are at the end of life at 25 years old and are obsolete. Replacement parts are no longer available and a failure would require replacement with a new recloser. An emergency replacement of a recloser could take a considerable amount of time to order and install. A feeder without a recloser relies on upstream protection to clear a fault which will take significantly longer to respond, if it is able to see the fault and respond. This can pose a public safety risk, for instance, a motor vehicle accident involving powerlines. For this reason, the affected feeder(s) at MS15 would be removed from service. MS15 is an important component in providing reliable service to a heavy commercial / industrial area of the City of North Bay, and a failure could mean that some customers could be left without power for a significant period of time as NBHDL reconfigures its system to push power from the city core to this section of the city. Important customers include a college, a community living center, an EMS station, an arena (also used as an emergency shelter), a bus station, a recycling & hazardous waste depot, and numerous manufacturing and processing facilities which would be significantly impacted by an outage. Having the MS15 feeders out of service would contribute more strain on neighboring stations and putting the system into a more vulnerable state. The RTU in the station is from the 1990's, it is at end of life, is obsolete and unsupported, with replacement parts no longer available. A failure of the RTU will significantly impact SCADA at the station and will hinder NBHDL's operational abilities. The RTU collects information from the station relays and provides operational and diagnostic information to NBHDL's SCADA system. If the RTU were to fail the station would not be able to communicate important information such as faults, failures, and other operational information to the control room. NBHDL considers SCADA a critical system in ensuring its distribution system remains safe and reliable. The information collected through SCADA is invaluable to NBHDL's operations.
	Related Objectives/Performance Targets	NBHDL Corporate Mission, Vision and Core Values CV3 and CV4 (as identified in Exhibit 1). This project contributes to NBHDL's goal of renewing its substation assets which are at end of life and maintaining its distribution network. The new reclosers, modern digital relays and modern RTU will decrease the failure risk of the station which will contribute to a more reliable station.
	Source and Nature of the Information Used to Justify the Investment	Costello Utility Consultants Substation Asset Condition Report, Metsco Asset Condition Report, NBHDL's Operating Knowledge and Experience

EVALUATION CRITERIA AND INFORMATION REQUIREMENTS (5.4.3.2.B)	**Secondary Drivers**	The secondary driver for this project is safety. If an outage were to leave some customers without power in the winter, it could be a serious public safety issue for keeping homes warm in Northern Ontario. Currently there are perimeter fencing deficiencies as well as a lack of sufficient amounts of insulating stone for the ground. The perimeter fence deters the general public from contacting electrical equipment and requires grounding and bonding to create safe touch voltages during faults. The stone cover increases the resistance of the top layer on the ground and increases the tolerable ground potential rise voltage during a fault. These will be corrected as part of the rehabilitation project.
	Related Objectives/Performance Targets	NBHDL Corporate Mission, Vision and Core Values CV2 and CV4 (as identified in Exhibit 1). The objective for the secondary driver of Safety is to bring the fence and stone up to current ESA Reg 22/04 standards.
	Source and Nature of the Information Used to Justify the Investment	Costello Utility Consultants Substation Asset Condition Report, Metsco Asset Condition Report, NBHDL's Operating Knowledge and Experience
	Section b)	
	Reliability Planning and Resilient Distribution System Design	North Bay Hydro adheres to good utility practice in ensuring that all projects are designed to be a part of resilient and reliable distribution system. While the MS15 Rehabilitation Project will not be a major re-design, improvement will still be made to the existing equipment and extend the life of the station by 20-25 years. The oil filled reclosers and relays are at end of life and are obsolete. If one of the reclosers were to fail, the station feeder or the whole station would be removed from service reducing the resiliency of the distribution network by decreasing the number of in-service assets and total capacity of the system. The oil filled reclosers will be replaced with modern vacuum reclosers. Newer reclosers will have a significantly reduced risk of failure, as well as available spare parts. The existing RTU is obsolete, at end of life, and there are no spare parts available. The RTU will be replaced with a modern unit which will be more reliable and allow for greater functionality. New RTUs are supported by manufacturers, and if an issue occurs it can be resolved. A new unit will be able to convey important operational information more quickly and reliably, with significantly reduced risk of failure.
	Adaptation to Future Challenges	The existing RTU is obsolete, at end of life, and there are no spare parts available. The RTU will be replaced with a modern unit which will allow for greater functionality in future smart grid initiatives. New RTUs have modern communication abilities, can be connected to field devices for greater smart grid capabilities, and can interface with more devices. The existing RTU is using a serial connection to communicate using the WiMAX system. The new RTU will be able to take advantage of the communication system, with greater cyber security, and convey important operational information more quickly and reliably.

EVALUATION CRITERIA AND INFORMATION REQUIREMENTS (5.4.3.2.B)	**Section c)**	
	Investment Priority Relative to Other Investments	Substation assets are prioritized separately from overhead / underground lines assets and the MS15 rehabilitation is the only substation construction project planned for 2021. The MS15 Rehabilitation project ranks as #1 in its prioritization for substation assets. Renewing the substation's assets which are at end of life is critical to continued safe and reliable electricity distribution. Many of the benefits associated with this project are avoided costs and reduction in risk cost. If a recloser were to fail, the associated unsupplied energy costs, as well as the impact to customer satisfaction and customer value, would be significant. The MS15 station supplies a considerable number of NBHDL's customers, as well as a number of customers which are difficult to supply from other stations. The increase in O&M costs from an RTU failure, such as truck rolls for things which can be done remotely, or increased time and resources locating an outage, can become a significant avoided cost. After this project is complete, along with other renewal projects which have been completed in the last few years, MS15 will be completely renewed.
	Prioritization Approach	NBHDL prioritizes the renewal of its substation assets based on the recommendation of the assessment report prepared by industry experts. NBHDL paces its substation investments as required based on the practices of its asset management.

EVALUATION CRITERIA AND INFORMATION REQUIREMENTS (5.4.3.2.B)		
	Section d) Analysis of the Project and Project Alternatives	
	Effect on System Operation Efficiency and Cost-Effectiveness (First Bullet)	This project will reduce the risk of failure and the associated increase to O&M costs (the lifetime cost of the asset increases as it exceeds its useful life). The oil reclosers are obsolete and at end of life. If one were to fail there would be a significant operational impact to the distribution system including sustained outages and decreased redundancy. It will reduce the risk of a failure to North Bay Hydro's SCADA equipment. If the RTU were to fail, it would result in significantly higher operating cost as multiple truck rolls to the station would be required for processes that are normally controlled remotely (such as hold offs). Operational data would also be cut off hindering system health monitoring such as system loading and voltage checks. Troubleshooting data would also not be made available to the control room, increasing outage durations as a truck would need to patrol the line.
	Net Benefits Accruing to Customers (Second Bullet)	The avoidance of potentially adverse effects on reliability will benefit customers, as outages can be a major inconvenience and a loss to productivity to businesses and residents who work from home. An avoidance of increased maintenance costs and maintaining remote control capabilities impacts the overall cost for the delivery of electricity.
	Impact on Reliability Performance (Including on the Frequency and Duration of Outages) (Third Bullet)	This project will avoid an adverse impact to the reliability performance of this line. If this project is not implemented, there will be a substantial increase to the risk of equipment failure. A failure of the reclosers would cause preventable sustained outages.
	Project Alternatives	There is no viable alternative to this project. SCADA and reclosers are considered an integral part of NBHDL's ability to safely and effectively operate its distribution system. Leaving the station in its present state has the potential to cause safety and reliability issues and lead to an increase in O&M costs for both routine maintenance requirements and truck rolls in the event of a failed asset. Deferring the project in favour for another project will result in overall lost benefit as determined by North Bay Hydro's Project Planning prioritization (see section 5.4.3.2.B.1.c for Prioritization Approach).
	Safety (5.4.3.2.B.2)	
	This project will also eliminate hazards associated with fencing issues (public safety) and inadequate insulating stone. A station's fence is the primary security feature to physically prevent the general public from accessing energized equipment and other potentially dangerous situations which can occur in a substation. The fence also needs to be properly bonded and grounded to mitigate potential touch hazards during a fault or equipment failure. The insulating stone increases the resistance of the ground surface and increases the tolerable ground potential rise voltage, which is both a worker and public safety issue.	
	Cyber-Security, Privacy (5.4.3.2.B.3)	
	New SCADA, digital relays, RTUs, and the WiMAX communication system are all designed with cyber security in mind. These systems provide necessary functionality for protection, SCADA, and investigation of incidents which is why they must be secured. The substation and SCADA networks are included in NBHDL's overall cyber security plan.	

EVALUATION CRITERIA AND INFORMATION REQUIREMENTS (5.4.3.2.B)

Co-ordination, Interoperability (5.4.3.2.B.4)

Section a)

Co-ordination with Utilities, Regional Planning and/or Links with 3rd Party Providers and/or Industry

Coordination with utilities, regional planning, third party providers, or other industries is not applicable to this project. This is an existing station with no forecasted significant changes in loading.

Section b)

Enabling of Future Technological Functionality or Addressing of Future Operational Requirements

This project will replace the existing RTU and relays with a modern unit which will have much greater future technological functionality.

The existing RTU's processing power is significantly less than the newer technology, limiting its ability to integrate with newer smart grid technologies. The RTU cannot take full advantage of the NBHDL's WiMAX system because it is a serial interface. A new RTU would be able to serve up diagnostic and troubleshooting information to SCADA much more quickly and securely using TCP/IP. The new unit will have current technology and is capable of integrating with existing smart grid equipment and processing information from other field devices if required. Furthermore, the RTU is no longer supported and cannot receive programming updates, whereas a new unit will be supported by its manufacturer.

The new relays have more built-in functionality than the existing units. The new units can send oscillography and sequence of event records remotely to NBHDL's control room, aiding in outage response times. New relays also have built-in distributed generation protection capabilities, enabling future smart grid projects.

Environmental Benefits (5.4.3.2.B.5)

Electrical equipment has historically used oil or gas as insulating materials in load break equipment. Oil and gas leaks can prove to be environmentally detrimental, especially if the materials enter a local water system. Used oil must be disposed of appropriately, and more oil must be manufactured to refill the reclosers. This project will replace the existing oil reclosers with vacuum reclosers that are oil / gas free and are more environmentally friendly. Pulling a vacuum in a sealed chamber is more environmentally friendly because there are no waste products or possible environmental containments if the recloser has a failure. If the vacuum seal were to fail, air would enter the recloser and that would be the extent of the environmental changes in the area.

Conservation and Demand Management (5.4.3.2.B.6)

This project is not applicable to any rate funded conservation or demand program.

SYSTEM RENEWAL SPECIFIC REQUIREMENTS (5.4.3.2.C.b)

Category-Specific Requirements - System Renewal (5.4.3.2.C.b.)

Relationship Between the Characteristics of Targeted Assets and the Consequences of Asset Performance Deterioration or Failure (5.4.3.2.C.b. First Bullet)

Asset Performance Targets and Asset Lifecycle Optimization Policies and Practices (First Sub-Bullet)

The existing assets (reclosers and RTU) are past their useful life and will result in an increase of the asset's lifecycle cost and an increase in the risk of failure. The oil reclosers were installed in 1990 and have fulfilled the expected years of service. The RTU is also from the 90's and is well beyond its technical useful life, and is obsolete. These assets have been utilized beyond the expected lifetime and are in need of replacement.

Asset Condition Relative to Typical Life Cycle (Second Sub-Bullet)

The station assessment has shown the condition of the assets are typical for the age of the assets, however, the reclosers and RTU are at the end of their typical life cycle, and are technologically obsolete and at risk of failure.

Number of Customers in Each Class Potentially Affected (Third Sub-Bullet)

15F1

- Residential: 119
- GS: 281

15F2

- Residential: 173
- GS: 97

15F3

- Residential: 365
- GS: 15

Quantitative Customer Impact and Risk (Fourth Sub-Bullet)

The area supplied by MS15 include residential, commercial and industrial area with long feeders, parts of which are along treed areas. North Bay Hydro collects outages statistics to analyze it distribution system performance on a feeder level with a particular focus on interruptions caused by defective equipment and tree contacts.

If this project is not implemented, there will be a substantial increase to the risk of equipment failure and therefore an increased risk to sustained outages. There are momentary and sustained faults downstream of MS15 every year, and it is critical that the station equipment can react to protect the public and distribution system.

Qualitative Customer Impact and Risk (Fifth Sub-Bullet)

The rehabilitation of MS15 will address aging assets serving a significant number of customers. The age of the reclosers represents an increased risk of service interruption to customers. In the event of catastrophic failure, some customers may be without power for a substantial period of time due to the need to push power from neighbouring stations to the area. This service area contains many important customers which includes a college, a community living center, an EMS station, an arena (also used as an emergency shelter), a bus station, a recycling & hazardous waste depot, and numerous manufacturing and processing facilities which would be significantly impacted by an outage. If this situation were to occur during the winter, it could pose a significant public safety issue. Customer safety could be impacted, and satisfaction would be extremely low in such a case. The MS15 Rehabilitation project will address the issue by minimizing risk and ensuring customer satisfaction is maintained at a high level. Replacing the assets would increase the reliability of the station, which is consistent with industry goals and customer expectations.

SYSTEM RENEWAL SPECIFIC REQUIREMENTS (5.4.3.2.C.b)	
	Value of Customer Impact (Sixth Sub-Bullet)
	Customer impact is high in terms of the consequence of potential failure. In the event of a failure, a large number of customers would be impacted and backup service may not be available for all customers. Although customer impact will always be high because substation assets serve a large number of customers, the MS15 rehabilitation project will minimize the probability of failure to ensure customer impact is managed.
	Other Factors Affecting Project Timing (5.4.3.2.C.b. Second Bullet)
	North Bay Hydro used Costello's Substation Condition Assessment Report to identify substation deficiencies to determine the priorities based on the factors identified in section 5.4.3.2.B.1.c for Prioritization Approach. For system renewal projects, the reduction of the risk cost (probability of failure vs the consequence of failure) and the optimization of the total life cycle cost for the asset is the main consideration for project benefits and prioritization. The timing of the proposed projects have been planned in a manner to maximize investment benefits.
	Consequences for System O&M costs (5.4.3.2.C.b. Third Bullet)
	This project will reduce the risk of equipment failure which will always result in a trouble call. It will also reduce the risk of a failure to North Bay Hydro's SCADA equipment, which would result in multiple truck rolls to the station for processes that are normally controlled remotely (such as hold offs). A failure in SCADA connectivity would increase operational costs due to truck patrolling when trying to locate the cause of an outage. Regular maintenance costs can also be slightly reduced as vacuum reclosers have less maintenance costs than oil reclosers.
	Reliability and Safety Factors (5.4.3.2.C.b. Fourth Bullet)
	This project will not have a material impact on improving the system reliability, but there will be a detrimental impact on system reliability if the project is not implemented. The impacts on public safety and the elimination of potential hazards were considered as factors to the importance of the project (See section 5.4.3.2.B.2 above).
	Analysis of Project Benefits and Timing (5.4.3.2.C.b. Fifth Bullet)
	North Bay Hydro uses the substation condition report information to organize the most appropriate timing of its projects (see section 5.4.3.2.B.1.c for Prioritization Approach). For system renewal projects, the reduction of the risk cost (probability of failure vs the consequence of failure) and the optimization of the total life cycle cost for the asset is the main consideration for project benefits and prioritization. The timing of NBHDL's proposed projects have been planned in a manner to maximize investment benefits.
	Like for Like Renewal Analysis (5.4.5.2.C.b. Sixth Bullet)
	Like for like renewal analysis of this project is not applicable as this project has not been configured at an extra cost to address other distributor planning objectives. This project has been configured solely to meet a system renewal requirement and any benefits that are realized as a result.

GENERAL INFORMATION ON THE PROJECT/PROGRAM (5.4.3.2.A)

2021 Capital Project Summary

5.4.3.2.A - General Information on the Project / Program

Project Name	MS18 Substation Rehabilitation - Engineering
Investment Category	System Renewal
Project Description	The MS18 Substation Rehabilitation project involves the substation engineering review and design of ground grid improvements, switch gears, relays and Remote Terminal Unit (RTU) replacements. The current ground grid does not currently cover all touch potential gate areas as well as the areas outside the building. The existing switchgears, relays and RTU are at end of life and were identified as requiring replacement during the preliminary investigation. The project will also correct deficiencies with the riser pole, perimeter fencing, and layers of insulating stone. Part of this work will be to determine the exact scope of work for the construction. Construction and commissioning of these improvements will occur in 2022.

Capital Investment

(5.4.3.2.A. First Bullet)	Gross Capital	$82,619
	O&M Costs (if applicable)	$0.00
(5.4.3.2.A. Second Bullet)	Capital Contributions	$0.00
	Net Capital	$82,619

Customer Attachments/Load (kVA)

(5.4.3.2.A. Third Bullet)	Customer Attachments (#):	1720
	Customer Load (peak KVA)	Transformer T1: 7950 kVA
		Transformer T2: 4720 kVA

Project Timing

(5.4.3.2.A. Forth Bullet)	Start Date	Engineering Start Date	July 2, 2021
		Construction Start Date	May 15, 2022
	Expected In-Service Date	In Service Date	August 30, 2022
	Expenditure Timing	Q1: 0%	$0
		Q2: 0%	$0
		Q3: 100%	$82,619
		Q4: 0%	$0

GENERAL INFORMATION ON THE PROJECT/PROGRAM (5.4.3.2.A)	**Risk and Risk Mitigation**	
	(5.4.3.2.A. Fifth Bullet)	Risks for this project are minimal as the work is only for the engineering of the work to be undertaken in 2022. The largest risks for this project are as follows: 1) Scope creep: During the engineering process, additional deficiencies could be identified and require repairs/replacements. This would increase the scope of the engineering work and therefore increase the cost of the engineering work. This in turn will increase the cost of the overall project for 2022. Mitigation: During design, NBH shall ensure that any recommendations from the consultant for additional work is properly justified and reviewed. Only issues that are of significant importance that would have an impact on the overall life of the asset will be entertained for improvements. NBH shall monitor closely the level of effort the consultant undertakes for all work, including this additional work, to ensure that it is reasonable in cost and time. 2) Schedule delays: Although this is a small risk considering the current scope of the project. If the project does not start on schedule or the consultant progresses slowly through the project, the engineering could drag on into Q4 or even 2022. Mitigation: NBH shall initiate the hiring of the consultant in the 1st or 2nd quarter of 2021 to ensure the project starts on time in the 3rd quarter. The design of this project shall take approximately 3 months. NBH will also project manage the consultant closely to ensure regular progress is made and the engineering schedule is followed. 3) Tendering prices: NBH will issue a tender package for consulting engineering firms to bid on the design of this work. Depending on market conditions, the cost of the work could end up being higher or lower than expected, which would require adjustments in capital project delivery. Mitigation: NBH will advertise the engineering early in 2021 as this typically provides more competitiveness amongst the engineering firms as they look for work in 2021. Securing a consultant early will provide the best approach. The other mitigating aspect will be to clearly scope out the assignment. Terms of reference that are specific with minimal room for interpretation typically provide better tender prices due to reduced risks to the consultant's work. The project itself will be managed by NBHDL's internal project management process which includes update meetings, progress tracking, and developed action plans.
	Comparative Information	
	(5.4.3.2.A. Sixth Bullet)	A best comparable project to the MS18 Engineering project would be the MS11/MS13 engineering work which occurred in 2019. The rehabilitation project involved replacing the ground grid, fence, relays, reclosers and RTUs at the station. The equipment at MS11/MS13 had reached the end of its typical useful life, was technically obsolete, and had no available spare parts. The main driver for the project was risk of failure, with safety as the secondary driver Although some of the replacement components are not the same as the

		requirements for MS18, the tender documents and contract package drawings will be similar. The MS18 facility is an urban building design which increases the complexity of the rehabilitation which will require more time and offset the lower engineering costs due to components that will not be replaced. MS11/MS13 Engineering Costs: $ 118,908 for two stations ($59,454 each) (this bid was approximately 35% below expectations). The successful consultant was new to NBH and they advised they provided a low bid in order to demonstrate that they could perform good work and develop a relationship with NBH. The average bid price from all consultants was $150,254 for both stations.
	Total Capital & OM&A Costs Associated with REG Investments	
	(5.4.3.2.A. Seventh Bullet)	This project is not associated with REG investment; Capital and OM&A cost related to REG will not be incurred
	Leave to Construct Approval	
	(5.4.3.2.A. Eighth Bullet)	This project does not require Leave to Construct approval under Section 92 of the OEB Act and therefore this does not apply

EVALUATION CRITERIA AND INFORMATION REQUIREMENTS (5.4.3.2.B)		
	5.4.3.2.B - Evaluation Criteria and Information Requirements	
	Efficiency, Customer Value, Reliability (5.4.3.2.B.1)	
	Section a)	
	Main Driver (Trigger)	The main driver to this project is to ensure the engineering is completed in 2021 so that the project can be tendered for construction early in 2022 in order to get the best bid prices and minimize schedule risks. North Bay Hydro evaluates all its substation assets and replaces them in a planned manner that distributes work throughout the forecasted years to balance its expenditures. NBHDL typically performs construction on one substation and the engineering of next year's substation, every year. By performing the engineering in the prior year, NBHDL can be ready to tender the work early in the following year. Advertising contracts early provide the most competitive bidding environment which reduces the cost of construction to the utility. It also allows sufficient time to develop the most cost-effective design possible. The switchgears are from 1997 and will be 25 years old at the time of replacement which is the end of their typical service life. In 2020, a switchgear failure created a critical outage and the repairs required the station to be down for an extended period of time. Their condition is currently fair, however due to the need to distribute substation investments, NBHDL plans to replace them in 2022. The ground grid improvements are required to ensure adequate safety to NBH workers and the public. Since this station is located downtown, there are numerous pedestrians and people lurking around the area and some of them were living on the property, outside the station walls. Having many people around increases the risk of a touch potential incident. The RTU, relays and reclosers in the station are from 1997, are at end of life, obsolete and unsupported, with replacement parts no longer available. A failure of the RTU or relays will significantly impact SCADA at the station and will hinder NBHDL's operational abilities. The RTU collects information from the station relays and provides operational and diagnostic information to NBHDL's SCADA system. If the RTU were to fail the station would not be able to communicate important information such as faults, failures, and other operational information to the control room. NBHDL considers SCADA a critical system in ensuring its distribution system remains safe and reliable. The information collected through SCADA is invaluable to NBHDL's operations. Ultimately, RTU or relay failures at MS18 will increase the response time in the downtown area of North Bay. An area that is critical for the North Bay economy. Reclosers will also need to be replaced in the future, but since their condition is considered good, NBHDL will attempt to extend their service life.
	Related Objectives/Performance Targets	NBHDL Corporate Mission, Vision and Core Values CV3 and CV4 (as identified in Exhibit 1). This project contributes to NBHDL's goal of renewing its substation assets which are at end of life and maintaining its distribution network. The new, modern digital relays, RTU and switchgear will decrease the failure risk of the station which will contribute to a more reliable station.

