ASSESSMENT OF REGULATED NUCLEAR ASSET DEPRECIATION RATES AND GENERATING STATION LIVES

DECEMBER 2020

Prepared for Ontario Power Generation

Concentric Advisors, ULC
200 Rivercrest Drive SE, Ste 277
Calgary, AB, Canada T2C 2X5
403.257.5946

Washington, D.C. Office
1300 19th St NW, Ste 620
Washington, DC, USA 20036
202.587.4470

Headquarters
293 Boston Post Rd West, Ste 500
Marlborough, MA, USA 01752
508.263.6200

Chicago, IL Office
350 West Hubbard Street, Ste 600
Chicago, IL, USA 60654
224.999.7372

Concentric Advisors® and its logo are federally registered trademarks of Concentric Energy Advisors®. Any unauthorized use is prohibited.

December 28, 2020

Ontario Power Generation
700 University Avenue
Toronto, ON M5G 1X6

Attention: Matt Kirk
Senior Manager, Regulatory Research & Analysis

Dear Mr. Kirk;

Pursuant to your request, we conducted a review and assessment of the regulated life estimates related to the Ontario Power Generation nuclear generation assets as of December 31, 2019. Our report presents a description of review undertaken by Concentric as well as our recommendations for a small number of revisions to the average service life estimates. Concentric completed a similar study of the hydroelectric generation assets in December 2019.

We gratefully acknowledge the assistance of Ontario Power Generation personnel in the completion of the review.

Should you have any questions or concerns, please do not hesitate to contact me directly at 587.997.6489

Yours truly,

Concentric Advisors, ULC

Larry E. Kennedy
Vice President

LEK/ta
Project: 70061

TABLE OF CONTENTS

1 BASIS OF STUDY 1-1
1.1 Introduction and Scope 1-1
1.2 Background 1-1
1.3 Summary of Results 1-3
2 PLAN OF STUDY 2-1
2.1 Information Provided by OPG 2-1
2.2 Procedures Performed 2-1
3 DEVELOPMENT OF DEPRECIATION RATES 3-1
3.1 Depreciation 3-1
3.2 Estimation of Generating Asset Lives 3-2
3.2.1 Average Service Life 3-2
3.2.2 Prior Assignments and Review of the DRC Process 3-2
3.2.3 Operating Discussions and Site Tours 3-2
3.2.4 Review of Accounting Policies 3-3
3.2.5 Analysis and Results of DRC Reviews 3-3
3.2.6 Professional Judgement 3-4
3.2.7 Life Span Dates 3-4
3.3 Average Service Life Assessments 3-6
3.3.1 Plant Accounts as of 2019 Year-End 3-6
3.3.2 Darlington Unit 2 Refurbishment 3-7
4 RESULTS OF STUDY 4-1
4.1 Results 4-1

SECTION 1

1 BASIS OF STUDY

1.1 Introduction and Scope

Concentric Advisors, ULC ("Concentric" or "Concentric Advisors") has been retained by Ontario Power Generation ("OPG") to review the average service life estimates of its regulated nuclear generation assets based on December 31, 2019 asset values and of the plant associated with the return to service of Unit 2 refurbishment at the Darlington Nuclear Generating Station ("Darlington NGS") in June 2020. This report sets forth the findings of our independent review.

The average service life estimates recommended in this report are considered in OPG's depreciation review process in establishing the asset depreciation rates and generating station lives for the Property, Plant and Equipment ("PP&E") of OPG's prescribed facilities, including directly assigned corporate PP&E balances. As the depreciation and amortization expense for regulated revenue requirement purposes includes intangible assets, average service lives for intangible assets were also included in this analysis. As further discussed in section 3.3.2, a significant new addition was made to the PP&E of OPG's regulated assets upon returning to service Unit 2 of the Darlington NGS.

The facilities for which average service lives were analyzed consist of two nuclear generation facilities, the Darlington NGS and the Pickering Nuclear Generating Station ("Pickering NGS"). As part of this study, Concentric Advisors reviewed the operating considerations and typical station configurations of these nuclear generation facilities. This included a review of notes from site tours taken in prior studies and detailed operational staff discussions.