	Source and Nature of the Information Used to Justify the Investment	Costello Utility Consultants Substation Asset Condition Report, Metsco Asset Condition Report, NBHDL's Operating Knowledge and Experience
EVALUATION CRITERIA AND INFORMATION REQUIREMENTS (5.4.3.2.B)	**Secondary Drivers**	The secondary driver for this project is safety. If an outage were to leave some customers without power in the winter, it could be a serious public safety issue for keeping homes warm in rural Northern Ontario. Even during months without extreme weather, customers, for example, requiring oxygen, elevators, or stair lifts, would have a more dangerous situation without power for 24-48 hours. Currently there are perimeter fencing deficiencies as well as a lack of insulating stone for the ground. The perimeter fence deters the general public from making contact with electrical equipment and requires grounding and bonding to create safe touch voltages during faults. The stone cover increases the resistance of the top layer on the ground and increases the tolerable ground potential rise voltage during a fault. These will be corrected as part of the rehabilitation project. Fencing improvements and vegetation clearing will be required to ensure homeless people do not utilize the substation yard as a living space.
	Related Objectives/Performance Targets	NBHDL Corporate Mission, Vision and Core Values CV2 and CV4 (as identified in Exhibit 1). The objective for the secondary driver of Safety is to bring the fence and stone up to current ESA Reg 22/04 standards.
	Source and Nature of the Information Used to Justify the Investment	Costello Utility Consultants Substation Asset Condition Report, Metsco Asset Condition Report, NBHDL's Operating Knowledge and Experience
	Section b)	
	Reliability Planning and Resilient Distribution System Design	North Bay Hydro adheres to good utility practice in ensuring that all projects are designed to be a part of resilient and reliable distribution system. While the MS18 Rehabilitation – Engineering project will not be a major re-design, the improvements will prepare for construction that will extend the life of the station by 20-25 years. The switchgears will be approaching 25 years of age at replacement. Failure are one of the switchgears resulted in an outage and significant downtime in the downtown area. The existing RTU is obsolete, at end of life, and there are no spare parts available. The RTU will be replaced with a modern unit which will be more reliable and allow for greater functionality. New RTUs are supported by manufacturers, and if an issue occurs it can be resolved. A new unit will be able to convey important operational information more quickly and reliably, with significantly reduced risk of failure. The existing relays are obsolete and regularly create communication errors with the control station. They are outdated and will be replaced with newer models.
	Adaptation to Future Challenges	The RTU will be replaced with a modern unit which will allow for greater functionality in future smart grid initiatives. New RTUs have modern communication abilities, can be connected to field devices for greater smart grid capabilities, and can interface with more devices. The existing RTU is using a serial connection to communicate using the WiMAX system. The new RTU will

		be able to take advantage of the communication system, with greater cyber security, and convey important operational information more quickly and reliably. The new relays will have the potential to provide additional functionality in the future when North Bay hydro upgrades its SCADA system. It will also be ready to accommodate new reclosers as required.

EVALUATION CRITERIA AND INFORMATION REQUIREMENTS (5.4.3.2.B)	**Section c)**	
	Investment Priority Relative to Other Investments	Substation assets are prioritized separately from overhead and underground line assets. Of the two Distribution System renewal substations projects planned for 2021, the MS18 Rehabilitation Engineering project **ranks as #2 in its prioritization**. Proper engineering completed in a manner to provide the best cost-effective solution is required for every project. This will allow NBHDL to be ready for advertising in the most competitive season which will allow NBHDL to save money and maximize value. Delaying the engineering to the following year will push out the tender dates when contractors are already busy and push the construction period to the fall which is not ideal for restoration and preventative maintenance prior to energizing the station. (NBHDL always performs preventative maintenance following construction activities at a substation when the station is down to minimize customer impacts and maximize work efficiency). Renewing the substation's assets which are at end of life is critical to continued safe and reliable electricity distribution. Many of the benefits associated with this project are avoided costs and reduction in risk cost. If a switchgear were to fail again, the associated unsupplied energy costs, as well as the impact to customer satisfaction and customer value, would be significant. The MS18 station supplies a considerable number of NBHDL's important customers (downtown area, municipal and provincial government, etc.). The increase in O&M costs from an RTU failure, such as truck rolls for things which can be done remotely, or increased time and resources locating an outage, can become a significant avoided cost.
	Prioritization Approach	See Section 4.2.2 of the DSP. North Bay Hydro uses the recommendation of output of the Substation Condition Assessment Report and Substation Consulting experts to prioritize its substation projects.

EVALUATION CRITERIA AND INFORMATION REQUIREMENTS (5.4.3.2.B)		
	Section d) Analysis of the Project and Project Alternatives	
	Effect on System Operation Efficiency and Cost-Effectiveness (First Bullet)	This project will prepare for the construction of MS18 which will reduce the risk of failure and the associated increase to O&M costs (the lifetime cost of the asset increases as it exceeds its useful life). It will reduce the risk of a failure to North Bay Hydro's SCADA equipment. If the RTU were to fail, it would result in significantly higher operating cost as multiple truck rolls to the station would be required for processes that are normally controlled remotely (such as hold offs). Operational data would also be cut off hindering system health monitoring such as system loading and voltage checks. Troubleshooting data would also not be made available to the control room, increasing outage durations as a truck would need to patrol the line.
	Net Benefits Accruing to Customers (Second Bullet)	The avoidance of potentially adverse effects on reliability will benefit customers, as outages can be a major inconvenience and a loss to productivity to businesses and residents who work from home. An avoidance of increased maintenance costs and maintaining remote control capabilities impacts the overall cost for the delivery of electricity.
	Impact on Reliability Performance (Including on the Frequency and Duration of Outages) (Third Bullet)	This project will avoid an adverse impact to the reliability performance of this line. If this project is not implemented, there will be a substantial increase to the risk of equipment failure. A failure of the reclosers would cause preventable sustained outages. In 2020, NBHDL experienced a failure in the 18T2-L switch gear which resulted in an outage of the 15M3 44kV sub transmission feeder. This was a significant outage effecting approximately 3,560 customers (0.147 SAIFI) for 2 hours (0.294 SAIDI) as crews worked to isolate the station and resupply the affected areas from neighboring stations. As seen from the case above, a single failure of an important substation asset such as a switch gear or recloser can have significant impacts on reliability performance.
	Project Alternatives	The alternatives are as follows: 1) Not perform the engineering in 2021 and complete in 2022 during the same year as the planned construction. This will increase costs for 2022 due to additional work requirements and delays in construction. It will also cause workload issues with internal staff as they will have extra time to support work in 2021 and be overloaded with work in 2022. 2) Perform design work in-house. North Bay Hydro does not have sufficient internal knowledge to properly design a substation. 3) Leaving the station in its present state has the potential to cause safety and reliability issues and lead to an increase in O&M costs for both routine maintenance requirements and truck rolls in the event of a failed asset. 4) Replacing the project in favour for another project will result in overall lost benefit as determined by North Bay Hydro's Project Planning prioritization (see section 5.4.3.2.B.1.c for Prioritization Approach).
	Safety (5.4.3.2.B.2)	

	This project will also eliminate hazards associated with fencing issues (public safety) and inadequate insulating stone. A station's fence is the primary security feature to physically prevent the general public from accessing energized equipment and other potentially dangerous situations which can occur in a substation. The fence also needs to be properly bonded and grounded to mitigate potential touch hazards during a fault or equipment failure. The insulating stone increases the resistance of the ground surface and increases the tolerable ground potential rise voltage, which is both a worker and public safety issue. There are many homeless people in that area that have setup living quarters in the substation yard. Improving the fence will improve the safety in the area for all people.
	Cyber-Security, Privacy (5.4.3.2.B.3)
	New SCADA, digital relays, RTUs, and the WiMAX communication system are all designed with cyber security in mind. These systems provide necessary functionality for protection, SCADA, and investigation of incidents which is why they must be secured. The substation and SCADA networks are included in NBHDL's overall cyber security plan.
EVALUATION CRITERIA AND INFORMATION REQUIREMENTS (5.4.3.2.B)	**Co-ordination, Interoperability (5.4.3.2.B.4)** **Section a)** **Co-ordination with Utilities, Regional Planning and/or Links with 3rd Party Providers and/or Industry**
	Coordination with utilities, regional planning, third party providers, or other industries is not applicable to this project. This is an existing station with no forecasted significant changes in loading.
	Section b) **Enabling of Future Technological Functionality or Addressing of Future Operational Requirements**
	This project will replace the existing RTU and relays with a modern unit which will have much greater future technological functionality. The existing RTU's processing power is significantly less than the newer technology, limiting its ability to integrate with newer smart grid technologies. The RTU cannot take full advantage of the NBHDL's WiMAX system because it is a serial interface. A new RTU would be able to serve up diagnostic and troubleshooting information to SCADA much more quickly and securely using TCP/IP. The new unit will have current technology and is capable of integrating with existing smart grid equipment and processing information from other field devices if required. Furthermore, the RTU is no longer supported and cannot receive programming updates, whereas a new unit will be supported by its manufacturer. The new relays have more built-in functionality than the existing units. The new units can send oscillography and sequence of event records remotely to NBHDL's control room, aiding in outage response times. New relays also have built-in distributed generation protection capabilities, enabling future smart grid projects.
	Environmental Benefits (5.4.3.2.B.5)
	Electrical equipment has historically used oil or gas as insulating materials in load break equipment. Oil and gas leaks can prove to be environmentally detrimental, especially if the materials enter a local water system. This engineering project will ensure that all replaced components include the most environmentally sustainable standards and adhere to the latest environmental regulations.
	Conservation and Demand Management (5.4.3.2.B.6)
	This project is not applicable to any rate funded conservation or demand program.

SYSTEM RENEWAL SPECIFIC REQUIREMENTS (5.4.3.2.C.b)

Category-Specific Requirements - System Renewal (5.4.3.2.C.b.)

Relationship Between the Characteristics of Targeted Assets and the Consequences of Asset Performance Deterioration or Failure (5.4.3.2.C.b. First Bullet)

Asset Performance Targets and Asset Lifecycle Optimization Policies and Practices (First Sub-Bullet)

The existing RTU is past its useful life and will result in an increase of the asset's lifecycle cost and an increase in the risk of failure. The switchgear was installed in 1990, has already suffered a major failure and is classified as having a "fair" condition, installed in 1990 and have fulfilled the expected years of service. The risk of failure for this switchgear is considered high since it has already failed once. These assets have been utilized beyond the expected lifetime and are in need of replacement.

Asset Condition Relative to Typical Life Cycle (Second Sub-Bullet)

The station assessment has shown the condition of the majority of the assets are typical for the age of the assets, however, the switchgear, reclosers and RTU are at the end of their typical life cycle, and are technologically obsolete and at risk of failure. The condition of the reclosers at the station is considered "good", therefore replacement is not expected at this time, however they will be reviewed as part of this engineering assignment.

Number of Customers in Each Class Potentially Affected (Third Sub-Bullet)

18F1

- Residential: 165
- GS: 105

18F2

- Residential: 314
- GS: 26

18F3

- Residential: 63
- GS: 27

18F4

- Residential: 263
- GS: 147

18F5

- Residential: 152
- GS: 128

18F6

- Residential: 212
- GS: 118

Quantitative Customer Impact and Risk (Fourth Sub-Bullet)

The area supplied by MS18 is the downtown urban area. North Bay Hydro collects outage statistics to analyze the distribution system performance on a feeder level with a particular focus on interruptions caused by defective equipment and tree contacts. If this project is not implemented, there will be a substantial increase to the risk of equipment failure and therefore an increased risk to sustained outages. There are momentary and sustained faults downstream of MS18 every year, and it is critical that the station equipment can react to protect the public and distribution system.

Qualitative Customer Impact and Risk (Fifth Sub-Bullet)

	The rehabilitation of MS18 will address aging assets serving a significant number of customers. In the event of catastrophic failure, some customers may be without power for 24-48 hours due to the inability to push power from neighbouring stations to the City limits. If this situation were to occur during the winter, it would pose a significant public safety issue. Customer safety could be impacted, and satisfaction would be extremely low in such a case. The MS18 Rehabilitation project will address the issue by minimizing risk and ensuring customer satisfaction is maintained at a high level. Replacing the assets would increase the reliability of the station, which is consistent with industry goals and customer expectations.
SYSTEM RENEWAL SPECIFIC REQUIREMENTS (5.4.3.2.C.b)	**Value of Customer Impact (Sixth Sub-Bullet)**
	Customer impact is high in terms of the consequence of potential failure. In the event of a failure, a large number of customers, including numerous business, would be impacted and backup service may not be available for all customers. Although customer impact will always be high because substation assets serve a large number of customers, the MS18 rehabilitation project will minimize the probability of failure to ensure customer impact is managed.
	Other Factors Affecting Project Timing (5.4.3.2.C.b. Second Bullet)
	North Bay Hydro used Costello's Substation Condition Assessment Report to identify substation deficiencies to determine the priorities based on the factors identified in section 5.4.3.2.B.1.c for Prioritization Approach. For system renewal projects, the reduction of the risk cost (probability of failure vs the consequence of failure) and the optimization of the total life cycle cost for the asset is the main consideration for project benefits and prioritization. The timing of the proposed projects has been planned in a manner to maximize investment benefits.
	Consequences for System O&M costs (5.4.3.2.C.b. Third Bullet)
	This project will reduce the risk of equipment failure which will always result in a trouble call. It will also reduce the risk of a failure to North Bay Hydro's SCADA equipment, which would result in multiple truck rolls to the station for processes that are normally controlled remotely (such as hold offs). A failure in SCADA connectivity would increase operational costs due to truck patrolling when trying to locate the cause of an outage. Regular maintenance costs can also be slightly reduced as vacuum reclosers have less maintenance costs than oil reclosers.
	Reliability and Safety Factors (5.4.3.2.C.b. Fourth Bullet)
	This project will not have a material impact on improving the system reliability, but there will be a detrimental impact on system reliability if the project is not implemented. The impacts on public safety and the elimination of potential hazards were considered as factors to the importance of the project (See section 5.4.3.2.B.2 above).
	Analysis of Project Benefits and Timing (5.4.3.2.C.b. Fifth Bullet)
	North Bay Hydro uses the substation condition report information to organize the most appropriate timing of its projects (see section 5.4.3.2.B.1.c for Prioritization Approach). For system renewal projects, the reduction of the risk cost (probability of failure vs the consequence of failure) and the optimization of the total life cycle cost for the asset is the main consideration for project benefits and prioritization. The timing of NBHDL's proposed projects have been planned in a manner to maximize investment benefits.
	Like for Like Renewal Analysis (5.4.5.2.C.b. Sixth Bullet)
	Like for like renewal analysis of this project is not applicable as this project has not been configured at an extra cost to address other distributor planning objectives. This project has been configured solely to meet a system renewal requirement and any benefits that are realized as a result.

GENERAL INFORMATION ON THE PROJECT/PROGRAM (5.4.3.2.A)

2021 Capital Project Summary

5.4.3.2.A - General Information on the Project / Program

Project Name

Primary Services - System Renewal

Investment Category

System Renewal

Project Description

Primary service are services where high voltage (12.47kV or 4.1kV) is supplied to a property typically for a large load customer. Primary Service projects (system renewal) represents a number of small unplanned projects that may take place over the year involving the replacement of a NBHDL owned primary service asset. This can include the replacement of underground cables, terminations, conduit, transformer bases, and any other auxiliary equipment that is found to be in very poor condition and is in need of immediate or near future replacement.

This type of project typically arises from trouble calls, maintenance inspections, and information provided from 3rd parties.

Capital Investment

(5.4.3.2.A. First Bullet)

Gross Capital	$132,411
O&M Costs (if applicable)	N/A

(5.4.3.2.A. Second Bullet)

Capital Contributions	$0.00
Net Capital	$132,411

Customer Attachments/Load (kVA)

(5.4.3.2.A. Third Bullet)

Customer Attachments (#):	N/A
Customer Load (peak KVA)	N/A

Project Timing

(5.4.3.2.A. Forth Bullet)

Start Date	January 1, 2021		
Expected In-Service Date	December 31, 2021		
Expenditure Timing	Q1:	25%	$33,103
	Q2:	25%	$33,103
	Q3:	25%	$33,103
	Q4:	25%	$33,103

Risk and Risk Mitigation

(5.4.3.2.A. Fifth Bullet)	The circumstances in which primary service (system renewal) projects occur often requires the immediate attention as the asset has failed or is near failure. The risk to implementation of these projects is typically not applicable as they often involve "like for like" replacements performed under emergency / high priority basis as a response to a trouble call or a field inspection.

Comparative Information (5.4.3.2.A. Sixth Bullet)

Primary service projects are budgeted using a five-year historical average. Comparable investments in previous years are as follows:

	Actual						Planned	
	2015	2016	2017	2018	2019	Average	2020	2021
Capital (Gross)	$389	$0	$479,851	$78,448	$110,649	$133,868	$137,877	$132,411

Total Capital & OM&A Costs Associated with REG Investments

(5.4.3.2.A. Seventh Bullet)	This project is not associated with REG investment; Capital and OM&A cost related to REG will not be incurred

Leave to Construct Approval

(5.4.3.2.A. Eight Bullet)	This project does not require Leave to Construct approval under Section 92 of the OEB Act and therefore this does not apply

5.4.3.2.B - Evaluation Criteria and Information Requirements

EVALUATI

Efficiency, Customer Value, Reliability (5.4.3.2.B.1)

Section a)

Main Driver (Trigger)	Failure risk of the primary service asset is the main driver for the majority of these projects. These assets are typically not scheduled for replacement as part of NBHDL's system renewal program, but have been discovered to no longer able to meet its safety or functional requirements and must be replaced. These assets may present an immediate risk to safety and / or the reliability of the customers' service. This includes cases where the asset has already failed and replacement of an asset is required to restore power to a customer.
Related Objectives/Performance Targets	NBHDL Corporate Mission, Vision and Core Values CV3 and CV4 (as identified in Exhibit 1).
Source and Nature of the Information Used to Justify the Investment	Asset Inspections (NBH Inspection Programs), ESA, Customer Reporting, Communication Companies are all means of discovery to identify these assets. The consequence of not doing anything is used to provide the justification.
Secondary Drivers	Not Applicable
Related Objectives/Performance Targets	Not Applicable
Source and Nature of the Information Used to Justify the Investment	Not Applicable
Section b)	

Reliability Planning and Resilient Distribution System Design	Primary service (system renewal) projects are small scope projects that only service one customer, usually involve like for like replacements, and do not typically have an impact on the overall distribution system design. However, NBHDL will adhere to good utility practice in ensuring that all projects are designed to be a part of resilient and reliable distribution system when applicable.
Adaptation to Future Challenges	The nature of primary service projects (system renewal) typically does not present opportunities for adaptation to future challenges.
Section c)	
Investment Priority Relative to Other Investments	Investments are required in order to ensure continued service to existing customers and eliminate safety issues, regardless of what other investments may have been planned.
Prioritization Approach	These projects will be prioritized according to the risk they present to the safety and reliability of the customers' service. This considers the probability of failure and the consequence of the failure. Safety is always the highest priority.
Section d) **Analysis of the Project and Project Alternatives**	
Effect on System Operation Efficiency and Cost-Effectiveness (First Bullet)	The effect on system operation efficiency and cost-effectiveness may vary from project to project; however, the nature of primary service projects will typically have no effect on this in most cases.

Net Benefits Accruing to Customers (Second Bullet)	Primary Service (System Renewal) projects have a direct benefit to the customer in a reliable service. Primary service customers include large load business (reason for the primary service) and any failure may significantly affect their business operations or production.
Impact on Reliability Performance (Including on the Frequency and Duration of Outages) (Third Bullet)	Primary services may affect a single customer or multiple customers; however, the overall reliability of NBHDL's system is usually only marginally impacted by failed assets. There may be situations where a failed primary service asset can affect the distribution feeder it is connected to. The potential of the impact varies from project to project.
Project Alternatives	Alternatives are rarely considered for these projects as the majority involves like for like replacements. These assets have degraded or been damaged beyond any repairs and have replacement as the only viable solution.

Safety (5.4.3.2.B.2)

The majority of these projects involve assets that have failed or are about to fail and therefore the work almost always involves eliminating a potential for a safety hazard.

Cyber-Security, Privacy (5.4.3.2.B.3)

Not applicable to this project

Co-ordination, Interoperability (5.4.3.2.B.4)

Section a)

Co-ordination with Utilities, Regional Planning and/or Links with 3rd Party Providers and/or Industry

Not applicable to this project

Section b)

Enabling of Future Technological Functionality or Addressing of Future Operational Requirements

The nature of primary service projects involves the unplanned replacement of failed or close to failing assets and typically do not provide opportunities of **e**nabling of future technological functionality or addressing of future operational requirements.

Environmental Benefits (5.4.3.2.B.5)

The nature of these projects does not impact the environment in any substantial manner other than the impacts associated with the manufacturing of the materials.

Conservation and Demand Management (5.4.3.2.B.6)

Not applicable to this project

Category-Specific Requirements - System Renewal (5.4.3.2.C.b.)

SYSTEM RENEWAL SPECIFIC REQUIREMENTS (5.4.3.2.C.b)

Relationship Between the Characteristics of Targeted Assets and the Consequences of Asset Performance Deterioration or Failure (5.4.3.2.C.b.First Bullet)

Asset Performance Targets and Asset Lifecycle Optimization Policies and Practices (First Sub-Bullet)

Assets involved with these projects are replaced because they have failed or are close to failure and are often done under emergency conditions. Lifecycle optimization policies and practices seek to avoid these kinds of circumstances. **See section 3.3 of the DSP for more information on Asset Life Cycle Optimization Policies and Practices.**

Asset Condition Relative to Typical Life Cycle (Second Sub-Bullet)

As stated above, the assets involved with these projects have failed or about to fail and therefore have reached the end of their life. The asset's condition relative to typical life varies from project by project, but the nature of the circumstances under which these projects occurs typically involves the asset exceeding their useful life

Number of Customers in Each Class Potentially Affected (Third Sub-Bullet)

The number of customers varies project by project

Quantitative Customer Impact and Risk (Fourth Sub-Bullet)

The quantitative customer impact varies project by project

Qualitative Customer Impact and Risk (Fifth Sub-Bullet)

The renewal of these assets will ensure future reliability statistics are maintained at or above the target, and eliminate safety issues All of which will maintain or improve customer satisfaction.

Value of Customer Impact (Sixth Sub-Bullet)

The value of customer impact varies project by project.

Other Factors Affecting Project Timing (5.4.3.2.C.b.Second Bullet)

Due to the nature of the projects, they are done immediately or scheduled very quickly. Other projects are deferred if required.

Consequences for System O&M costs (5.4.3.2.C.b.Third Bullet)

These projects do not materially impact system O&M costs

Reliability and Safety Factors (5.4.3.2.C.b.Fourth Bullet)

There will be no material impact on reliability, however spot replacement of end of life assets as a whole will help reduce interruptions related to failed equipment. The elimination of safety hazards are considered as factors to the importance of the project. .

Analysis of Project Benefits and Timing (5.4.3.2.C.b.Fifth Bullet)

Investments in this category are required immediately and are not subject to project prioritization as they for the most part are non-discretionary.

Like for Like Renewal Analysis (5.4.5.2.C.b.Sixth Bullet)

The majority of the assets replaced in this category fall under the like-for-like renewal but are typically not configured at extra costs.

2021 Capital Project Summary

5.4.3.2.A - General Information on the Project / Program

Project Name

Minor Betterments - System Access

Investment Category

System Access

Project Description

Minor Betterment projects represent small unplanned projects over the year that fall under one of the following:

1) The rehabilitation or expansion of high voltage and low voltage lines required to service new customers or upgrade existing customers (5 poles or less). This type of project arises from service requests from new or existing customers. **(System Access)**

2) Small renewal projects to replace assets found in very poor condition and require immediate replacement (5 poles or less). This type of project arises from trouble calls, maintenance programs, and information provided from 3rd parties (ESA, customers, communication companies). (System renewal)

This project summary will detail projects relating to #1

Capital Investment

(5.4.3.2.A. First Bullet)

Gross Capital	$212,096
O&M Costs (if applicable)	$0.00

(5.4.3.2.A. Second Bullet)

Capital Contributions	$0.00
Net Capital	$212,096

Customer Attachments/Load (kVA)

(5.4.3.2.A. Third Bullet)

Customer Attachments (#):	N/A
Customer Load (peak KVA)	N/A

Project Timing

(5.4.3.2.A. Forth Bullet)

Start Date		January 1, 2021	
Expected In-Service Date		December 31, 2021	
Expenditure Timing	Q1:	25%	$53,024

Q2:	25%	$53,024
Q3:	25%	$53,024
Q4:	25%	$53,024

Risk and Risk Mitigation

(5.4.3.2.A. Fifth Bullet)	Projects are completed as required. The only risks to completion of these type of projects would be if a high volume of them occurred within a short period of time. This would be managed with the use of queue process, first in, first out, and as a last resort by the hiring of contractors. This has not been required to date.

Comparative Information (5.4.3.2.A. Sixth Bullet)

Comparable investments in previous years are as follows:

	Actual						Planned	
	2015	2016	2017	2018	2019	Average	**2020**	**2021**
Capital (Gross)	$303,735	$211,159	$315,714	$63,115	$167,322	$212,209	**$223,679**	**$212,096**

Total Capital & OM&A Costs Associated with REG Investments

(5.4.3.2.A. Seventh Bullet)	This project is not associated with REG investment; Capital and OM&A cost related to REG will not be incurred

Leave to Construct Approval

(5.4.3.2.A. Eight Bullet)	This project does not require Leave to Construct approval under Section 92 of the OEB Act and therefore this does not apply

5.4.3.2.B - Evaluation Criteria and Information Requirements

EVALUATION CRITERIA AND INFORMATION REQUIREMENTS (5.4.3.2.B)

Efficiency, Customer Value, Reliability (5.4.3.2.B.1)

Section a)

Main Driver (Trigger)	The main driver behind all of these projects is service requests, and the new or upgraded assets needed to accommodate the service requests.
Related Objectives/Performance Targets	Conditions and requirements to be met in the DSC
Source and Nature of the Information Used to Justify the Investment	Request for service and the requirement to add or upgrade assets to facilitate the request

Secondary Drivers	Not Applicable
Related Objectives/Performance Targets	Not Applicable
Source and Nature of the Information Used to Justify the Investment	Not Applicable
Section b)	
Reliability Planning and Resilient Distribution System Design	Minor Betterments are small scope projects and do not typically have an impact on the overall distribution system design. However, NBHDL will adhere to good utility practice in ensuring that all projects are designed to be a part of resilient and reliable distribution system when applicable. This includes pole heights being adjusted to align to future needs, and transformer sizing being increased or decreased based on loading information.
Adaptation to Future Challenges	Adaptation to future challenges will vary from project to project; however, the unplanned nature of minor betterment projects may not always present opportunities for this.
Section c)	
Investment Priority Relative to Other Investments	As these projects are to enable the connection of demand work (subdivisions, secondary services, and primary services), they follow the requirements to connect customers set forth in the DSC and therefore are given top priority, and prioritized based on connection timeline requirements of the customers.
Prioritization Approach	Minor Betterment (system renewal) investments are prioritized based on the order in which the requests come in above planned system renewal projects
Section d) **Analysis of the Project and Project Alternatives**	
Effect on System Operation Efficiency and Cost-Effectiveness (First Bullet)	The effect on system operation efficiency and cost-effectiveness may vary from project to project; however, the nature of minor betterment projects will typically have no effect on this in most cases
Net Benefits Accruing to Customers (Second Bullet)	System access minor betterment projects are customer driven and benefits the customer in accommodating connections and upgrades to services

Impact on Reliability Performance (Including on the Frequency and Duration of Outages) (Third Bullet)	The nature of system access minor betterment projects typically does not have any impact to reliability performance.
Project Alternatives	Minor Betterment projects relating to system access are driven by customer requests and the specific requirements of the customer. Projects are considered individually and the most cost-effective solutions to provide the assets up the point of connection of the customer are chosen, unless other options are requested by the customer, it is against policies and practices, or it does not comply municipal or provincial policy.

Safety (5.4.3.2.B.2)

These projects are not intended to address safety concerns; however, NBHDL correct any safety concerns if an opportunity to do so arises out of a project.

Cyber-Security, Privacy (5.4.3.2.B.3)

Not Applicable

Co-ordination, Interoperability (5.4.3.2.B.4)

Section a)

Co-ordination with Utilities, Regional Planning and/or Links with 3rd Party Providers and/or Industry

Coordination with customers and electricians are an important part of these projects, as it determines the options available or desired. As the projects involve new assets, coordination with the City of North Bay is required when assessing feasible alternatives, as they have final approval on location of all assets within the road allowance.

Section b)

Enabling of Future Technological Functionality or Addressing of Future Operational Requirements

The nature of system access minor betterment projects typically does not incorporate the enabling of future technological functionality or addressing of future operational requirements

Environmental Benefits (5.4.3.2.B.5)

The nature of these projects does not impact the environment in any substantial manner other than the impacts associated with the manufacturing of the materials.

Conservation and Demand Management (5.4.3.2.B.6)

Not Applicable

Category-Specific Requirements - System Access (5.4.3.2.C.a.)

Factor Affecting Implementing Project Timing / Priority (5.4.3.2.C.a.First Bullet)

The timing of individual projects is based on what is required by the customer. As noted above, this work is top priority and therefore is handled as explained above in section 5.4.3.2.B.4

Factors Relating to Customer Preference or Third Party Input (5.4.3.2.C.a.Second Bullet)

These projects are initiated by customers and are designed to meet the needs of customer requirements

Factors Affecting Final Project Costs (5.4.3.2.C.a.Third Bullet)

The factors affecting final costs are normally a function of the following:

- Municipal and Provincial requirements (i.e. parts of town that must be underground),
- Customer Requests / Requirement (i.e. the customer wants an extension to be underground)
- Design Requirements
- Construction Requirements

Each project is assessed on a case by case basis due to the large variety of different considerations that may apply to any given project. Details such as the location (urban or rural), the terrain and subsurface conditions (earth or rock), the amount of infrastructure to be installed, the time of year (ground frost), permits, and any other customer specific requirements are all details that affect the final project cost.

Controllable Cost Minimization (5.4.3.2.C.a.Forth Bullet)

The work required on the main lines to connect new customers or upgrade existing customers is done as cost effective as possible, unless influenced by factors out of NBHDL's control. In line extension situations, the customer is responsible for the full costs at which time the economic evaluation process is initiated.

Other Planning Objectives Met (5.4.3.2.C.a.Fifth Bullet)

Depending on the project specific circumstances, other planning objectives may be considered under these types of projects if an opportunity to do so presents itself. Typically, the projects pertain only to the installing or upgrading of assets to accommodate the requested customers connections. The consideration for meeting other planning objectives can only be assessed once a request is brought forth.

Technically Feasible Project Options (5.4.3.2.C.a.Sixth Bullet)

NBHDL as a standard practice make a reasonable attempt consider all options with respect to the assets required to provide the requested service. However, whether an option is technically feasible can only be determined upon a technical review, which is done on a project by project basis. This can not start until an individual project is initiated.

In extension scenarios, the customer has the right to request underground servicing if desired.

Summary of Options Analysis (5.4.3.2.C.a.Seventh Bullet)

Alternatives are considered; however, the analysis is completed on a project by project basis and after the project is initiated. As the expenditure is based on forecasted amounts, this section is not relevant until a project is started or scheduled. When these projects are initiated, they will be prioritized based on DSC requirements and, with all things equal, on a queue basis, first in, first out.

Results of the Final Economic Evaluation (5.4.3.2.C.a.Eighth Bullet)

When applicable, capital contributions toward the cost of these projects are collected by NBHDL in accordance with the DSC and the provisions of its COS. NBHDL uses the economic evaluation methodology from the DSC to determine the level of capital contribution for each project. Results are not included as they cannot be determined until projects are brought forth. The majority of these projects do not require an economic evaluation to be required.

Nature and Magnitude of System Impacts, Costs, and Cost Coverage (5.4.3.2.C.a.Ninth Bullet)

System Access Minor Betterment projects for the most part have a low impact on the system, even when up to 5 poles are required. Individual project costs are typically below the materiality threshold and contributions from the customer are made in situations where applicable (line extensions with more than 2 poles) to cover costs, although the majority of the work does not require contribution.

GENERAL INFORMATION ON THE PROJECT/PROGRAM (5.4.3.2.A)

2021 Capital Project Summary

5.4.3.2.A - General Information on the Project / Program

Project Name	Primary Services		
Investment Category	System Access		
Project Description	This category represents the capital work necessary to rehabilitate and/or expand infrastructure to service new customers or maintain existing customers, residential and general service, over the 400A threshold available from the secondary system. These projects involve primary (high voltage) servicing and overhead or pad-mounted transformation.		
Capital Investment			
(5.4.3.2.A. First Bullet)	Gross Capital	$198,457	
	O&M Costs (if applicable)	$0.00	
(5.4.3.2.A. Second Bullet)	Capital Contributions	$0.00	
	Net Capital	$198,457	
Customer Attachments/Load (kVA)			
(5.4.3.2.A. Third Bullet)	Customer Attachments (#):	N/A	
	Customer Load (peak KVA)	N/A	
Project Timing			
(5.4.3.2.A. Forth Bullet)	Start Date	January 1, 2021	
	Expected In-Service Date	December 31, 2021	
	Expenditure Timing	Q1: 25%	$49,614
		Q2: 25%	$49,614
		Q3: 25%	$49,614
		Q4: 25%	$49,614

Risk and Risk Mitigation

(5.4.3.2.A. Fifth Bullet)	This type of servicing is common to NBHDL and is covered by well established processes both from design and construction perspectives which mitigates issues around timing related risk. As customer connections are very important NBHDL, timelines are strictly monitored and enforced to ensure obligations set forth in the DSC are met and that customer satisfaction is maintained.

Comparative Information (5.4.3.2.A. Sixth Bullet)

Comparable investments in previous years are as follows:

	Actual						Planned	
	2015	2016	2017	2018	2019	Average	2020	2021
Capital (Gross)	$34,001	$126,338	$48,741	$263,306	$512,611	$197,000	$203,532	$198,457

Total Capital & OM&A Costs Associated with REG Investments

(5.4.3.2.A. Seventh Bullet)	This project is not associated with REG investment; Capital and OM&A cost related to REG will not be incurred

Leave to Construct Approval

(5.4.3.2.A. Eight Bullet)	This project does not require Leave to Construct approval under Section 92 of the OEB Act and therefore this does not apply

5.4.3.2.B - Evaluation Criteria and Information Requirements

EVALUATION CRITERIA AND INFORMATION REQUIREMENTS (5.4.3.2.B)

Efficiency, Customer Value, Reliability (5.4.3.2.B.1)

Section a)

Main Driver (Trigger)	Projects are mandatory and scope and timelines are based on requirements put forth by customers and/or obligations set forth for connecting customers in the DSC
Related Objectives/Performance Targets	Conditions and requirements to be met in the DSC
Source and Nature of the Information Used to Justify the Investment	Request for service and obligations set forth in the DSC
Secondary Drivers	Not Applicable
Related Objectives/Performance Targets	Not Applicable

Source and Nature of the Information Used to Justify the Investment	Not Applicable
Section b)	
Reliability Planning and Resilient Distribution System Design	NBHDL adheres to good utility practice in ensuring that all projects are designed to be a part of resilient and reliable distribution system and that includes primary services.
Adaptation to Future Challenges	The nature of primary service projects typically will not include any adaptation to future challenges outside the needs of the customers
Section c)	
Investment Priority Relative to Other Investments	Upgrading existing or installing new primary services are top priority. Planning and design of these projects is handled through engineering work orders and are scheduled with crews as required.
Prioritization Approach	Primary services are prioritized based on the order in which the requests come in above planned system renewal projects
Section d) **Analysis of the Project and Project Alternatives**	
Effect on System Operation Efficiency and Cost-Effectiveness (First Bullet)	The nature of primary service projects has no effect on system operation efficiency and cost-effectiveness.
Net Benefits Accruing to Customers (Second Bullet)	Primary service projects are customer driven and benefits the customer in accommodating a connection or upgrades to their primary service.
Impact on Reliability Performance (Including on the Frequency and Duration of Outages) (Third Bullet)	The nature of primary service projects has no impacts to reliability performance

Project Alternatives	Primary service projects are driven by customer requests and the specific requirements of the customer. Design and methodology for such projects is standardized through NBHDL policies and practices and in line with NBHDL's Conditions of Service. Alternatives are limited as servicing options are standardized, but if alternatives do exist, they are normally the choice of the customer. For example, the decision between an overhead or underground service is that of the customers.

Safety (5.4.3.2.B.2)

These projects are not intended to address safety concerns; however, NBHDL will seek to correct any potential safety concerns if an opportunity to do so arises from a proposed project.

Cyber-Security, Privacy (5.4.3.2.B.3)

Not Applicable

Co-ordination, Interoperability (5.4.3.2.B.4)

Section a)

Co-ordination with Utilities, Regional Planning and/or Links with 3rd Party Providers and/or Industry

Coordination with customers and electricians are an important part of primary service projects. For services of this size, the process starts with the customer filling out a NBHDL electrical planning requirements (EPR) form. An estimate, based on the information on the form is provided to the customer and the customer makes a decision to move forward with the servicing or not.

NBHDL construction activates are based on a work order produced from Engineering and the scheduling of work is coordinated directly with the Operations department and the customer. Authorization from the Electrical Safety Authority is required prior to reconnection or new connection of all primary services, which is handled via an established process.

Section b)

Enabling of Future Technological Functionality or Addressing of Future Operational Requirements

The nature of primary service projects typically does not incorporate the enabling of future technological functionality or addressing of future operational requirements outside the needs of the customer.

Environmental Benefits (5.4.3.2.B.5)

The nature of these projects does not impact the environment in any substantial manner other than the impacts associated with the manufacturing of the materials.

Conservation and Demand Management (5.4.3.2.B.6)

Not Applicable

Category-Specific Requirements - System Access (5.4.3.2.C.a.)

Factor Affecting Implementing Project Timing / Priority (5.4.3.2.C.a.First Bullet)

The timing of individual projects is based on what is required by the customer. As noted above, this work is top priority and therefore is handled as explained above in section 5.4.3.2.B.4

Factors Relating to Customer Preference or Third Party Input (5.4.3.2.C.a.Second Bullet)

These projects are initiated by customers and are designed to meet the needs of customer requirements.

Factors Affecting Final Project Costs (5.4.3.2.C.a.Third Bullet)

As every primary service project is unique, final costs of individual projects can not be determined until the proposed work is shared with NBHDL. Factors that affect project costs are length of service, size of customer's main switchgear and main breaker and subsurface conditions. Charges to the customer are based on fixed and variable costs, that are updated annually.

Controllable Cost Minimization (5.4.3.2.C.a.Forth Bullet)

The design and connection of primary services is standardized and therefore costs are controlled through well established processes, the use of standard material, and the efficiencies established through NBHDL's experience in connecting such projects.

Other Planning Objectives Met (5.4.3.2.C.a.Fifth Bullet)

Depending on the project specific circumstances, other planning objectives may be considered under these types of projects if an opportunity to do so presents itself. Typically, the projects pertain only to the installing or upgrading of assets to accommodate the requested customers connections. The consideration for meeting other planning objectives can only be assessed once a request is brought forth.

Technically Feasible Project Options (5.4.3.2.C.a.Sixth Bullet)

Customers have options with respect to servicing, however feasible options must be reviewed on a project by project basis, which can not start until the project is initiated.

Summary of Options Analysis (5.4.3.2.C.a.Seventh Bullet)

Alternatives are considered; however, the analysis is completed on a project by project basis, and after the project is initiated. As the expenditure is based on forecasted amounts, this section is not relevant until a project is started or scheduled. When these projects are initiated however, they will be prioritized based on DSC requirements and, with all things equal, on a queue basis, first in, first out.