1.2 Background

In March 2007, Concentric Advisors (then operating as Gannett Fleming) submitted a report titled "Review of the Ontario Power Generation Inc. Depreciation Review Process" (the "2007 Report"). The 2007 Report presented a summary of the findings of an independent review of the processes, procedures and methods used by OPG to review its depreciation expense. The 2007 Report indicated that "Gannett Fleming has found that the processes, procedures and methods followed by Ontario Power Generation Inc. adequately meet regulatory objectives regarding depreciation generally accepted by Canadian regulatory authorities."[1] Additionally, Gannett Fleming found that "OPG's current Depreciation Review Process results in the depreciation expense component of the revenue requirement that reasonably and appropriately reflects the consumption of the average service life of OPG's regulated assets. Gannett Fleming also views that, overall, the Depreciation Review Committee ("DRC") process is adequate in meeting the generally accepted regulatory objectives regarding depreciation for regulated North American utilities."[2] Overall, the 2007 Report concluded that the procedural foundation upon which OPG's DRC had developed average service life estimates was robust and appropriate. The 2007 Report contributed, in part, to the Ontario Energy Board's ("OEB") acceptance of OPG's depreciation expense in the EB-2010-0008 proceeding

[1] Cover letter to the 2007 Report
[2] 2007 Report, page III-2.

Subsequently, Gannett Fleming was retained by OPG to complete independent comprehensive assessments of depreciation rates and generating station lives of OPG's prescribed hydroelectric and nuclear assets based on December 31, 2010 and, most recently, December 31, 2012 asset values and for the Niagara Tunnel placed in service in 2013. These assessments were documented by Gannett Fleming in reports titled "Assessment of Regulated Asset Depreciation Rates and Generating Station Lives" dated December 16, 2011 ("2011 Report") and November 29, 2013 ("2013 Report"), respectively.

Both the 2011 Report and the 2013 Report found that "the currently approved average service life estimates continued to be based on a procedurally sound and reasonable DRC process" and that "to a large extent, the work prepared over the past several years by the DRC [continued] to be a reliable information source."[3] Both reports noted that OPG had continued to calculate depreciation rates based on the Average Life Group Procedure – Whole Life Technique, using the straight-line method of depreciation for virtually all plant comprising regulated assets.

As part of the 2011 Report and the 2013 Report, Gannett Fleming reviewed the average service life estimates for each depreciable group and the generating station lives based on their professional judgement, taking into consideration the results of the DRC process, the company's practices and outlook as they relate to plant operation, asset condition and retirement, the service life estimates of peer electric generation companies (as applicable), and the experience of Gannett Fleming in selecting average service lives for similar plant. In adopting this approach to their assessment, Gannet Fleming noted that "[i]n the specific circumstances of the OPG average service life estimation, the volume of historic retirement transactions available to be analyzed is not sufficient to undertake a detailed study of retirement history" and "[a]s such, a retirement rate analysis was not completed by Gannett Fleming."[4]

The 2011 Report and the 2013 Report recommended a small number of revisions to the average service life estimates for OPG's hydroelectric assets, which were adopted in full by OPG. Gannett Fleming also concluded that "the use of life span dates is appropriate for the OPG nuclear generation plants" and "that the factors considered and methods used by the DRC in the assessment of life span dates remain appropriate and consistent with common regulatory practices and should continue to be used in future reviews."[5]

Gannett Fleming also recommended that each "account should be subjected to a complete depreciation study which re-evaluates its average service life estimates periodically", noting "that the practice of OPG to review its various asset accounts and depreciation service lives over an approximate five-year cycle [through the DRC process] meets this common depreciation practice."[6]

The 2011 Report and 2013 Report were filed with the OEB in OPG's 2014-2015 payment amounts proceeding, EB-2013-0321, in satisfaction of the OEB's direction regarding an independent depreciation study. In its EB-2013-0321 decision, the OEB accepted the results of the 2011 Report

[3] 2013 Report, page I-7
[4] 2013 Report, page II-11
[5] 2013 Report, page II-14
[6] 2013 Report, page II-11

as updated by the 2013 Report for both nuclear and hydroelectric assets, including OPG's continued use of the average life group method to determine depreciation expense, and approved the depreciation expense as filed for inclusion in OPG's payment amounts. [7]

In line with the recommended cycle of approximately five years for a periodic depreciation study, no independent depreciation assessment was filed by OPG in EB-2016-0152, the most recent cost-based nuclear payment amounts OEB proceeding. In the EB-2016-0152 decision, the OEB accepted OPG's proposal to conduct an independent depreciation review for the regulated nuclear assets after completion of Unit 2 refurbishment at the Darlington NGS.[8]

1.3 Summary of Results

Concentric has reviewed the DRC process and again finds it to be procedurally sound, reasonable and resulting in valid depreciation rates and generating station lives that accurately reflect the consumption of average service life of OPG's regulated assets. Overall, Concentric finds that the work prepared by the DRC continues to be an overall reliable source of information in conducting this 2020 Depreciation Rates Assessment.