Results of the Final Economic Evaluation (5.4.3.2.C.a.Eighth Bullet)

When applicable, capital contributions toward the cost of these projects are collected by NBHDL in accordance with the DSC and the provisions of its COS. NBHDL uses the economic evaluation methodology from the DSC to determine the level of capital contribution for each project. Results are not included as they cannot be determined until projects are brought forth. The majority of these projects do not require an economic evaluation.

	Nature and Magnitude of System Impacts, Costs, and Cost Coverage (5.4.3.2.C.a.Ninth Bullet)
	Primary service projects for the most part have a low impact on the system, although some can have a moderate impact depending on service size requirements. Individual project costs are typically below the materiality threshold and contributions from the customer, based on variable and fixed fees, cover the costs of servicing. When a customer requests a primary service that requires expansion of the system, the expansion is covered under a different type of project such as minor betterment or major betterment.

GENERAL INFORMATION ON THE PROJECT/PROGRAM (5.4.3.2.A)

2021 Capital Project Summary

5.4.3.2.A - General Information on the Project / Program

Project Name	Secondary Services		
Investment Category	System Access		
Project Description	This category represents the capital work required to upgrade existing or install new secondary (low voltage) service wires, overhead and underground, from distribution plant located on the municipal street or in easements on private property to customer's premises. The majority of the work involves the services to the residential class.		
Capital Investment			
(5.4.3.2.A. First Bullet)	Gross Capital	$296,184	
	O&M Costs (if applicable)	$0.00	
(5.4.3.2.A. Second Bullet)	Capital Contributions	$0.00	
	Net Capital	$296,184	
Customer Attachments/Load (kVA)			
(5.4.3.2.A. Third Bullet)	Customer Attachments (#):	N/A	N/A
	Customer Load (peak KVA):	N/A	N/A
Project Timing			
(5.4.3.2.A. Forth Bullet)	Start Date	January 1, 2021	
	Expected In-Service Date	December 31, 2021	
	Expenditure Timing	Q1: 25%	$74,046
		Q2: 25%	$74,046
		Q3: 25%	$74,046
		Q4: 25%	$74,046

Risk and Risk Mitigation

(5.4.3.2.A. Fifth Bullet)	This work is very routine for NBHDL and is covered by well established processes both from design and construction perspectives which mitigates issues around timing related risk. As customer connections are very important NBH, timelines are strictly monitored and enforced to ensure obligations set forth in the DSC are met and that customer satisfaction is maintained

Comparative Information (5.4.3.2.A. Sixth Bullet)

	Actual						Planned	
	2015	2016	2017	2018	2019	Average	2020	2021
Capital (Gross)	$311,613	$262,233	$337,984	$259,093	$309,997	$296,184	$284,691	$296,184

Total Capital & OM&A Costs Associated with REG Investments

(5.4.3.2.A. Seventh Bullet)	This project is not associated with REG investment; Capital and OM&A cost related to REG will not be incurred

Leave to Construct Approval

(5.4.3.2.A. Eight Bullet)	This project does not require Leave to Construct approval under Section 92 of the OEB Act and therefore this does not apply

5.4.3.2.B - Evaluation Criteria and Information Requirements

EVALUATION CRITERIA AND INFORMATION REQUIREMENTS

Efficiency, Customer Value, Reliability (5.4.3.2.B.1)

Section a)

Main Driver (Trigger)	Projects are mandatory and scope and timelines are based on requirements put forth by customers and/or obligations set forth in connecting customers in the DSC
Related Objectives/Performance Targets	Requirements set out in the DSC
Source and Nature of the Information Used to Justify the Investment	Request for service and obligations set forth in the DSC
Secondary Drivers	Not Applicable
Related Objectives/Performance Targets	Not Applicable

Source and Nature of the Information Used to Justify the Investment	Not Applicable
Section b)	
Reliability Planning and Resilient Distribution System Design	North Bay Hydro adheres to good utility practice in ensuring that all projects are designed to be a part of resilient and reliable distribution system.
Adaptation to Future Challenges	The nature of secondary service projects typically will not include any adaptation to future challenges outside the needs of the customers
Section c)	
Investment Priority Relative to Other Investments	Upgrading existing or installing new services are top priority but represent very small projects individually, and are easily handled by day to day operations. This work is processed by the engineering department and scheduled through the dedicated service truck daily to ensure timelines are met.
Prioritization Approach	Secondary services are prioritized based on the order in which the requests come in above planned system renewal projects
Section d) **Analysis of the Project and Project Alternatives**	
Effect on System Operation Efficiency and Cost-Effectiveness (First Bullet)	The nature of secondary service projects has no effect on system operation efficiency and cost-effectiveness.
Net Benefits Accruing to Customers (Second Bullet)	Secondary service projects are customer driven and benefits the customer in accommodating a connection or upgrades to their primary service.
Impact on Reliability Performance (Including on the Frequency and Duration of Outages) (Third Bullet)	The nature of secondary service projects has no impacts to reliability performance.

Project Alternatives	Secondary service projects are driven by customer requests and the specific requirements of the customer. Design and methodology for such projects is standardized through NBHDL policies and practices and in line with NBHDL's Conditions of Service. Alternatives are limited as servicing options are standardized, but if alternatives do exist, they are normally the choice of the customer. For example, the decision between an overhead or underground service is that of the customers.

Safety (5.4.3.2.B.2)

These projects are not intended to address safety concerns

Cyber-Security, Privacy (5.4.3.2.B.3)

Not Applicable

Co-ordination, Interoperability (5.4.3.2.B.4)

Section a)

Co-ordination with Utilities, Regional Planning and/or Links with 3rd Party Providers and/or Industry

Coordination with customers and electricians are an important part of secondary service work. This is handled through a well-established service request procedure, known as a service spot. Actual coordination for installation is done through the Operations Clerk and the scheduling of the dedicated service truck. Authorization from the Electrical Safety Authority is required prior to reconnection or new connection of all secondary services, which is handled via an established process.

Section b)

Enabling of Future Technological Functionality or Addressing of Future Operational Requirements

The nature of secondary service projects typically does not incorporate the enabling of future technological functionality or addressing of future operational requirements outside the needs of the customer.

Environmental Benefits (5.4.3.2.B.5)

The nature of these projects does not impact the environment in any substantial manner other than the impacts associated with the manufacturing of the materials.

Conservation and Demand Management (5.4.3.2.B.6)

Not Applicable

Category-Specific Requirements - System Access (5.4.3.2.C.a.)

Factor Affecting Implementing Project Timing / Priority (5.4.3.2.C.a.First Bullet)

The timing of individual projects is based on what is required by the customer. As noted above, this work is top priority and therefore is handled by daily operations.

Factors Relating to Customer Preference or Third Party Input (5.4.3.2.C.a.Second Bullet)

These projects are initiated by customers and are designed to meet the needs of customer requirements

Factors Affecting Final Project Costs (5.4.3.2.C.a.Third Bullet)

As every secondary service project is unique, final costs of individual projects can not be determined until the proposed work is shared with NBHDL. However, costing is based on fixed and variable costs, that are updated annually.

Controllable Cost Minimization (5.4.3.2.C.a.Forth Bullet)

The design and connection of secondary services is standardized and therefore costs are controlled through well established processes, the use of standard material, and the efficiencies established through NBHDL's thorough experience in connecting such projects.

Other Planning Objectives Met (5.4.3.2.C.a.Fifth Bullet)

Typically, the nature of these projects pertain only to the installing or upgrading of assets to accommodate the requested customers connections.

Technically Feasible Project Options (5.4.3.2.C.a.Sixth Bullet)

Customers have options with respect to servicing, however feasible options must be reviewed on a project by project basis, which can not start until the project is initiated.

Summary of Options Analysis (5.4.3.2.C.a.Seventh Bullet)

Alternatives are considered; however, the analysis is completed on a project by project basis, and after the project is initiated. As the expenditure is based on forecasted amounts, this section is not relevant until a project is started or scheduled. When these projects are initiated however, they will be prioritized based on DSC requirements and, with all things equal, on a queue basis, first in, first out.

Results of the Final Economic Evaluation (5.4.3.2.C.a.Eighth Bullet)

The nature of these projects does not require an economic evaluation.

Nature and Magnitude of System Impacts, Costs, and Cost Coverage (5.4.3.2.C.a.Ninth Bullet)

Secondary services projects have a very low impact on the system, costs are minimal but are fully recovered through a fee schedule. When a customer requests a secondary service that requires expansion of the system, the expansion is covered under a different type of project such as minor betterment or major betterment.

GENERAL INFORMATION ON THE PROJECT/PROGRAM (5.4.3.2.A)

2021 Capital Project Summary

5.4.3.2.A - General Information on the Project / Program

Project Name	Subdivisions		
Investment Category	System Access		
Project Description	This project represents the capital work required to build and connect new subdivisions driven by developer demand. The expenditure represents cost to provide material to developers, and NBHDL labour to install transformers and make primary and secondary connections. Where possible, capital contributions toward the cost of these projects are collected by NBHDL in accordance with the DSC and the provisions of its COS. NBHDL uses the economic evaluation methodology from the DSC to determine the level of capital contribution for each project and those levels are injected into the annual capital budget.		
Capital Investment			
(5.4.3.2.A. First Bullet)	Gross Capital		$83,757
	O&M Costs (if applicable)		$0.00
(5.4.3.2.A. Second Bullet)	Capital Contributions		$0.00
	Net Capital		$83,757
Customer Attachments/Load (kVA)			
(5.4.3.2.A. Third Bullet)	Customer Attachments (#):	N/A	
	Customer Load (peak KVA)	N/A	
Project Timing			
(5.4.3.2.A. Forth Bullet)	Start Date	January 1, 2021	
	Expected In-Service Date	December 31, 2021	
	Expenditure Timing	Q1: 25%	$20,939
		Q2: 25%	$20,939
		Q3: 25%	$20,939
		Q4: 25%	$20,939

Risk and Risk Mitigation

(5.4.3.2.A. Fifth Bullet)	The timing of these projects are dictated by developer demand which can be hard to accommodate as requested. However, as with all demand work, these projects become top priority when brought to NBHDL`s attention as per the obligations set forth in the DSC for connecting new customers. To help accommodate subdivision requests inventory levels are kept at a level that enables subdivision connections in a timely manner. A process for connecting new subdivisions is in place, which aids in planning and coordinating the demand work and helps mitigate some of the risk around timing.

Comparative Information (5.4.3.2.A. Sixth Bullet)

Comparable investments in previous years are as follows:

	Actual						**Planned**	
	2015	2016	2017	2018	2019	Average	**2020**	**2021**
Capital (Gross)	$157,890	$40,094	$3,846	$50,745	$166,214	$83,758	**$111,006**	**$83,757**

Subdivision developments vary significantly in the City of North Bay as can be observed by the investments identified above. There are 5 developments currently underway. 4 of which have a design and a combined value of $236,683 and the fifth project is in its preliminary stages. All of those projects are currently scheduled for 2020, however the COVID19 situation has pushed out some schedules. Based on NBHDL's experience, familiarity, and ongoing communication with local developers, NBHDL believes that there is a likelihood of all of these projects eventually proceeding, however, also in NBHDL's experience, there are typically delays to the projects and the scopes are often changed (broken down into multiple phases). Taking NBHDL's experience into consideration, it is assumed that some of these projects will proceed in 2020 and will extend into 2021 and potentially 2022.

Total Capital & OM&A Costs Associated with REG Investments

(5.4.3.2.A. Seventh Bullet)	This project is not associated with REG investment; Capital and OM&A cost related to REG will not be incurred

Leave to Construct Approval

(5.4.3.2.A. Eight Bullet)	This project does not require Leave to Construct approval under Section 92 of the OEB Act and therefore this does not apply

5.4.3.2.B - Evaluation Criteria and Information Requirements

EVALUATION CRITERIA AND INFORMATION REQUIREMENTS

Efficiency, Customer Value, Reliability (5.4.3.2.B.1)

Section a)

Main Driver (Trigger)	Projects are mandatory and scope and timelines are based on requirements put forth by developers and/or obligations set forth in connecting customers in the DSC
Related Objectives/Performance Targets	Requirements set out in the DSC

Source and Nature of the Information Used to Justify the Investment	Request for service and obligations set forth in the DSC
Secondary Drivers	Not Applicable
Related Objectives/Performance Targets	Not Applicable
Source and Nature of the Information Used to Justify the Investment	Not Applicable
Section b)	
Reliability Planning and Resilient Distribution System Design	North Bay Hydro adheres to good utility practice in ensuring that all projects are designed to be a part of resilient and reliable distribution system. Subdivisions are always designed in a manner to accommodate future considerations and to be part (or eventually part) of a loop feed (power can be routed in different directions). This includes the installation of extra conduit for future use and installing equipment such as primary junction boxes in strategic locations.
Adaptation to Future Challenges	Subdivision are typically designed in a manner that will allow expansion and growth. This often includes extra conduit to allow for single to three phase circuit conversion and the installation of junction boxes in strategic locations. The adaptation to future challenges will vary from project to project however.
Section c)	
Investment Priority Relative to Other Investments	These projects are mandatory and therefore become top priority when NBHDL is made aware of them.
Prioritization Approach	Subdivisions are prioritized based on the order in which the requests come in, above planned system renewal projects.
Section d)	
Analysis of the Project and Project Alternatives	
Effect on System Operation Efficiency and Cost-Effectiveness (First Bullet)	The nature of subdivision projects typically has no effect on existing system operation efficiency and cost-effectiveness.

Net Benefits Accruing to Customers (Second Bullet)	Subdivision projects are customer driven and benefits the customer in accommodating new connections.
Impact on Reliability Performance (Including on the Frequency and Duration of Outages) (Third Bullet)	The nature of subdivision projects has no impacts to reliability performance.
Project Alternatives	Subdivision projects are driven by developer requests. Design and methodology for such projects is standardized through NBHDL policies and practices, although it differs from project to project based on developer specific requirements. Alternatives cannot be considered until individual projects are brought forth.

Safety (5.4.3.2.B.2)

These projects are not intended to address safety concerns.

Cyber-Security, Privacy (5.4.3.2.B.3)

Not Applicable

Co-ordination, Interoperability (5.4.3.2.B.4)

Section a)

Co-ordination with Utilities, Regional Planning and/or Links with 3rd Party Providers and/or Industry

Coordination is required with a number of different parties during subdivision projects. An understanding of the project and the requirements of the developer needs to be understood, which is typically handled through in person and on-site meetings. The coordination with other utilities is required to ensure designs of all new infrastructure don't interfere with each other and efficiencies are leveraged (i.e. joint trenching), which is typically handled with a utility coordination meeting involving all parties. The construction must be coordinated with all the involved parties, which is typically handled by a project manager designated by the developer. Success of these projects rests on effective coordination from start to finish.

Section b)

Enabling of Future Technological Functionality or Addressing of Future Operational Requirements

The nature of subdivision projects typically does not incorporate the enabling of future technological functionality or addressing of future operational requirements outside the needs of the customer.

Environmental Benefits (5.4.3.2.B.5)

The nature of these projects does not impact the environment in any substantial manner other than the impacts associated with the manufacturing of the materials.

Conservation and Demand Management (5.4.3.2.B.6)

Not Applicable

Category-Specific Requirements - System Access (5.4.3.2.C.a.)

-

Factor Affecting Implementing Project Timing / Priority (5.4.3.2.C.a.First Bullet)

The timing of individual projects is based on what is required by the developer. As noted above, this work becomes top priority when it is brought forth.

Factors Relating to Customer Preferance or Third Party Input (5.4.3.2.C.a.Second Bullet)

These projects are initiated by developers and are designed to meet the needs of the proposed development.

Factors Affecting Final Project Costs (5.4.3.2.C.a.Third Bullet)

Final costs of individual projects can not be determined until the proposed development is communicated to NBHDL. The conditions of the land being developed, the number of lots and the type of residences being proposed are the largest factors that affect project costs.

Controllable Cost Minimization (5.4.3.2.C.a.Forth Bullet)

The design of subdivision projects is fairly standardized and therefore costs are controlled through well established processes, the use of standard material, and the efficiencies established through NBHDL's experience in connecting such projects. The developer also has the option to perform various parts of the required work in efforts to reduce costs further.

Other Planning Objectives Met (5.4.3.2.C.a.Fifth Bullet)

This cannot be determined until projects are brought forth, and will differ from project to project. However, in all subdivision projects, NBHDL considers future development in the design to ensure extensions, or future development can be easily handled while minimizing costs to do so.

Technically Feasible Project Options (5.4.3.2.C.a.Sixth Bullet)

Alternatives are discussed; however, the feasible options must be reviewed on a project by project basis, which can not start until the project is initiated

Summary of Options Analysis (5.4.3.2.C.a.Seventh Bullet)

Alternatives are considered; however, the analysis is completed on a project by project basis, and after the project is initiated. As the expenditure is based on forecasted amounts, this section is not relevant until a project is started or scheduled. When these projects are initiated however, they will be prioritized based on DSC requirements and, with all things equal, on a queue basis, first in, first out.

Results of the Final Economic Evaluation (5.4.3.2.C.a.Eighth Bullet)

Capital contributions toward the cost of these projects are collected by NBHDL in accordance with the DSC and the provisions of its COS. NBHDL uses the economic evaluation methodology from the DSC to determine the level of capital contribution for each project. Results are not included as they cannot be determined until projects are brought forth.

Nature and Magnitude of System Impacts, Costs, and Cost Coverage (5.4.3.2.C.a.Ninth Bullet)

As NBHDL's system is not constrained, and growth in the City of North Bay has been stagnant, new subdivision projects will not have a significant impact on the system. Costs have averaged $83,758 annually for such projects and capital contributions are covered by the economic evaluation model.

GENERAL INFORMATION ON THE PROJECT/PROGRAM (5.4.3.2.A)

2021 Capital Project Summary

5.4.3.2.A - General Information on the Project / Program

Project Name

Road Relocations

Investment Category

System Access

Project Description

This category represents capital expenditures required to comply with statutory obligations related to the relocation of overhead and underground facilities installed within municipal or provincial owned road allowances. Based on a legislated cost sharing formula, the City or MTO, contribute 50% of all labour, labour saving devices, and equipment costs. Cost sharing does not include material cost however. In the case where the governing body directs NBHDL to replace overhead plant with underground plant the governing body funds the cost differential between overhead and underground

Capital Investment

(5.4.3.2.A. First Bullet)

Gross Capital	$99,387
O&M Costs (if applicable)	$0.00

(5.4.3.2.A. Second Bullet)

Capital Contributions	$0.00
Net Capital	$99,387

Customer Attachments/Load (kVA)

(5.4.3.2.A. Third Bullet)

Customer Attachments (#):	N/A
Customer Load (peak KVA)	N/A

Project Timing

(5.4.3.2.A. Forth Bullet)

Start Date	January 1, 2021		
Expected In-Service Date	December 31, 2021		
Expenditure Timing	Q1:	25%	$24,847
	Q2:	25%	$24,847
	Q3:	25%	$24,847

Q4:	25%	$24,847	

Risk and Risk Mitigation

(5.4.3.2.A. Fifth Bullet)

The timing of these projects is dictated by the City of North Bay, or the Ministry of Transportation and therefore timing is out of NBHDL's control.

Meetings with the City of North Bay, as referenced in Section 2.2.1.2 of DSP, take place continuously through out the year which helps ensure these projects don't come as a surprise and allows NBHDL to plan them amongst planned work

Comparative Information (5.4.3.2.A. Sixth Bullet)

	Actual						Forecast	
	2015	2016	2017	2018	2019	5-Year Avg	**2020**	**2021**
Capital (Gross)	$40,606	$7,737	$9,960	$48,323	$390,265	$99,378	**$105,113**	**$99,378**

Although the City of North Bay does not have any significant road relocation project plans at this time that will impact North Bay Hydro's Assets, the City does have projects that require road relocations on a yearly basis. In 2020, the City of North Bay is undergoing the major reconstruction of an artery which required poles to be moved in 2019 and a significant amount of underground work to be undertaken in 2020. Without more detailed information from the city, it is prudent for North Bay Hydro to use the 5-year average as the base for expenditures.

Total Capital & OM&A Costs Associated with REG Investments

(5.4.3.2.A. Seventh Bullet)

This project is not associated with REG investment; Capital and OM&A cost related to REG will not be incurred

Leave to Construct Approval

(5.4.3.2.A. Eight Bullet)

This project does not require Leave to Construct approval under Section 92 of the OEB Act and therefore this does not apply

5.4.3.2.B - Evaluation Criteria and Information Requirements

EVALUATION CRITERIA AND INFORMATION

Efficiency, Customer Value, Reliability (5.4.3.2.B.1)

Section a)

Main Driver (Trigger)

Projects are mandatory and scope and timelines are based on what the City of North Bay or MTO requests.

Related Objectives/Performance Targets

Requirements set out in the DSC

Source and Nature of the Information Used to Justify the Investment

Request from local or provincial authority

Secondary Drivers	Not Applicable
Related Objectives/Performance Targets	Not Applicable
Source and Nature of the Information Used to Justify the Investment	Not Applicable
Section b)	
Reliability Planning and Resilient Distribution System Design	North Bay Hydro adheres to good utility practice in ensuring that all projects are designed to be a part of resilient and reliable distribution system. This includes road relocations.
Adaptation to Future Challenges	Adaptation to future challenges will vary from project to project
Section c)	
Investment Priority Relative to Other Investments	These projects are mandatory and therefore become top priority when NBHDL is made aware of them.
Prioritization Approach	Road Relocations projects are prioritized based on discussions with the City of North Bay and the Ministry of Transportation. These projects are always considered a higher priority than any discretionary project. If the amount of road relocation projects exceeds the budgeted amounts, North Bay Hydro will reduce its discretionary spending accordingly to ensure that the spending is properly maintained for the given year. When comparing road relocations to other system access, North Bay Hydro will evaluate the scope of work and will develop of plan of work that balances customer access expectations with city requirements.
Section d) **Analysis of the Project and Project Alternatives**	
Effect on System Operation Efficiency and Cost-Effectiveness (First Bullet)	The cost model involves the following: The City pays for half of the labour-costs for the new construction and North Bay Hydro pays the other half of the labour costs plus the material. At the end, it all becomes North Bay Hydro assets. Road relocations can be beneficial projects to North Bay Hydro if the assets are in poor condition, but it has happened that the city created projects that required relatively new assets to be relocated. In the latter case, there is no system efficiency to such as project as it takes resources and valuable assets out of commission and although there is some cost-sharing with the City of North Bay, NBHDL still needs to spend capital dollars unnecessarily.

	Contrary to the above paragraph, if the line is in poor condition, North Bay Hydro will gain from a road relocation as it will restore an asset in need of replacement at a subsidized cost from the City of North Bay. For those reasons, it is extremely important for North Bay Hydro to keep up to date with the City of North Bay's capital projects to try and line-up NBHDL assets renewals with City work if possible.
Net Benefits Accruing to Customers (Second Bullet)	Customers will have the benefit of a newly constructed electrical system in their area. In some instances, the benefit may be minimal if the system assets were still in good condition and not close to their end of life replacement schedule, but there are some instances where the road relocation project replaces an older asset. Another benefit is that these asset replacements are on the cost-sharing model identified above, therefore the customers only have to pay a portion of the costs of the project through their hydro rates (they pay the remainder through their municipal taxes).
Impact on Reliability Performance (Including on the Frequency and Duration of Outages) (Third Bullet)	The replacement of any asset brings in a new asset (100% Health) that will be always be in better condition, unless the asset being replaced is also new itself. The degree to which reliability may be improved will be proportional to the age difference of the assets.
Project Alternatives	The relocation of distribution assets is mandatory and is based on the proposed road design, however NBHDL's design is coordinated with the authorities, or authorities' agent, requesting the relocation of the road to determine the best alternative for relocation, while trying to keep costs controlled. NBHDL is not fully in control of the outcomes or the alternative selected on these types of projects. NBHDL works closely with the City to discuss alternatives and ensure the best solution is developed that can provide the best value for both parties.

Safety (5.4.3.2.B.2)

The intention of these types of projects are not to address safety concerns, although at times, end of life assets are replaced which may involve the elimination of safety hazards.

Cyber-Security, Privacy (5.4.3.2.B.3)

Not Applicable

Co-ordination, Interoperability (5.4.3.2.B.4)

Section a)

Co-ordination with Utilities, Regional Planning and/or Links with 3rd Party Providers and/or Industry

As referenced in section **2.2 of the DSP**, coordination with the City of North Bay and MTO is on-going throughout the year, which helps with respect to road relocation project coordination. Once a project is initiated NBHDL works closely with the authority requesting the work to consider alternatives, while trying to minimize costs.

The last meeting that was held with the City of North Bay to review all their current and future construction and development projects was on April 21, 2020.

Section b)

Enabling of Future Technological Functionality or Addressing of Future Operational Requirements

The enabling of future technological functionality or addressing of future operational requirements will vary from project to project if applicable.

Environmental Benefits (5.4.3.2.B.5)

The nature of these projects does not impact the environment in any substantial manner other than the impacts associated with the manufacturing of the materials.

Conservation and Demand Management (5.4.3.2.B.6)

Not Applicable

Category-Specific Requirements - System Access (5.4.3.2.C.a.)

-

Factor Affecting Implementing Project Timing / Priority (5.4.3.2.C.a. First Bullet)

The timing of individual projects is based on scheduling provided by the owner of the road. NBHDL works closely with the local authorities to ensure projects don't come as a surprise, but timing is for the most part not in NBHDL's control. Once NBHDL is aware of a project, it begins engineering immediately and attempts to schedule the work so that it is completed before the City's contractor mobilizes to do their work. This is in an effort to avoid conflicts between contractors and to avoid the City being designated as constructor under Ministry of Labour requirements.

Factors Relating to Customer Preference or Third-Party Input (5.4.3.2.C.a. Second Bullet)

NBHDL works closely with the owner of the road to ensure the relocation of distribution assets is acceptable. All local utilities (communication companies, gas, water, sewer, etc.) work together to minimize costs and disruption, both in design and construction.

Factors Affecting Final Project Costs (5.4.3.2.C.a. Third Bullet)

Final costs of individual projects can not be determined until a road relocation project is started. However, length of road section being relocated, subsurface conditions, and traffic involved are all things that can affect the final costs of any road relocation project.

If the City of North Bay wishes to modify the asset in a certain manner, for example, moving the lines from overhead to underground, then NBHDL will work with them to perform this work. However, in these circumstances, the City will pay 100% of the costs to modify the assets.

Controllable Cost Minimization (5.4.3.2.C.a. Forth Bullet)

Through coordinated design, distribution assets are relocated in a way to minimize costs as much as possible. Since NBHDL has control over the work it performs, it can maintain its standard operating efficiencies. Due to standing agreements, 50% of labour, labour saving devices, and equipment is covered by the road authority, while 100% of the materials are covered by North Bay Hydro.

NBHDL reviews the projects carefully to identify locations where assets could remain as existing in order to avoid expenditures to both North Bay Hydro and the City.

A review of the work and timing is completed. If the work has to be done at the same time as the contractor is on site, the City might offer their contractor to do some excavation (if available) at no cost to NBHDL. For example, in one instance, a duct bank needed to be cut and partially reconstructed. The general contractor, to avoid having another contractor on-site and accelerate the work performed all the excavation, compaction, duct bank removal and provided fill to complete the work once the duct bank was constructed if NBHDL was willing to construct the duct bank within a short timeframe. To save costs, NBHDL took advantage of this situation and the project was completed at a lower than expected cost.

Other Planning Objectives Met (5.4.3.2.C.a. Fifth Bullet)

Other planning objectives are considered during road relocation projects; however, specifics cannot be identified until projects are initiated. It is NBHDL's methodology to take advantage of the mandatory work to address any other issues, such as safety concerns, or requirements for the future in efforts to save cost, such as taller poles than what was existing to address new framing standards, or the installation of ductwork while the road is excavated to save future excavation costs. These types of options are considered on all projects.

Technically Feasible Project Options (5.4.3.2.C.a. Sixth Bullet)

Alternatives are discussed; however, the feasible options must be reviewed on a project by project basis, which can not start until the project is initiated.

Relocation, removal of backlot, tree clearing are all aspects that are reviewed as options when coordinating with the City.

Summary of Options Analysis (5.4.3.2.C.a. Seventh Bullet)

Alternatives are considered; however, the analysis is completed on a project by project basis, and after the project is initiated. As the expenditure is based on forecasted amounts, this section is not relevant until a project is started or scheduled.

Results of the Final Economic Evaluation (5.4.3.2.C.a. Eighth Bullet)

These projects do not require an economic evaluation.

Nature and Magnitude of System Impacts, Costs, and Cost Coverage (5.4.3.2.C.a. Ninth Bullet)

Typically, road relocation projects have a very minimal impact on the system, costs can range from low to high ($10k-$500k), and 50% of labour, labour saving devices, and equipment costs are covered by the road authority requesting the work.

At, times the value of road relocation projects is minimal since the city does not cover all the costs and the work often involves assets that have a significant amount of remaining life to them.

GENERAL INFORMATION ON THE PROJECT/PROGRAM (5.4.3.2.A)

2021 Capital Project Summary

5.4.3.2.A - General Information on the Project / Program

Project Name	Yard Fabric Structure				
Investment Category	General Plant				
Project Description	Construction of a 42' x 120' fabric structure in the rear yard of the property to house wire reels, transformers, vehicles and assembly of composite poles.				
Capital Investment					
(5.4.3.2.A. First Bullet)	Gross Capital	$136,947			
	O&M Costs (if applicable)	$0.00			
(5.4.3.2.A. Second Bullet)	Capital Contributions	$0.00			
	Net Capital	$136,947			
Customer Attachments/Load (kVA)					
(5.4.3.2.A. Third Bullet)	Customer Attachments (#):	na			
	Customer Load (peak KVA)	na			
Project Timing					
(5.4.3.2.A. Fourth Bullet)	Start Date	04-Jan-21			
	Acquired Date	15-May-21			
	Expected In-Service Date	15-Jun-21			
	Expenditure Timing		Q1:	0%	$0
			Q2:	100%	$136,947
			Q3:	0%	$0
			Q4:	0%	$0
Risk and Risk Mitigation					
(5.4.3.2.A. Fifth Bullet)	Risks would include delays in schedule and additional costs due to ground preparation. In order to mitigate those risks, the project is scheduled to start in the spring of 2021 for completion by the end of the year. This should be sufficient time to complete the project. To mitigate ground preparation risks, test pits will be dug on the property. There are risks to tearing the fabric during storms or adverse weather events, however other similar structures constructed in North Bay were reviewed and the owners seemed satisfied with their quality and strength with no issues brought to NBHDL's attention. Such structures are utilized at road maintenance facilities where sand and salt are stored and where large vehicles enter which signify the ruggedness of the structure.				

Comparative Information

(5.4.3.2.A. Sixth Bullet) See information below.

Total Capital & OM&A Costs Associated with REG Investments

(5.4.3.2.A. Seventh Bullet) This project is not associated with REG investment; Capital and OM&A cost related to REG will not be incurred

Leave to Construct Approval

(5.4.3.2.A. Eight Bullet) This project does not require Leave to Construct approval under Section 92 of the OEB Act and therefore this does not apply

5.4.3.2.B - Evaluation Criteria and Information Requirements

EVALUATION CRITERIA AND INFORMATION REQUIREMENTS (5.4.3.2.B)

Efficiency, Customer Value, Reliability (5.4.3.2.B.1)

Section a)

Main Driver (Trigger)

Obtaining access to equipment in winter conditions. This project will allow NBHDL employees (mostly power line maintainers) to have easy access to materials and equipment in the winter months by avoiding to hire a contractor to remove snow to access the equipment and delays for line staff to get to their equipment. Staff typically need ½ hour to clear snow covered equipment. This will also allow the protection of 10 vehicles from being covered in snow which would eliminate 5 minutes of clearing time per vehicle (saving 50 min.).

The cost to hire a contractor to remove snow is approximately $2614 per snow removal. Snow removal from the yard was requested 3 times in 2019. There are 82.7 snowfall days in North Bay, ON with a yearly average snowfall of 299.7cm (averages of 1981-2010 per Environment Canada). In addition, North Bay Hydro is purchasing more composite poles which require assembly in the yard. This structure would allow the line crews to assemble those composite poles during rain or snowfall days.

Secondary Drivers

Will create a vehicle shelter to avoid having to clear them on every snow day. It will provide a protected area against rain and snow for line crews to perform work, such as composite pole assembly. This cover will also protect the special racks that were purchased for this pole assembly. This will also prevent transformers and wire reels from freezing on the cement pads.

Related Objectives/Performance Targets

NBHDL Corporate Mission, Vision and Core Values CV3 and CV4 (as identified in Exhibit 1).

The objective is to keep equipment clear of snow and easily accessible. This will improve emergency response times in the winter by having the equipment protected.

Source and Nature of the Information Used to Justify the Investment	- Line staff and people who clear vehicles regarding the time it takes for clearing - Billing information from contractors that come to clear snow - Environment Canada

Section b)

Reliability Planning and Resilient Distribution System Design	This fabric structure will help the reliability as it will improve the crew response time in the winter. A frozen reel or transformer can take up to 30 minutes to clear out of the ground depending on depth of snow and ice.
Adaptation to Future Challenges	Climate change will bring larger and more frequent storm events that could bring larger snowfalls and/or ice. This will make clearing of ice and snow more frequent and difficult. This shelter will help protect the equipment against future extreme weather conditions caused by climate change. The shelter will also provide a protected space to continue to perform work and outdoor training during significant adverse weather events. This will increase staff productivity since they will be able to do something instead of just waiting the storm out.

Section c)

Investment Priority Relative to Other Investments	As a utility that is looking for efficiency, any asset that can accelerate the response time of our crews is considered as beneficial investment. This is the only new component of its facility that NBHDL intends to do in 2021. The only other facility spending will be for regular maintenance and repairs.
Prioritization Approach	NBH's approach to prioritization is always by looking at items that bring a high cost-benefit to the company. As a small utility, NBH is always looking at methods to bring value to customers. This structure is low cost and will bring value by accelerating response time for work and outages as identified in the timelines above.

Section d)

Analysis of the Project and Project Alternatives

Effect on System Operation Efficiency and Cost-Effectiveness (First Bullet)	The fabric structure provides operational efficiencies as work can be performed quicker in dry conditions than wet conditions. The shelter will also offer shade for the hot summer months. Studies have shown that hot weather can have an adverse effect on employee productivity levels by up to 20% and increase distraction up to 45%. (Greg Peverill-Conti, Captivate Office Pulse Finds Summer Hours are Bad for Business, 2012). Having a shaded area to perform outdoor tasks can maintain productivity. In addition, distractions can lead to safety incidents. System operation will be enhanced by a minimum of 30 min. per time that the crews spend clearing the equipment in addition to the time it takes to clear their pickup vehicles. Taking time away from restoration means that crew might need to use overtime hours to perform those tasks instead of regular time. Overtime is paid at twice the regular rate. This type of structure is low maintenance and once it is in place, will require very little long-term maintenance expenditures since there are no moving parts. This will make it a very cost-effective structure.

	This type of structure has vertical walls which maximizes the use of space underneath (as opposed to a domed structure).
Net Benefits Accruing to Customers (Second Bullet)	Keeping equipment sheltered from winter conditions will allow crews to save time spent on removing snow and ice built up on the equipment. After a major snow storm, out door equipment can be buried and essentially have to be "dug out" to access. In certain cases, typically involving freezing rain / ice, a piece of equipment may need to be brough indoors to defrost for a certain period of time. In emergency outage situations, any time saved accessing equipment will benefit the customer in the form of a quicker restoration. Customers who heat their homes with electricity in the middle of winter will appreciate this accelerated restoration time since ½ hour can make a big difference when the outdoor temperature is at -30 deg C. A CMHC study mentioned that in winter months, it will only take several hours for temperature to fall below 14 or 15°C. (Cooling Rates of Houses During Extended Power Failures, June 2003 Technical Series 03-106). After this, the temperature reduction rate decreases. In that study, 12-17 days after the power failure, the temperature had fell to an average of 7.4°C with weather mean ranging from -7 to -8°C. This temperature is definitely not comfortable for people and ½ hour will have an impact on them. All this to say, that outage restoration times in the winter can have a serious affect on customers and a shelter that can immediately improve response times will bring significant value to the customers.
Impact on Reliability Performance (Including on the Frequency and Duration of Outages) (Third Bullet)	This shelter will not impact the frequency of outages, but will impact the duration as most outages occur during adverse events, which in turn is where this shelter shall bring benefits. See above for details on benefits to customers.
Project Alternatives	In order to provide outside element protection for equipment and workers, a variety of alternatives were investigated: a) No change/maintain existing Pros: No capital costs. Cons: Equipment remains in yard frozen and snow covered in winter. Delays in access. Costs in clearing. Trucks not covered. No location to assemble composite poles in the winter during snow days.

b) Steel Quonset Hut:
Pros: The steel Quonset hut provides similar benefits as the other 3 structural options (all have indoor storage/working space protected from the elements). This structure is extremely durable as it is made of steel. It holds up very well to extreme weather conditions and extremely well to fire due to its high melting point. They do not undergo warping, tearing or ripping. These are pre-engineered, therefore saving the cost of engineering and time for the design compared to a structural steel building. The manufacturer also claims that the building is zombie proof.
Cons: Cost of steel is higher than fabric, therefore the cost of this structure is higher at $193,500. This type of structure loses height at the sides of the building due to the dome shaped design, which reduces its workable space and room.

c) Metal Storage Building:
Pros: A metal storage building provides the same access benefits as the 3 structural options. It typically has vertical walls which maximizes workable space. This building would be very durable against the elements and would be very resistant to fire depending on the framing of the structure, whether wood or steel trusses would be used. It would not undergo warping, tearing or ripping.
Cons: The cost of this structure is expected to be the highest of all the shelter types since it requires specific engineered plans which will add cost and time to the schedule for construction. The construction of this structure would also be longer as there are more components to assemble.

d) Fabric Structure: Pros: Lowest cost of all the structures at: $136,947. The lightweight material minimizes the structural framing requirements, therefore maximizing space and minimizing the structure size. The structure is pre-engineered and can be erected quickly, within 2-3 weeks for smaller structures. The panels can be replaced if damaged by storm events and the open area allows for more light to enter. The structure can be erected on concrete blocks, therefore requiring no foundation and making it possible to relocate in the yard if needed.
Cons: Fabric is weaker than steel and can be susceptible to tearing or warping during storm events or if it is hit by machinery, exposing the equipment to the weather.

Safety (5.4.3.2.B.2)

The fabric structure will improve safety as all equipment underneath will be clearly visible and accessible at all times (since it will not be covered by snow). This will minimize tripping hazards in the yard. The fabric type also allows for more natural light to enter the structure, maintaining good visibility. It will also protect vehicles from being covered in snow and ensure that staff are not driving with a vehicle that is not properly cleared. One safety risk is that too many items could be placed inside which could create a hazard. A method of storage will need to be developed and specific locations will need to be designated. It could also create a hazard for vehicles driving around the structure as it could be another obstacle for them to hit. If staff are under the structure and the tarp ripped, snow could fall on them, although that has not occurred on other similar structures.

Cyber-Security, Privacy (5.4.3.2.B.3)

Not applicable.

Co-ordination, Interoperability (5.4.3.2.B.4)

Section a)

Co-ordination with Utilities, Regional Planning and/or Links with 3rd Party Providers and/or Industry

There is no way to coordinate with other utilities.

Section b)

Enabling of Future Technological Functionality or Addressing of Future Operational Requirements

This structure design provides an open area that can accommodate a variety of different equipment, material or vehicles and the storage layout can be modified to suit changing needs. It can be used for a variety of work operations. NBHDL will be using more composite poles and has recently purchased specific composite pole assembly racks. These racks will be located underneath the structure to protect them and will serve as the main assembly location. The Fabric Structure design also allows the structure to be relocated in the event that the yard layout is re-organised. The structure will prepare NBHDL well to handle climate change impacts to the increase in frequency and severity of storm events.

Environmental Benefits (5.4.3.2.B.5)

The environmental benefits include less idling of vehicles to thaw a frozen windshield and warm up the vehicle in the winter.

Conservation and Demand Management (5.4.3.2.B.6)

Not applicable.

Category-Specific Requirements - General Plant (5.4.3.2.C.d.)

GENERAL PLANT SPECIFIC REQUIREMENTS

The Results of Quantitative and Qualitative Analysis, Including Assessments of Financially Feasible Options to the Proposed Project, and Identifying the Benefits of the Proposed Investment (5.4.3.2.C.d. First Bullet)

The comparison between the alternatives is detailed above. In summary, NBHDL requires a facility that will provide material, equipment and vehicle protection to reduce the maintenance cost of the yard and to reduce the level of effort to clear equipment when required. Looking at the variety of shelter possibilities, a fabric shelter is deemed to provide the highest cost-benefit. The fabric structure will provide the required sheltered space and protection from the elements at the lowest cost compared to the alternative structures. The Do Nothing alternative will eliminate any expenditure, but will not improve the efficiency of the utility in its operations.