Concentric also finds that OPG's practice of reviewing significant asset accounts and depreciation service lives over an approximate five-year cycle under the DRC process continues to meet the recommended practice of continued surveillance to maintain the use of appropriate depreciation rates, when supplemented by a periodic comprehensive independent assessment.

Concentric also finds OPG's continued use of the Straight-Line Method and the Average Life Group Procedure – Whole Life Technique to determine depreciation expense to be reasonable, and its use of, and approach to determining life span dates for the Darlington NGS and Pickering NGS are valid.

In reviewing depreciation rates for OPG's nuclear plant accounts and having regard to the plant associated with the return to service of Unit 2 of Darlington NGS, Concentric supports the average service lives currently in use, subject to recommended changes for the following accounts:

- Nuclear – Shutdown Cooling System Heat Exchangers – Pickering: from 25 years to 30 years;
- Nuclear – Building Electric Service Supply – Pickering 1&4 and Bruce: from 40 years to 55 years;
- Nuclear – Fuel Channel Assemblies: from 28 years to 30 years;
- Nuclear – Calandria Tubes – Pickering 5-8 and Darlington: from 28 years to 30 years; and
- New Account: Nuclear – Instrumentation and Control – Darlington Refurbishment: 30 years.
- New Account: Nuclear – Service Water and Fire Protection System – Darlington Refurbishment: 30 years

Concentric also believes that the life span dates currently in place for depreciation purposes for the regulated nuclear generating assets are reasonable for use in this study, recognizing that OPG

[7] EB-2013-0321 Decision and Order, page 98
[8] EB-2016-0152 Decision and Order, page 86

is in the midst of implementing plans for optimizing the planned shutdown dates for the Pickering NGS.

In conjunction with the above asset class changes, Concentric finds the process used by OPG to componentize the capital amount placed in service upon completion of refurbishment for Unit 2 of Darlington NGS in June 2020 to result in reasonable and valid depreciation rates going forward.

SECTION 2

2 PLAN OF STUDY

This study is presented in the following order:

Section 1:	Presents the Scope of the Study and provides background of prior study conclusions with a brief summary of the depreciation study results
Section 2:	Contains statements with respect to the plan and the basis of the study
Section 3:	Discusses development of average service life estimates, and presents descriptions of the methods used and factors considered in the service life study
Section 4:	Presents study results by depreciable group in Table 1

2.1 Information Provided by OPG

OPG has provided Concentric with required information, as of December 31, 2019, for all accounts being studied. This information has been compiled from the plant accounting records and includes the following:

- current balances by vintage year for each account (aged balances). The balances provide the amount of investment sorted by installation year currently in operation. This file is only inclusive of current plant in service and does not include any retirement information;
- retirement transactions for all accounts. The transactions include information regarding the transaction year of the retirement, the installation year of the asset being retired, and the original cost of the asset being retired; and
- copies of the most recent DRC reviews for all nuclear plant asset accounts.

2.2 Procedures Performed

The above data was reviewed and reconciled to Company control schedules to ensure accuracy and reasonableness. These checks include that the surviving investment by account equals (or can be reconciled to) the Company's gross plant in service and accumulated depreciation ledger balances.

In addition, Concentric performed the following procedures to form the basis of the results of this study:

- confirm accounting policies being followed in accordance with US generally accepted accounting principles ("US GAAP");
- conduct interviews with OPG personnel to obtain understanding of nuclear plant operations;
- review of DRC recommendations and supporting documentation; and
- review of prior working papers and supporting documents from the 2011 Report and the 2013 Report.

SECTION 3

3 DEVELOPMENT OF DEPRECIATION RATES

3.1 Depreciation

Depreciation, as applied to depreciable electric plant, means the loss in service value not restored by current maintenance, incurred in connection with the consumption or prospective retirement of electric plant in the course of service from causes which are known to be in current operation and against which the utility is not protected by insurance. Among the causes to be given consideration are wear and tear, decay, action of the elements, inadequacy, obsolescence, changes in the art, changes in demand and requirements of public authorities, and, in the case of certain electric companies, the exhaustion of natural resources.[9]

Depreciation, as used in accounting, is a method of distributing fixed capital costs, less net salvage, over a time period by allocating annual amounts to expense. Each annual amount of such depreciation expense is part of that year's total cost of providing electric utility service. Normally, the time over which the fixed capital cost is allocated to the cost of service, is equal to the time over which an item renders service – that is, the item's service life. The most prevalent method of allocation is to distribute an equal amount of cost to each year of service life. This method is known as the Straight-Line method of depreciation.