Business Case Documenting the Justification for the Expenditure, Alternatives Considered, Benefits for Customers (Short / Long Term), and Impact on Distributor Costs (Short / Long Term) (5.4.3.2.C.d. Second Bullet)

- See Section 5.4.3.2.B.1 for Alternatives Considered, Benefits for Customers, and Impact on Distributor Costs

b) Steel Quonset Hut: Pros: The steel Quonset hut provides the same access benefits as the other 3 structural options. Since this structure is completely made of steel, it is extremely durable. It holds up very well to extreme weather conditions and extremely well to fire due to its high melting point. They do not undergo warping, tearing or ripping. These are pre-engineered, therefore saving the cost of engineering and time for the design compared to a structural steel building.
Cons: The overall height of the building is only 20' vs. 22' for the Fabric Structure. The door height is not as high as the fabric structure door either. The cost of steel is higher than fabric, therefore the cost of this structure is more at $193,500. Loss of space on the sides of the building due to the dome shaped design, which reduces its workable space and room. These structures would also require lighting.
c) Metal Storage Building: Pros: A metal storage building provides the same access benefits as the other 2 structural options. It typically has vertical walls which eliminates loss of workable space due to curved walls. This building would be very durable against the elements and would be very resistant to fire depending on the framing of the structure, whether wood or steel trusses would be used. It would not undergo warping, tearing or ripping.
Cons: The cost of this structure is the highest of all the shelter types at over $200,000. It requires specific engineered plans which will add cost and time to the schedule for construction. The construction of this structure would also be longer as there are more components to assemble.
d) Fabric Structure: Pros: Lowest cost of all the structures at: $136,947. The lightweight material minimizes the structural framing requirements, therefore maximizing space and minimizing the structure size. The structure is pre-engineered and can be erected quickly, within 2-3 weeks for smaller structures. The panels can be replaced if damaged by storm events and the fabric material allows for more light to enter. The structure can be erected on concrete blocks, therefore requiring no foundation and making it possible to relocate if needed.
Cons: Fabric is weaker than steel and can be susceptible to tearing or warping during storm events or if it is hit by machinery, exposing the equipment to the weather.

GENERAL INFORMATION ON THE PROJECT/PROGRAM (5.4.3.2.A)

2021 Capital Project Summary

5.4.3.2.A - General Information on the Project / Program

Project Name	General Building Work			
Investment Category	General Plant			
Project Description	The work entails various maintenance items for the building as identified in the 2019 Building Condition Assessment Report. Some of the main components of the work involve installing a French Drain around the building to prevent further degradation of the building exterior, replace flashing to ensure that it slopes properly to prevent water from pooling towards the building, repair metal siding to prevent water ingress in the building envelop and accelerated degradation.			
Capital Investment				
(5.4.3.2.A. First Bullet)	Gross Capital	$130,300		
	O&M Costs (if applicable)	$0.00		
(5.4.3.2.A. Second Bullet)	Capital Contributions	$0.00		
	Net Capital	$130,300		
Customer Attachments/Load (kVA)				
(5.4.3.2.A. Third Bullet)	Customer Attachments (#):	not applicable		
	Customer Load (peak KVA)	not applicable		
Project Timing				
(5.4.3.2.A. Forth Bullet)	Start Date	January 1, 2021		
	Expected In-Service Date	December 31, 2021		
	Expenditure Timing	Q1:	0%	$0
		Q2:	25%	$32,575
		Q3:	50%	$65,150
		Q4:	25%	$32,575
Risk and Risk Mitigation				

(5.4.3.2.A. Fifth Bullet)	Schedule risks related to contractors not hired early enough in the year, which could lead to them not being able to complete the work in the planned construction year Facility risks relating to delays in construction include an increase in water infiltration causing additional damage, which in turn could increase future repair costs. Cost risks relate to tender prices coming in higher than expected which would increase facility expenditures over budget or push out other required asset repairs scheduled for completion in 2021. Delaying these other projects would also lead to further deterioration of the building assets.
Comparative Information **(5.4.3.2.A. Sixth Bullet)**	None of this work has been completed in the past, therefore there are no comparatives. Alternatives to these undertakings are identified in a section below.
Total Capital & OM&A Costs Associated with REG Investments **(5.4.3.2.A. Seventh Bullet)**	Not applicable.
Leave to Construct Approval **(5.4.3.2.A. Eighth Bullet)**	Not applicable.

5.4.3.2.B - Evaluation Criteria and Information Requirements

EVALUATION CRITERIA AND INFORMATION REQUIREMENTS (5.4.3.2.B)

Efficiency, Customer Value, Reliability (5.4.3.2.B.1)

Section a)

Main Driver (Trigger)	Work is to extend the life of the building and maintain its value. In order to extend the life of the building, it is important to prevent damage to the interior of the building that would cause further deterioration and create additional costly repairs.
Secondary Drivers	Employee Health, Safety and Productivity. It is important that employees work in a healthy and safe environment free of defects and/or hazards. It is important to prevent injuries such as slipping in pooling water or ice in the winter, respiratory issues due to mold that could develop if water infiltration is not contained.
Related Objectives/Performance Targets	NBHDL Corporate Mission, Vision and Core Values CV2 (as identified in Exhibit 1).
Source and Nature of the Information Used to Justify the Investment	A Building Condition Assessment was completed in 2019 by a 3rd party engineering firm. The report identified a series of short and long-term investment requirements to maintain the safety and functionality of the building.

Section b)	
Reliability Planning and Resilient Distribution System Design	This maintenance will ensure that utility work can proceed as currently setup and will slow the rate of deterioration of the building until a new building can be constructed.
Adaptation to Future Challenges	These improvements are being made to maintain the current building only. They do not provide additional operational benefits. No building improvements are planned as part of this.
Section c)	
Investment Priority Relative to Other Investments	These investments are of high priority to prevent further deterioration and increased costs of repair. As examples, the pooling of water around the outside of the structure is causing long-term damage to the structural integrity of the building. The thermography identified numerous electrical components which had hot spots that need to be addressed. Although not an immediate safety concern, electrical hotspots create a safety risk if left unaddressed.
Prioritization Approach	Each asset was assigned a standard label to identify its condition. Good: Assets that appear to be in new, refurbished or recently-repaired condition. There are no observed deficiencies; Fair: The asset appears in a condition that is consistent with its age. Some deficiencies may be apparent, but they are not severe nor do they impair the function of the system in a major way; Poor: The asset appears to be defective or deficient for its intended purpose. Major repairs or replacement is expected to be required in the immediate term or in the near future. Following the asset condition, each asset was given a priority class for that asset to justify the urgency of the repair or replacement. These were identified as follows: Class A - Life Safety: Asset must be maintained in working condition to prevent loss of life. Any replacement or repairs which are required should be considered paramount in importance and urgency. Class B - Structural Integrity: The asset is a component of the building structure and its failure could pose a significant risk to the safety of the occupants. Any replacement or repairs which are required should be addressed immediately. Class C - Legislative Requirements: The asset is in need of modifications or upgrades to ensure that it meets the current applicable codes and standards. Class D - Building Functionality: The asset provides an integral function for the intended purpose of the building. The deterioration of the asset is not expected to expose the occupants to safety risks, although the serviceability of the building may be affected and productivity may decline as a result. Class E - Cost-Effective Upgrades: The asset is not essential to the safety of the occupants or the function of the building. Any repairs or upgrades could be considered to be merely aesthetic.
Section d) **Analysis of the Project and Project Alternatives**	

Effect on System Operation Efficiency and Cost-Effectiveness (First Bullet)	The proposed repairs are meant to ensure proper operation of the facility. If water infiltration is not addressed, the freeze-thaw cycles in northern Ontario will increase the gaps in the structure and cause additional damage to the building, these gaps will allow more water which in turn will keep increasing the size of the gaps. Once water is well infiltrated, it can cause rot to wooden areas which could lead to relocate staff in order to do more internal structural repairs.
Net Benefits Accruing to Customers (Second Bullet)	Continuous damage to the building means that some areas of the facility cannot be utilized, reduce staff efficiency and will require additional work for repairs, which will result in higher costs to customers to maintain the old facility. If some areas have to be isolated for construction due to significant repair requirements instead of the maintenance requirements identified in this section, staff will need to be relocated. NBHDL does not have many options to relocate staff within its facility and might need to rent a trailer.
Impact on Reliability Performance (Including on the Frequency and Duration of Outages) (Third Bullet)	No impacts on reliability.
Project Alternatives	The alternatives are as follows: A) Do nothing: No maintenance or repairs to existing deficiencies and only critical work would be completed to ensure continued operation. This would accelerate the structural degradation of the building and create safety hazards as discussed above. The building's current image is already non-appealing and the exterior does not look like a professional organization. To not perform any maintenance would also worsen the public image of North Bay Hydro. B) Proactively repair and/or replace all deficient items: This alternative would be to bring all components of the building to a good condition based on age and/or condition. This level of improvement would be expensive for an old structure that does not operate well for its current use. Major pro-active repairs would result in additional costs to the customers and would not be cost-efficient. C) Aesthetics Improvements only: In order to retain an image of a professional workplace. Aesthetic improvements could be made to cover-up the deficiencies. Paint could be applied over rusted areas, caulking could fill holes, cover-ups could be installed to hide the deficient items. This approach would provide a positive image to the public on the short term, but deterioration would continue and costs of repairs would continue to rise.

GENERAL PLANT

Safety (5.4.3.2.B.2)

Hot spots in some of the electrical panels could cause fires if not addressed in a timely manner. Improper drainage around the building accumulates water and causes slippery situations in the winter. Water ingress can also rot wood and develop mold spores that would impact the health of the workers. Addressing those issues will help protect employee and public safety.

Cyber-Security, Privacy (5.4.3.2.B.3)

Not applicable.

Co-ordination, Interoperability (5.4.3.2.B.4)

Section a)

Co-ordination with Utilities, Regional Planning and/or Links with 3rd Party Providers and/or Industry

Not applicable since this work is required to maintain North Bay Hydro's building facility. North Bay Hydro will investigate relocating and sharing space with other contractors. This work will be performed as part of the overall building future planning.

Section b)

Enabling of Future Technological Functionality or Addressing of Future Operational Requirements

These improvements will not address future technological functionality. They only repair/maintain existing deficient items.

Environmental Benefits (5.4.3.2.B.5)

None of the work proposed will provide an environmental benefit.

Conservation and Demand Management (5.4.3.2.B.6)

Not applicable.

Category-Specific Requirements - General Plant (5.4.3.2.C.d.)

The Results of Quantitative and Qualitative Analysis, Including Assessments of Financially Feasible Options to the Proposed Project, and Identifying the Benefits of the Proposed Investment (5.4.3.2.C.d. First Bullet)

	The results of all the components of the building condition assessment are located in Induspec's Building Condition Assessment Report located in Appendix G of the DSP. It includes recommendations for improvements for the 0-5, 6-10 and 11-20 year timeframes. Only the 0-5 year items were considered and out of those items, only the most urgent items were placed on the maintenance and repair list for safety and building condition maintenance purposes.
	Business Case Documenting the Justification for the Expenditure, Alternatives Considered, Benefits for Customers (Short / Long Term), and Impact on Distributor Costs (Short / Long Term) (5.4.3.2.C.d. Second Bullet) The business case for this work is located in the attached building condition assessment document created by Induspec. There is a list of items that require maintenance or repair. Only the most important items were selected for repairs in 2021.

GENERAL INFORMATION ON THE PROJECT/PROGRAM (5.4.3.2.A)

2021 Capital Project Summary

5.4.3.2.A - General Information on the Project / Program

Project Name

Replacement of Truck 34

Investment Category

General Plant

Project Description

The project involves the replacement of Truck 34, a 2008 55' double bucket material handling aerial device truck with a 55' to 65' double bucket material handling device. The existing vehicle will be over 13 years and is scheduled to be replaced as part of our fleet replacement schedule created by John Saunders, Utility Services in 2013-2014.

The procurement of the truck started in 2020 with a Purchase Order issued to Posi+, the lowest bidder. The cab and chassis have a project delivery timeline of fall 2021 and the aerial lift / bucket to arrive early 2022. The finished unit will be delivered and put into service in Q2 2022. The total cost of the truck is **$464,143**.

The replacement of Truck 34 with a 55' to 65' aerial device is crucial for future construction as NBHDL is designing more projects with taller poles including composite poles that are typically 55' to 75'.

Capital Investment

(5.4.3.2.A. First Bullet)	Gross Capital	$119,649	
	O&M Costs (if applicable)	$0.00	(not applicable)
(5.4.3.2.A. Second Bullet)	Capital Contributions	$0.00	
	Net Capital	$119,649	

Customer Attachments/Load (kVA)

(5.4.3.2.A. Third Bullet)	Customer Attachments (#):	Not applicable
	Customer Load (peak KVA)	Not applicable

Project Timing

(5.4.3.2.A. Forth Bullet)	Start Date	Oct-19
	Expected In-Service Date	Jun-21

Expenditure Timing	Q1:	0%	$0
	Q2:	0%	$0
	Q3:	26%	$119,649
	Q4:	0%	$0
	Q2 (2022):	74%	$344,494

Risk and Risk Mitigation

The main risk of not replacing this truck is that if NBHDL keeps only one truck to maintain poles above 55' and that truck is undergoing repairs or maintenance activities during a storm event, NBHDL will have no capacity to restore power to customers who are served by taller composite poles. Without a truck with a tall reach, restoration would have to be done by manually climbing the poles which would be much slower and difficult to perform in addition to reducing the safety of the power line maintainers.

One risk will be the adherence by the supplier to the delivery schedule. That risk has been already been mitigated by starting the procurement process in 2019. To further mitigate the risk, NBHDL will request delivery updates quarterly to ensure the truck still plans on being delivered in Q2 of 2021.

Additional risks include deficiencies in the product that was ordered. Vehicle inspections prior to delivery will reduce those risks as it will provide an ability for NBHDL to identify issues prior to delivery and the manufacturer to address them. NBHDL has also ordered the vehicle from Posi+ which is a renowned manufacturer of utility trucks. NBHDL has had a good experience with this manufacturer in the past, therefore further minimizing risks of complications or issues.

(5.4.3.2.A. Fifth Bullet)

Risks for not acquiring this truck are identified throughout the document.

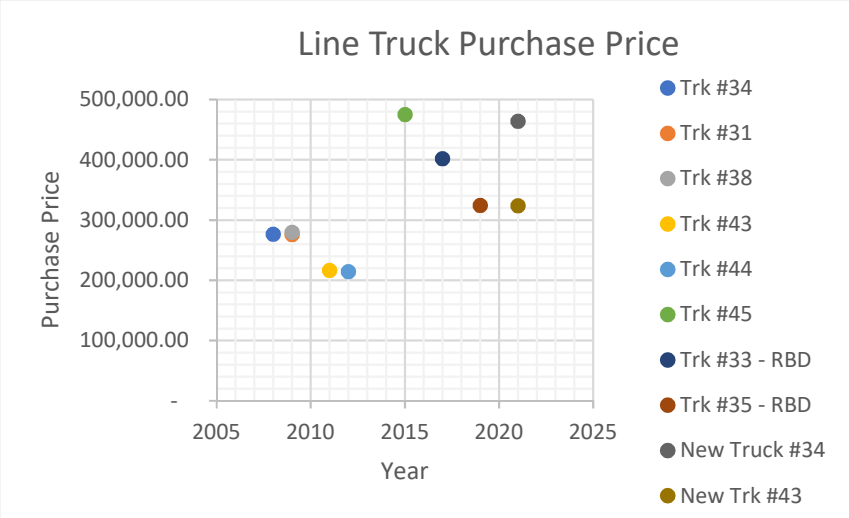
Comparative Information

NBHDL has two trucks with this reach (including the truck to be replaced). Truck 45 is the closest comparator since it has a 55' to 83' aerial device. Truck 45 was purchased in 2015 at a cost of $475,201. The new Truck 34 has a reach of 55' to 65' and a cost of $464,143. This price is in line with the cost of Truck 45.

(5.4.3.2.A. Sixth Bullet)

Gross vehicle replacement costs for large trucks over the past 5 years are as follows:
2015: Truck 45: $475,201
2017: Truck 33: $402,067
2019: Truck 35: $324,244
2021: Truck 43: $323,941 (on order)

The new Truck 34 cost is slightly less expensive than Truck 45, the only other truck with a reach above 55'. This is reasonable since Truck 45 has a longer reach (up to 83'). Truck 34 will be more expensive than the other 2 RBDs and Truck 43 since those are smaller line trucks. The cost of Truck 34 is reasonable. The chart below identifies the relative costs of trucks purchased since 2008.



Total Capital & OM&A Costs Associated with REG Investments

(5.4.3.2.A. Seventh Bullet)

This project is not associated with a REG investment; capital and OM&A costs related to REG will not be incurred.

Leave to Construct Approval

(5.4.3.2.A. Eight Bullet)

This project does not require Leave to Construct approval under Section 92 of the OEB Act and therefore this does not apply.

5.4.3.2.B - Evaluation Criteria and Information Requirements

EVALUATION CRITERIA AND INFORMATION

Efficiency, Customer Value, Reliability (5.4.3.2.B.1)

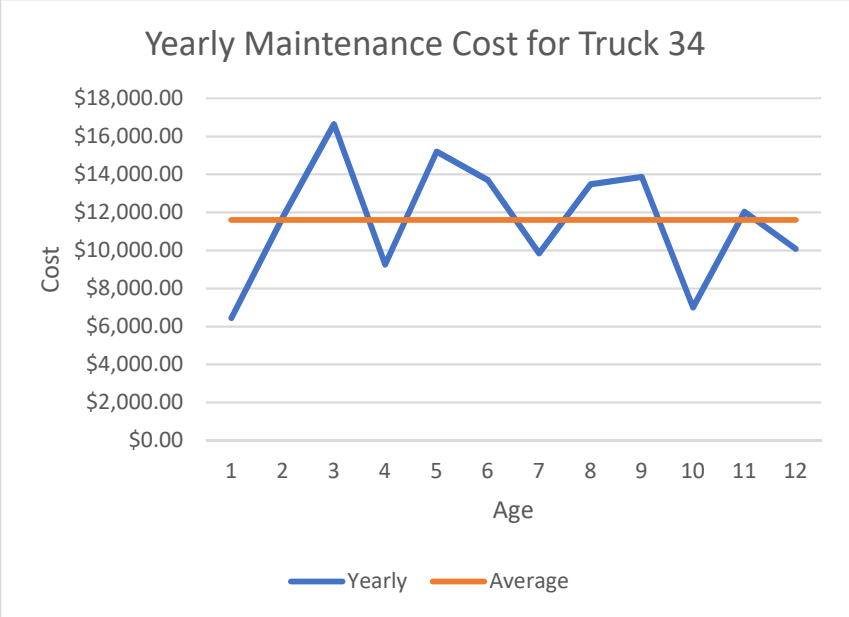
Section a)

Main Driver (Trigger)

The main driver to the project is the replacement of an end of life truck and per NBHDL's truck replacement schedule created by John Saunders, an independent 3rd party, in 2015, NBHDL needs to replace this truck in order to follow its fleet replacement management practice.

The fleet replacement schedule identified that it is important to keep vehicles as long as possible, but the key is to replace them before major repairs are required, such as the ones due to diesel engines, Allison transmission failures or major overhaul of aerials. It is also important to follow the truck replacement schedule to spread out the truck replacement investments and avoid years with multiple truck replacement needs or significant repairs. The report recommends ideal line truck replacements to occur at 12 years of age. This truck will be 13 years old by the time it is replaced.

Secondary Drivers	As the truck ages, some components may need to be replaced due to age and wear. For example, the cost of replacing the hydraulic hoses on the boom would be $10,000-$12,000. This replacement could be expected when the truck reaches 15 years of age (per Motion Canada (maintenance contractor)) in addition to regular maintenance. In addition, a hydraulic pump replacement could be expected between 15-20 years of age at a cost of $3,000 to $5,000. Although the current main rotation bearing is within tolerances, wear will continue to increase and the replacement would be approximately $12,000-$15,000 with the truck being down for 3-4 weeks. In addition, a component of the truck caught fire in December 2018 which can be a sign of failures to come. The following chart represents the yearly spending for Truck 34 with an average spending of $11,609. There are some fluctuations with the maintenance, but it is holding well up to now.

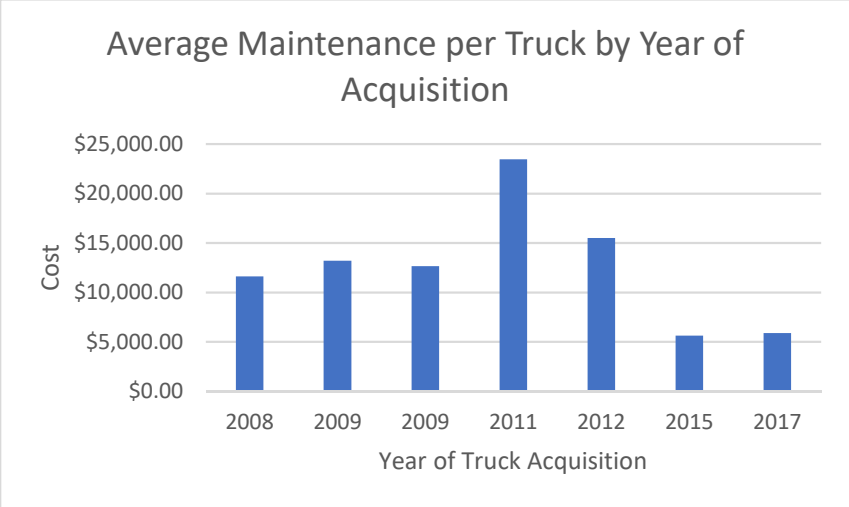


Related Objectives/Performance Targets	All vehicles are expected to be operational 100% of the time except for scheduled maintenance and testing. North Bay Hydro only has 2 trucks with a reach of 55' and greater. There is a need to have at least one truck available 100% of the time for regular and emergency work in order to reach the taller poles. In order to meet the 100% availability, 2 trucks are required to ensure coverage when one is under maintenance. NBHDL Corporate Mission, Vision and Core Values CV3 and CV4 (as identified in Exhibit 1).
Source and Nature of the Information Used to Justify the Investment	The Fleet Assessment and Replacement Strategy completed by John Saunders Utility Services and maintenance records.

Section b)

Reliability Planning and Resilient Distribution System Design	NBHDL only has two trucks that can reach above 55'. It currently has assets on 1743 poles over 55' out of 12960 poles (13.73%) (NBHDL and foreign owned) and there are numerous projects planned with infrastructure that will require the capacity to reach that height. Providing a second truck that can reach those heights will ensure sufficient vehicle capacity to install NBHDL's future infrastructure/construction plans.

A new truck will minimize trucks repairs as the parts will be further away from their end of life timelines, such as for the components identified above under "Secondary Drivers". It will reduce down time and improve efficiency of construction. It will also help reduce restoration time in a major outage. The following chart demonstrates the total maintenance per vehicle based on their age of acquisition. Except for the 2 service trucks acquired in 2012, there is a downward trend in truck maintenance.



Adaptation to Future Challenges

New infrastructure is becoming taller due to new standards, therefore bucket trucks that reach higher are critical to maintain NBHDL's infrastructure. As more infrastructure are being replaced with taller poles, this truck will be able to service them.

In addition, composite poles are becoming more common in the network. Those poles cannot be climbed manually and a bucket truck must be utilized to install and maintain them. Having a second truck is imperative for this work.

Section c)

Investment Priority Relative to Other Investments

The replacement of this truck is based on the replacement strategy provided in the Fleet Assessment completed by John Saunders Utility Services in 2013. It has also been prioritized by the fact that NBHDL has only one truck with a reach above 65 feet and is in need of a second one to execute construction of tall poles, especially for the taller composite poles.

Prioritization Approach

The truck was prioritized based on age and need for an aerial device with a higher reach for tall pole installation. The truck is of 2008 vintage

Section d)

Analysis of the Project and Project Alternatives

Effect on System Operation Efficiency and Cost-Effectiveness (First Bullet)

The truck forms part of the NBHDL fleet which allows NBHDL employees to efficiently maintain a safe and reliable distribution system for the City. As poles have continued to increase in height (to meet regulation) it has been identified that a second bucket truck to reach the taller poles is required. This truck will also allow for work on pole lines that are offset a fair distance from the road because truck with shorter boom lengths cannot reach as far off the right-of-way.

Net Benefits Accruing to Customers (Second Bullet)

The replacement of Truck 34 will allow NBHDL to maintain its ability to provide a safe and reliable distribution system. The replacement removes an end of life truck.

Impact on Reliability Performance (Including on the Frequency and Duration of Outages) (Third Bullet)

The replacement of Truck 34 allows for the continued efficient day to day operations of the NBHDL business. Reliability performance is impacted as the replacement permits safe and timely restoration of outages when presented.

Project Alternatives

This project is a replacement of an end of life truck and therefore there are only three alternatives: 1) Do not replace the truck; or 2) replace it with a truck of a different size than the truck NBHDL decided on; 3) sharing a truck with a neighbouring utility; or 4) Replace the truck the following year.

1) Not replacing the truck will leave the already small NBHDL fleet short by 1 bucket truck, and will also result in limiting construction crew work to only one truck in the fleet with a reach over 55'. Given that NBHDL requires a reach greater than 55' for O&M and construction, this alternative is not efficient since a significant amount of work requires reaches above 55'. Also, if the other 55' truck is not available due to repairs or maintenance, NBH would have no other truck that could reach the tall poles. In addition, NBHDL has already signed a contract with Posi+ as trucks have to be ordered over a year in advance, NBHDL would encounter contract cancellation penalties.

2)

   a. Replacement with smaller truck: As poles have continued to increase in height, replacing with a smaller size bucket truck (which NBHDL has 4), will not allow NBHDL to safely and efficiently maintain all of its assets. NBHDL already has a sufficient number of smaller trucks.

   b. Replacement with a larger truck would be more expensive at approximately $600,000 (per Posi+ estimate) and provide limited benefit to NBH as there are few locations that require a higher reach than 65' which will be the maximum reach height for the proposed truck.

3) NBHDL considered sharing a truck with a neighbouring utility, however the nearest adjacent utilities are 1.5 hour away. In any situation, the response time is not considered acceptable by NBHDL. The additional cost of labour resources to shuttle it back and forth between the utilities is also inefficient and since NBHDL has a limited amount of staff that can drive such a vehicle, it would take away restoration resources. There is also the risk that the truck would not be available at all since major storm events, such as the September 2018 micro-burst caused outages throughout the province of Ontario and utilities needed their vehicles for their own restoration requirements.

4) Replacing the truck in the following year would save costs in 2021, but would double the truck replacement costs for 2022 as there would be 2 large vehicles that would need to be acquired that year to

get back to the fleet replacement program in addition to the risk of additional maintenance costs.

Safety (5.4.3.2.B.2)

The new truck will replace an end of life asset. The replacement also allows for safer O&M procedures for the distribution system. Accessing the poles by boom & bucket provides a significant increase in safety over manually climbing and working with the use of a harness. Being a newer truck will make it more reliable and less prone to breakdowns on the side of the road, therefore minimizing workers being stranded on the road in winter conditions.

Cyber-Security, Privacy (5.4.3.2.B.3)

Not applicable to this project.

Co-ordination, Interoperability (5.4.3.2.B.4)

Section a)

Co-ordination with Utilities, Regional Planning and/or Links with 3rd Party Providers and/or Industry

This truck would be better able to support other utilities in the event of a major outage disaster since it will be able to reach all pole heights.

Section b)

Enabling of Future Technological Functionality or Addressing of Future Operational Requirements

The truck will employ state of the art controls and has been designed to allow for easy future installation of remote based IT equipment (laptop, etc.).

Environmental Benefits (5.4.3.2.B.5)

This new truck will meet all current environmental emission profiles and therefore the new truck will be an improvement over the existing truck.

GENERAL PLANT SPECIFIC REQUIREMENTS (5.4.3.2.C.d)

Conservation and Demand Management (5.4.3.2.B.6)

The current fleet schedule identifies a regular replacement program to ensure that the vehicle assets are functioning properly while minimizing maintenance costs. Purchasing this truck now will spread out the vehicle acquisition expenditures.

Category-Specific Requirements - General Plant (5.4.3.2.C.d.)

The Results of Quantitative and Qualitative Analysis, Including Assessments of Financially Feasible Options to the Proposed Project, and Identifying the Benefits of the Proposed Investment (5.4.3.2.C.d. First Bullet)

This truck replacement follows the fleet replacement schedule created in 2013 and applied to all fleet vehicles. Reduction in O&M costs as the new truck will have a warranty periods and are typically less prone to repairs. This was endorsed in the 2015 DSP application. The asset condition is on par with the typical life cycle cost for a truck of this type. This is also due to the regular maintenance applied per the manufacturer's recommendation.

Business Case Documenting the Justification for the Expenditure, Alternatives Considered, Benefits for Customers (Short / Long Term), and Impact on Distributor Costs (Short / Long Term) (5.4.3.2.C.d. Second Bullet)

Not replacing this truck would reduce system renewal efficiency and access to the electrical grid since many assets would only be able to be reached with one other truck (none if that truck is undergoing maintenance or repair activities). On larger projects, having 2 long reaching trucks provides efficiencies on working on conductors at the required heights. For example, when conductor stringing is underway, using one truck setup at each end of the pole line at the same time improves efficiency as it will avoid having to relocate the only 55'-83' truck to each location.

See above for additional business case justification.

GENERAL INFORMATION ON THE PROJECT/PROGRAM (5.4.3.2.A)

2021 Capital Project Summary

5.4.3.2.A - General Information on the Project / Program

Project Name

Replacement of Truck 43 – 2012 40' Altec TA-40 on 2012 Freightliner Extended Cab.

Investment Category

General Plant

Project Description

The project involves the replacement of the 2012 Truck 43. The existing vehicle will be 9 years old at its replacement and although it was not scheduled to be replaced as part of the fleet replacement schedule until 2025, the high level of maintenance that occurred over the years on this vehicle accelerated the need its replacement. Note: The new truck was ordered in 2019 and was scheduled to be delivered in Q4 2020, however it will can not be delivered completed until 2021. The cab and chassis will be received in 2020 and the aerial lift / bucket will be received in early 2021. The assembled unit will be delivered to NBHDL and put into service in Q2 2021. **The total cost of the truck is $323,941**

Capital Investment

(5.4.3.2.A. First Bullet)

Gross Capital	$214,084	
O&M Costs (if applicable)	$0.00	(not applicable)

(5.4.3.2.A. Second Bullet)

Capital Contributions	$0.00
Net Capital	$214,084

Customer Attachments/Load (kVA)

(5.4.3.2.A. Third Bullet)

Customer Attachments (#):	Not applicable
Customer Load (peak KVA)	Not applicable

Project Timing

(5.4.3.2.A. Forth Bullet)

Start Date	Oct-19		
Expected In-Service Date	Jun-21		
Expenditure Timing	2020 Q4	34%	$109,857
	Q1:	0%	$0
	Q2:	66%	$214,084
	Q3:	0%	$0
	Q4:	0%	$0

The Freightliner cab and chassis will be delivered to Posi+ in Q4 of 2020 with the remainder to be paid in 2021.

Risk and Risk Mitigation

Truck 43 is currently undergoing a significant amount of maintenance every year which signifies a higher than average failure rate. One risk is that this vehicle needs to spend a significant amount of time in the maintenance garage, where it is not available to staff to perform line work. This will limit the line truck availability and may restrict the amount or speed of capital work being performed or restoration in the event of outages.

Under Section 5.4.3.2.B.1 Main Driver, a summary of maintenance costs is provided. Both Service Trucks (Truck 43 and Truck 44) have the highest and second highest maintenance and repair costs of the fleet. This puts outage restoration and customer connection capabilities at risk since these trucks have the highest probability of failure based on current maintenance expenditures.

COVID19 has had an impact on the schedule. The truck was supposed to be delivered early in Q4 2020, however the Freightliner manufacturing facility (for the cab and chassis) had stopped production for over a month and Posi+ (aerial device manufacturer) also had its production shut down for a month. Production resumed in early May 2020, however, there is uncertainty regarding the production speed due to COVID19 working procedures which could lead to more delays. There is a risk that this truck delivery could push out until late 2021. In order to mitigate this risk, NBHDL will contact the manufacturer on a quarterly basis to determine progress. If delays persist, NBHDL will continue to utilize the existing truck and will continue with maintenance activities.

Additional risks include deficiencies in the product that was ordered. Vehicle inspections prior to delivery will reduce those risks as it will provide an ability for NBHDL to identify issues prior to delivery and the manufacturer to address them. NBHDL has ordered the vehicle from Posi+ which is a renowned manufacturer of utility trucks. NBHDL has had a good experience with this manufacturer in the past, therefore further minimizing risks of complications or issues. In addition, all other bucket trucks in the NBHDL fleet (except Truck 44) are manufactured by Posi+.

(5.4.3.2.A. Fifth Bullet)

Risks for not acquiring this truck are identified throughout the document.

Comparative Information

NBHDL has one identical truck to existing Truck 43 (Truck 44).

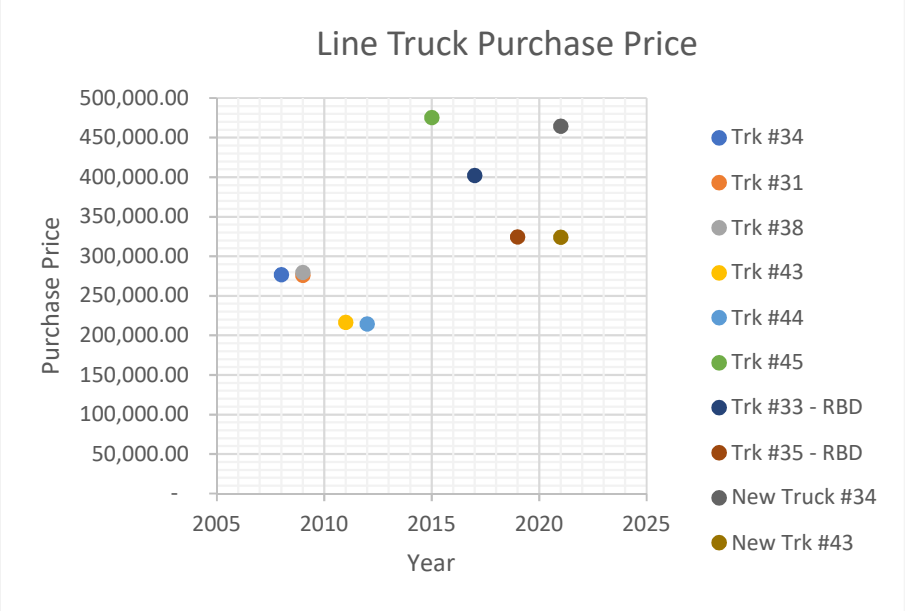
Truck 43 serves as the NBHDL Service/Trouble Truck. It is 2012 Altec 40' Single Bucket Telescopic Aerial Device (TA-40) on a 2012 Freightliner Extended cab and chassis.

The new Truck 43 will be a 2020 Posi+ with Single Bucket 42' Aerial Device on a Freightliner extended cab and chassis.

(5.4.3.2.A. Sixth Bullet)

Gross vehicle replacement costs for the previous similar trucks are as follows:

2012: Truck 43: $216,000
2012: Truck 44: $214,000
2015: Truck 45: $475,201
2017: Truck 33: $402,067
2019: Truck 35: $324,244



The price increase of the new Truck 43 compared to the old one is justified by inflation and the additional costs of these trucks. It is in line with other line trucks of similar size that have been acquired more recently such as Truck 35 which is a Radial Boom Derrick.

The truck was acquired through a competitive process and sent for bidding to Wajax and Posi+, which are 2 leading line truck manufacturers and the brands that North Bay Hydro utilizes. Maintaining a limited number of truck brands allows for efficiencies in repairs and maintenance since there are only 2 dealers that NBHDL has to deal with.

Total Capital & OM&A Costs Associated with REG Investments

(5.4.3.2.A. Seventh Bullet)

This project is not associated with a REG investment; capital and OM&A costs related to REG will not be incurred.

Leave to Construct Approval

(5.4.3.2.A. Eight Bullet)

This project does not require Leave to Construct approval under Section 92 of the OEB Act and therefore this does not apply.

5.4.3.2.B - Evaluation Criteria and Information Requirements

CRITERIA

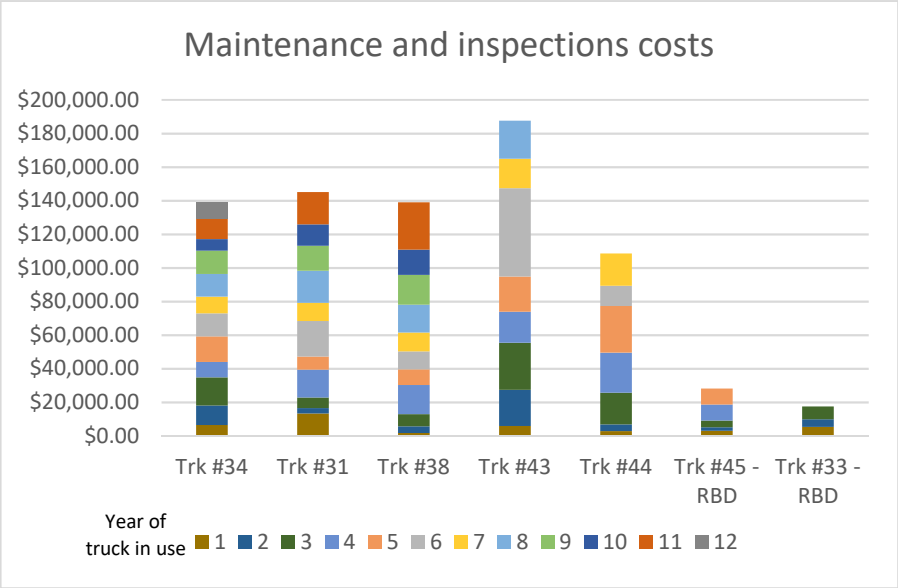
Efficiency, Customer Value, Reliability (5.4.3.2.B.1)

Section a)

Main Driver (Trigger)

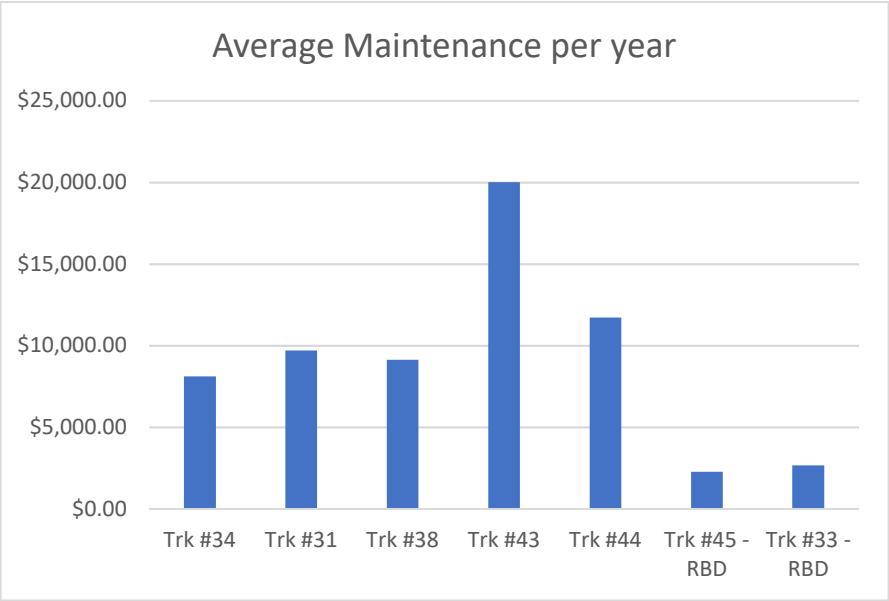
The main driver to replace this truck is the high maintenance costs associated with keeping this truck in operating condition. The high maintenance costs are mostly related to the aerial device portion of the vehicle (Altec). As an example, NBHDL needed to re-hose the 40' telescopic boom, which is considered premature for a truck of this age.

The maintenance costs for this vehicle reached $160,036.91 at the end of 2019 which is 74% of the total $216,479.03 cost of the vehicle. Maintenance activities for each other line trucks with at least 8 years of service is currently sitting at 40% or less.



As can be observed, of the seven trucks that have been acquired over the more recent years, Truck 43 has seen the highest maintenance costs.

When comparing average annual maintenance costs, Truck 43 also leads in overall spending with an average spending of $20,005/year.



	At a purchase price of $216,479 and using the existing yearly average maintenance costs, the maintenance costs of Truck 43 will exceed the initial purchase price by 2022.
Secondary Drivers	This truck is critical to the maintenance of NBHDL's distribution network as it serves as the Service Truck. The Service Truck is the most used line vehicle in the fleet with 9,712 hours of service as of December 2019 (the closest other line truck had 8,539 hours). It serves in a variety of services such as connecting new services, maintaining existing services, performing maintenance on equipment, repairing equipment, trouble calls, and outage work. The truck is designed to operated the bucket without installing outriggers for support. It can operate and be installed quickly and manoeuvre in small spaces. If this truck fails during an after-hours emergency situation, NBHDL would need to call in additional staff to get the other truck to do the emergency work. This would delay restoration times. Although this would be the situation for any truck that is used regularly for outage work, the issue is that this truck has the highest level of maintenance of all the line trucks. It is critical that the most used truck be reliable as we cannot afford to delay restoration work due to a know truck that is at a high risk of failure. One of the maintenance activities required the removal of the boom to replace and repair pins and bushings which put the truck out of service for over one month. The other 40' bucket truck (Truck 44), which is assigned to a construction crew, was removed from that service and used as the Service Truck during that time. This meant that one of the construction crews were short one line truck. This limits truck construction activities to work that does not require this truck. For example, work in small areas where outriggers cannot be lowered cannot be performed. On an additional note, Truck 44, which is identical to Truck 43 in brand and design, has the second highest maintenance costs of the line trucks identified above indicating poor quality in the construction of those vehicles. An earlier replacement of that truck can be expected in the near future.
Related Objectives/Performance Targets	All vehicles are expected to be operational 100% of the time except for scheduled maintenance and testing. Trucks are also expected to last the duration of their expected service life as identified in the Fleet Assessment and Replacement Strategy without maintenance and repair costs exceeding the value of the vehicle. NBHDL Corporate Mission, Vision and Core Values CV3 and CV4 (as identified in Exhibit 1).
Source and Nature of the Information Used to Justify the Investment	Maintenance records and the Fleet Assessment and Replacement Strategy completed by John Saunders Utility Services.
<u>Section b)</u>	
Reliability Planning and Resilient Distribution System Design	A new truck will minimize truck repairs as the parts will be further away from their end of life. Maintenance activities on the new truck will be less, which will allow more time for the truck to operate as the Service Truck and the crews will be able to retain all their construction activities by keeping their 40' bucket truck. This will maintain construction efficiency and it will help reduce restoration time in a major outage.