OPG continues to determine depreciation using the Straight-Line method for virtually all plant comprising regulated assets, based on the Average Life Group Procedure – Whole Life Technique. The Average Life Group Procedure is the most commonly used depreciation procedure for North American utilities, whereby one average service life estimate is applied to all assets and vintages within the asset class. The Whole Life Technique calculates depreciation on the basis of recovering the original cost of the investment over the entire life of an asset or group of assets with no provision for accumulated depreciation true-ups or depreciation rate adjustments. As such, a common life estimate is applied to each of the asset vintages, and each of the assets within each vintage. Concentric finds that the application of the Straight-Line method and the Average Life Group Procedure – Whole Life Technique results in a reasonable recovery of OPG's capital investment over time and recommends their continued application.

For the regulated nuclear asset classes, depreciation continues to be based on the lesser of the generation station life and asset class life. The generation station life is determined using a life span date for each of the Pickering NGS and Darlington NGS, as discussed in section 3.2.7. Asset retirement costs capitalized in connection with asset retirement obligations recognized pursuant to US GAAP and certain other asset classes are depreciated to the life span dates.

[9] Federal; Energy Regulatory Commission -Part 201- Uniform System of Accounts Prescribed for Electric Companies Subject to the Provisions of the Electric Act Definitions

3.2 Estimation of Generating Asset Lives

3.2.1 Average Service Life

The use of an average service life for property groups that include large numbers of similar assets implies that the various units in the group have different lives. Thus, the average life may be obtained by determining the separate lives of each of the units, or by constructing a life estimate that considers the retirements of units which survive at successive ages. As in the 2011 Report and the 2013 Report, the average service life estimates in this study were reviewed by Concentric Advisors using judgment which considered a number of factors, including:

- Understanding of the processes used in the development of the current average service life estimates through the completion of the 2007 Report reviewing the DRC process and through the completion of the 2011 Report and the 2013 Report assessing depreciation rates;
- Understanding of the assets currently in service through discussions with company staff, including representatives of the nuclear generation operating units;
- Previous physical site tours of nuclear generation sites;
- Review of current accounting practices and procedures applied and their consistency with those in place at the time of the 2013 Report;
- Review of analyses provided to DRC, up to the results of the 2019 DRC process; and
- The general experience and professional judgment of Concentric Advisors.

3.2.2 Prior Assignments and Review of the DRC Process

As described in section 1.2, Concentric Advisors (then operating as Gannett Fleming) was previously retained in 2007 to review the practices and procedures used by the DRC to review depreciation expense, and, in 2011 and 2013, for the completion of depreciation studies for OPG's regulated assets. The 2007 review resulted in a report submitted to OPG management and filed by OPG in OEB proceeding EB-2007-0905. The 2013 depreciation study resulted in a report submitted to OPG management and filed by OPG in OEB proceeding EB-2013-0321. These prior reviews provided Concentric with an understanding of the type of generation plant in service at OPG, the processes used by OPG in the determination of service life estimates, and the OEB's regulatory oversight. In addition to updated information provided by OPG for this current review, Concentric considered information from these prior studies.

3.2.3 Operating Discussions and Site Tours

Discussions with operations representatives provided Concentric with an understanding of the type of assets in service for nuclear service. Previous site tours provided Concentric Advisors with the necessary background to make an assessment of the physical installations of the OPG plant, and to understand the type of plant in service and the operating conditions of the facilities. Operational interviews were undertaken to understand the historic operating conditions that have led to retirement of plant in the past and to understand the current condition of the assets which may impact future retirement plans.

In conducting the 2013 depreciation study, Gannett Fleming toured the following generation sites:

- Darlington Nuclear Generating Station; and
- Pickering Nuclear Generating Station

While it is standard practice to tour facilities being studied, the COVID-19 pandemic resulted in restrictions and increased safety risks associated with global travel and non-essential plant site access throughout 2020, making it impractical to safely tour OPG's nuclear facilities. As such, Concentric relied on the understanding of the facilities gained from the site tours conducted in 2013 to inform this study.