Adaptation to Future Challenges

The new truck will meet all current emissions and safety standards. The new truck will have a backup camera.

Section c)

Investment Priority Relative to Other Investments

Truck 43 was scheduled for replacement in 2025, per the Fleet Assessment and Replacement Strategy created by John Saunders in 2013, at which time it would have been 13 years old. Replacing this vehicle in 2021 shortens the planned replacement by 4 years.
Due to the high maintenance costs, the decision to reprioritize will have an impact on future truck purchases. The change in priority will not alter the number of trucks being replaced, nor the expenditures, but will modify the order and year of replacement as the replacement of future trucks are being pushed out by one year to ensure the trucks remain as close as possible to their replacement schedule.

Upcoming Replacement Schedule

Truck	New Replacement Date
43	2020 / 2021 (due to COVID19 delays)
34	2021/ 2022 (due to COVID19 delays)
44	2022 / 2023
31	2023 / 2024
38	2024 / 2025

Truck 43 had a 2020 date and the truck currently in production, however COVID19 halted production of trucks at both Freightliner and Posi+ for over a month. These delays have pushed out the delivery date to 2021.

Prioritization Approach

The truck was prioritized based on maintenance costs and age. The truck is of 2012 vintage.

Section d)

Analysis of the Project and Project Alternatives

Effect on System Operation Efficiency and Cost-Effectiveness (First Bullet)

Spending money on truck repairs to the point that it approaches the original purchase price is not good use of capital dollars and customer funds. There is no evidence that the maintenance on this vehicle will not continue to increase and spending more money on repairs is like throwing good money after bad.

The truck forms part of the NBHDL fleet which allows NBHDL employees to efficiently maintain a safe and reliable distribution system for the City. Having a reliable Service Truck is imperative for the maintenance of the system in order to minimize restoration times during outages. If the truck fails during an outage, a second crew might have to come in to deal with the outage while the first crew deals with the broken truck. This is an inefficient use of resources as power line maintainers are paid double time for overtime work. Having 2 crews in because of a faulty truck increases the costs to the customer base.

In addition, modifying capital work schedules to accommodate truck re-assignment due to failing trucks creates inefficiency in planning and construction operations. These changes could cause delays to projects.

Net Benefits Accruing to Customers (Second Bullet)	The replacement of Truck 43 will allow NBHDL to connect, maintain and restore power to its customers in a timely manner to provide a safe and reliable distribution system. The replacement removes an unreliable truck that the cost of repairs on the vehicle will exceed the actual purchase cost of the truck. It will also prevent delays caused by truck reallocations during construction. This is a benefit to customers since construction work is nuisance to customers living on that street. The sooner a construction crew can complete their work, but less impacts it has on customers. Failing vehicles also has a negative reputational impact to NBHDL whereas the public might deem NBHDL staff are not maintaining their vehicles properly. And since people feel that they pay a sufficient amount of money for their hydro services (per the survey results), the expectation is that NBHDL will be able to perform their work with working equipment.
Impact on Reliability Performance (Including on the Frequency and Duration of Outages) (Third Bullet)	The replacement of Truck 43 allows for the continued efficient day to day operations of the NBHDL business. Reliability performance is impacted as the replacement permits safe and timely restoration of outages when presented. Breakdowns of this truck during an outage could impact SAIDI and SAIFI numbers since the restoration time will need to be extended.
Project Alternatives	This project is the replacement of a high maintenance truck which is nearing its end of life. The following are the alternatives: 1) Do not replace the truck: Not replacing the truck will require NBHDL to spend more money on maintenance for this truck to the extent that the money spent on maintenance will exceed the original purchase price. It will also add risk to the operational efficiency of both construction, restoration and customer access to power since there is only one other service truck and that truck also requires significant maintenance. In addition, NBHDL has already placed an order with Posi+ for this truck and the cab and chassis is currently in production and expected to be received to the Posi+ facility in Q4 2020. Cancelling the contract now will result in a 10% restocking fee to Posi+ ($32,394). 2) Sharing a truck with a neighbouring utility: This truck serves and operates every day that it is not in maintenance. It has the highest number of engine hours on it (9712 hours). Sharing this truck is not a feasible option. 3) Replacing the truck in the following year: This would save costs in 2021, but would double the truck replacement costs for 2022 as there would be 2 large vehicles that would need to be acquired that year to get back to the fleet replacement program in addition to the risk of additional maintenance costs. Same as Option 1, delays in replacement will only increase the risk of failure. 4) Eliminating this truck from the fleet: Eliminating this truck from the fleet will leave NBHDL with only one service truck and no alternatives. During maintenance for that truck, the service crew would need to take an RBD or a larger truck that may not fit in all locations within the City. It would also remove a construction truck from the construction crews, which would

impact construction efficiency, resulting in longer construction and restoration.

Safety (5.4.3.2.B.2)

The new truck will replace a high maintenance truck. Staff safety can be impacted if the vehicle breaks down on the side of a roadway since the line crews must manoeuvre around the vehicle in live traffic. This situation is even worse in the middle of winter in freezing conditions. Having a significant amount of problems with the boom could result in an employee being stranded in the bucket for a period of time until they can lower him down. The new truck will include a backup camera which adds significant safety benefits when backing up.

Cyber-Security, Privacy (5.4.3.2.B.3)

Not applicable to this project.

Co-ordination, Interoperability (5.4.3.2.B.4)

Section a)

Co-ordination with Utilities, Regional Planning and/or Links with 3rd Party Providers and/or Industry

This truck could provide support to utilities caught in a serious storm event where they need restoration help.

Section b)

Enabling of Future Technological Functionality or Addressing of Future Operational Requirements

The truck will employ state of the art controls and has been designed to allow for easy future installation of remote based IT equipment (laptop, etc.).

Environmental Benefits (5.4.3.2.B.5)

This new truck will meet all current environmental emission profiles and therefore the new truck will be an improvement over the existing truck.

Conservation and Demand Management (5.4.3.2.B.6)

The current fleet schedule identifies a regular replacement program to ensure that the vehicle assets are functioning properly while minimizing maintenance costs. Purchasing this truck now will allow NBHDL to spend money on a new vehicle instead of constantly repairing an old one. With the planned re-organizing of line truck spending, purchasing this truck now will maintain the spread of vehicle acquisition expenditures.

Category-Specific Requirements - General Plant (5.4.3.2.C.d.)

GENERAL PLANT SPECIFIC REQUIREMENTS (5.4.3.2.C.d)

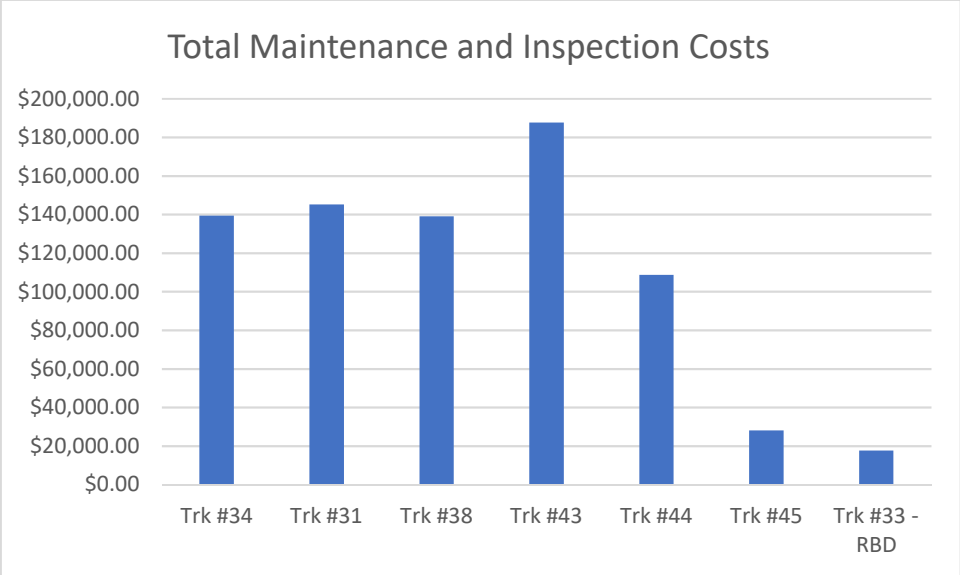
The Results of Quantitative and Qualitative Analysis, Including Assessments of Financially Feasible Options to the Proposed Project, and Identifying the Benefits of the Proposed Investment (5.4.3.2.C.d. First Bullet)

This truck replacement is being replaced to eliminate a high maintenance vehicle. The quantitative analysis detailing the yearly and total expenditures and comparing with the original purchase price is identified above. The replacement re-prioritizes the truck replacements, but will not increase the line truck expenditures as the same trucks will be purchased following the fleet replacement schedule created in 2013 and applied to all fleet vehicles, but in a modified order. There will be a reduction in O&M costs as the new truck will have a warranty periods and newer trucks are typically less prone to repairs as identified in the chart above. The fleet replacement schedule was endorsed in the 2015 DSP application. The asset condition is worse than the typical life cycle cost for a truck of this type and age.

Business Case Documenting the Justification for the Expenditure, Alternatives Considered, Benefits for Customers (Short / Long Term), and Impact on Distributor Costs (Short / Long Term) (5.4.3.2.C.d. Second Bullet)

Not replacing this truck would increase NBHDL's O&M expenditures in order to keep this truck in working order. The failures associated with this vehicle are not typical for a truck of this age.

The following is a chart demonstrating the maintenance and inspections costs per year of acquisition for various line trucks in the NBHDL fleet. Except for Truck #43, purchased in 2012, there is a general trend of lower maintenance costs for newer trucks compared to older trucks. Therefore, purchasing a new truck as scheduled can be expected to have lower maintenance and inspection costs. Removing this high maintenance truck from the lineup will enhance production, lower maintenance costs and provide NBHDL with a reliable fleet.



See above for additional business case justification.

APPENDIX 2-B: BOARD APPENDICES 2-ZA AND 2-ZB

Step 1: **2021 Forecasted Commodity Prices**

Forecasted Commodity Prices	Table 1: Average RPP Supply Cost Summary*	**non-RPP**	**RPP**
HOEP ($/MWh)	Load-Weighted Price for RPP Consumers	$20.87	$20.87
Global Adjustment ($/MWh)	Impact of the Global Adjustment	$109.47	$109.47
Adjustments ($/MWh)			$3.24
TOTAL ($/MWh)	Average Supply Cost for RPP Consumers		**$133.58**

Step 2: **Commodity Expense**

(volumes for the bridge and test year are loss adjusted)

Commodity — **2021 Test Year**

Customer		**Revenue**	**Expense**							
Class Name	UoM	USA #	USA #	Class A Non-RPP Volume**		Class B Non-RPP Volume**	Class B RPP Volume**	Average HOEP	Average RPP Rate	Amount
Residential	kWh	4006	4705			10,635,396	198,904,757	$ 0.02087	$ 0.13358	$26,791,658
GS<50	kWh	4010	4705			11,285,165	70,820,760	$ 0.02087	$ 0.13358	$9,695,759
GS>50	kWh	4035	4705	29,897,744		154,993,697	16,330,088	$ 0.02087	$ 0.13358	$6,040,058
GS>3000<4999	kWh	4010	4705	15,016,547				$ 0.02087	$ 0.13358	$313,395
Sent	kWh	4025	4705			8,988	113,003	$ 0.02087	$ 0.13358	$15,283
Street Light	kWh	4025	4705			2,115,470		$ 0.02087	$ 0.13358	$44,150
UMSL	kWh	4025	4705				41,024	$ 0.02087	$ 0.13358	$5,480
	kWh	4025	4705					$ 0.02087	$ 0.13358	$0
	kWh	4025	4705					$ 0.02087	$ 0.13358	$0
TOTAL				**44,914,291**		**179,038,716**	**286,209,633**			**$42,905,782**

Class A - non-RPP Global Adjustment — **2021**

Customer		**Revenue**	**Expense**	**Amount**	**kWh Volume**	**Hist. Avg GA/kWh *** **	**Amount**
GS>50		4035	4707	2,718,374.03	29,897,744.00	0.09092	$2,718,374
GS>3000<4999		4010	4707	973,807.62	15,016,547.00	0.06485	$973,808
		4010	4707				
				3,692,182	44,914,291		**$3,692,182**

Class B - non-RPP Global Adjustment — **2021**

Customer		**Revenue**	**Expense**							Amount
Class Name	UoM	USA #	USA #			Class B Non-RPP Volume			GA Rate/kWh	
Residential	kWh	4006	4707			10,635,396			$ 0.10947	$1,164,257
GS<50	kWh	4010	4707			11,285,165			$ 0.10947	$1,235,387
GS>50	kWh	4035	4707			154,993,697			$ 0.10947	$16,967,160
GS>3000<4999	kWh	4010	4707			0			$ 0.10947	$0
Sent	kWh	4025	4707			8,988			$ 0.10947	$984
Street Light	kWh	4025	4707			2,115,470			$ 0.10947	$231,580
UMSL	kWh	4025	4707							$0
	kWh	4025	4707							$0
Total Volume						**179,038,716**				
TOTAL										**$19,599,368**

1

		2021 Test Year	RPP		2021 Test Year	non-RPP		Total
Electricity Commodity	**Units**	Volume	Rate	$	Volume	Rate	$	$
Class per Load Forecast				-				
Residential	kWh	198,904,757		26,569,697	10,635,396		221,961	
GS<50	kWh	70,820,760		9,460,237	11,285,165		235,521	
GS>50	kWh*	16,330,088		2,181,373	184,891,441		3,858,684	
GS>3000<4999	kWh*	0		-	15,016,547		313,395	
Sent	kWh	113,003		15,095	8,988		188	
Street Light	kWh	0		-	2,115,470		44,150	
USML	kWh	41,024		5,480	0		-	
SUB-TOTAL		286,209,633		38,231,883	223,953,007		4,673,899	$ 42,905,782

Global Adjustment non-RPP	**Units**							
Class per Load Forecast		Volume	Rate	$	Volume	Rate	$	Total
Residential				0			1,164,257	
GS<50				0			1,235,387	
GS>50				0			19,685,534	
GS>3000<4999				0			973,808	
Sent				0			984	
Street Light				0			231,580	
USML				0			-	
SUB-TOTAL		0		0			23,291,550	$ 23,291,550

Transmission - Network								
Class per Load Forecast		Volume	Rate	$	Volume	Rate	$	Total
Residential	kWh	198,904,757	0.0072	1,432,114	10,635,396	0.0072	76,575	
GS<50	kWh	70,820,760	0.0069	488,663	11,285,165	0.0069	77,868	
GS>50	kW	41,729	2.7533	114,892	472,461	2.7533	1,300,828	
GS>3000<4999	kW	-	2.9206	-	27,098	2.9206	79,143	
Sent	kW	276	2.0868	577	22	2.0868	46	
Street Light	kW	-	2.0766	-	5,690	2.0766	11,816	
USML	kWh	41,024	0.0069	283	-		-	
SUB-TOTAL				2,036,530			1,546,276	3,582,806

Transmission - Connection								
Class per Load Forecast		Volume	Rate	$	Volume	Rate	$	Total
Residential	kWh	198,904,757	0.0069	1,372,443	10,635,396	0.0069	73,384	
GS<50	kWh	70,820,760	0.0061	432,007	11,285,165	0.0061	68,840	
GS>50	kW	41,729	2.4178	100,892	472,461	2.4178	1,142,317	
GS>3000<4999	kW	-	2.6719	-	27,098	2.6719	72,404	
Sent	kW	276	1.9080	527	22	1.9080	42	
Street Light	kW	-	1.8689	-	5,690	1.8689	10,635	
USML	kWh	41,024	0.0061	250	-	0.0061	-	
SUB-TOTAL				1,906,119			1,367,621	3,273,741

Wholesale Market Service								
Class per Load Forecast		Volume	Rate	$	Volume	Rate	$	Total
Residential	kWh	198,904,757	0.0030	596,714	10,635,396	0.0030	31,906	
GS<50	kWh	70,820,760	0.0030	212,462	11,285,165	0.0030	33,855	
GS>50	kWh	16,330,088	0.0030	48,990	184,891,441	0.0030	554,674	
GS>3000<4999	kWh	-	0.0030	-	15,016,547	0.0030	45,050	
Sent	kWh	113,003	0.0030	339	8,988	0.0030	27	
Street Light	kWh	-	0.0030	-	2,115,470	0.0030	6,346	
USML	kWh	41,024	0.0030	123	-	0.0030	-	
SUB-TOTAL				858,629			671,859	1,530,488

CBR								
Class per Load Forecast		Volume	Rate	$	Volume	Rate	$	Total
Residential	kWh	198,904,757	0.0004	79,562	10,635,396	0.0004	4,254	
GS<50	kWh	70,820,760	0.0004	28,328	11,285,165	0.0004	4,514	
GS>50	kWh	16,330,088	0.0004	6,532	154,993,697	0.0004	61,997	
GS>3000<4999	kWh	-	0.0004	-	-	0.0004	-	
Sent	kWh	113,003	0.0004	45	8,988	0.0004	4	
Street Light	kWh	-	0.0004	-	2,115,470	0.0004	846	
USML	kWh	41,024	0.0004	16	-	0.0004	-	
SUB-TOTAL				114,484			71,615	186,099

Class A CBR								
Class per Load Forecast		Volume	Rate	$	Volume	Rate	$	Total

Residential	kWh			-			-	
GS<50	kWh			-			-	
GS>50	kWh*			-	29,897,744	0.00031	9,130	
GS>3000<4999	kWh*			-	15,016,547	0.00019	2,923	
Sent				-			-	
Street Light				-			-	
USML				-			-	
SUB-TOTAL				-			12,054	12,054
RRRP								
Class per Load Forecast		Volume	Rate	$	Volume	Rate	$	Total
Residential	kWh	198,904,757	0.0005	99,452	10,635,396	0.0005	5,318	
GS<50	kWh	70,820,760	0.0005	35,410	11,285,165	0.0005	5,643	
GS>50	kWh	16,330,088	0.0005	8,165	184,891,441	0.0005	92,446	
GS>3000<4999	kWh	-	0.0005	-	15,016,547	0.0005	7,508	
Sent	kWh	113,003	0.0005	57	8,988	0.0005	4	
Street Light	kWh	-	0.0005	-	2,115,470	0.0005	1,058	
USML	kWh	41,024	0.0005	21	-	0.0005	-	
SUB-TOTAL				143,105			111,977	255,081
Low Voltage - No TLF adjustmen								
Class per Load Forecast		Volume	Rate	$	Volume	Rate	$	Total
Residential	kWh**	191,467,390	0.00015	28374.32092	10,237,722	0.00015	1517.16904	
GS<50	kWh**	68,172,659	0.00013	8931.44309	10,863,195	0.00013	1423.209925	
GS>50	kW	41,729	0.05193	2166.905881	472,461	0.05193	24533.99815	
GS>3000<4999	kW	-	0.05739	0	27,098	0.05739	1555.045765	
Sent	kW	276	0.04014	11.09233749	22	0.04014	0.882246154	
Street Light	kW	-	0.04098	0	5,690	0.04098	233.1812236	
USML	kWh**	39,490	0.00013	5.173628524		0.00013	0	
SUB-TOTAL		259,721,543		39,489			29,263	68,752
Smart Meter Entity Charge								
Class per Load Forecast		Customers	Rate	$	Customers	Rate	$	Total
Residential		20,268	0.57	138,635	1,084	0.57	7,413	
GS<50		2,285	0.57	15,630	364	0.57	2,489	
Seasonal				-				
SUB-TOTAL				154,265			9,902	164,167
SUB- TOTAL				43,484,503			31,786,017	75,270,520
ORECA CREDIT	21.20%			(9,218,715)			0	(9,218,715)
TOTAL				**34,265,789**			**31,786,017**	**66,051,805**

***The ORECA Credit of 21.2% will only apply to RPP proportion of the listed components. Impacts on distribution charges are excluded for the purpose of calculating the cost of power.

**** Class A CBR: use the average CBR per kWh, similar to how the Class A GA cost is calculated

2021 Test Year - Cop		
4705 -Power Purchased	$	42,905,782
4707- Global Adjustment	$	23,291,550
4708-Charges-WMS	$	1,983,722
4714-Charges-NW	$	3,582,806
4716-Charges-CN	$	3,273,741
4750-Charges-LV	$	68,752
4751-IESO SME	$	164,167
Misc A/R or A/P	$	(9,218,715)
TOTAL	**$**	**66,051,805**

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