Throughout the depreciation study process, virtual interviews of the operational representatives were undertaken by Concentric. The interviews covered the following topics, including, where applicable, inquiries regarding operational or other changes since the 2013 Report:

- Operating history of both nuclear generating stations;
- Replacement history of major plant components and review of significant retirement and life management programs at both plants;
- General operating experience of the major plant components;
- Review of any life restricting operational issues;
- Review of any issues that have emerged during the DRC process;
- Review of instances where advancements in technology may cause changes to average service life indications; and
- Review of the expected life span dates for all units at both plants.

3.2.4 Review of Accounting Policies

Concentric held discussions with finance management representatives during prior assignments to understand OPG's depreciation and accounting policies and practices in accordance with US GAAP. As part of the current assignment, Concentric confirmed with finance management representatives that there had been no changes to these policies and practices since the 2013 Report, including as they relate to capitalization thresholds, asset retirement obligations and treatment of retirement transactions.[10]

3.2.5 Analysis and Results of DRC Reviews

OPG is the world's largest operator of CANada Deuterium Uranium ("CANDU") nuclear units, has some of the oldest CANDU units, and has the most extensive operational knowledge of all CANDU operators in the world. OPG is heavily involved in technical exchanges with other CANDU operators,

[10] As previously noted in the 2013 Report (page II-7), OPG's accumulated depreciation accounts do not include embedded gains or losses from previous retirement transactions, as OPG books all such gains and losses to the income statement in the year of retirement in accordance with the provisions of US GAAP. As a result, there is no need to test the adequacy of accumulated depreciation balances. Concentric believes that the nature of the large plant components and small amount of retirement transactions continue to make this policy viable and reasonable for OPG.

and closely monitors equipment degradation issues in order to assess potential impacts on OPG's units. OPG is often the "lead" utility in terms of the knowledge of degradation issues that may impact unit and component lives. In the particular circumstance of the CANDU nuclear installations, OPG internal staff is recognized as experts in the technology.

The DRC has continued to complete detailed reviews of the average service life expectations for OPG's plant accounts. The DRC's technical reviews are conducted by internal experts in the specific areas associated with the different types of plant accounts, leveraging operational and industry experience. As part of the current assignment and the 2011 Report and 2013 Report, Concentric reviewed these analyses which provided a significant background on the physical condition of the assets, a meaningful history of the manner in which plant assets have provided electric generation service in the past, and identified major upcoming replacement or retirement programs.

Since the completion of the 2013 Report, the DRC completed a detailed review of the average service life expectations for virtually all plant accounts comprising the company's investment in the regulated nuclear business. This included one complete five-year review cycle (2013-2017) for regulated nuclear asset depreciation rates and, most recently, a review of plant accounts comprising over 60 percent of the regulated nuclear investment as part of the current five-year review cycle.[11] The DRC process resulted in a small number of changes to asset class depreciation rates since the 2013 Report, which were reviewed by Concentric as part of this assignment.

3.2.6 Professional Judgement

The use of professional judgment in the development of average service life estimates is a practice that is appropriate and has been used for many years before North American regulatory jurisdictions. When available, the use of statistical analysis of the historic retirement transactions combined with the use of professional judgment, including physical site inspections, review of accounting procedures and practices, use of operational staff interviews, review of prior studies, and review of the approved life estimates of peer companies, provides the most complete method of service life analysis. However, the use of professional judgment alone also provides an appropriate basis for developing average service life estimates, when appropriate factors are considered, and has been accepted as a valuable depreciation analysis tool in many North American jurisdictions.

As previously noted by Concentric in the 2013 Report, in the specific circumstances of the OPG average service life estimation, the volume of historic retirement transactions available to be analyzed is not sufficient to undertake a detailed actuarial study of retirement history. As such, a retirement rate analysis was not completed by Concentric Advisors.

3.2.7 Life Span Dates

Life expectancy of electric generation plant assets is impacted not only by physical wear and tear of the assets but also by economic factors including the feasibility of the economic replacement of major operating components or the economic viability of the plant as a whole. In circumstances where the replacement of major operating components is not economically feasible, the life of the major

[11] Percentage excludes asset retirement costs and certain other asset classes with service lives tied directly to the life span dates, which are inherently reviewed each time the life span dates are assessed.

component can be the determining factor of the generation plant and all of the assets within the plant. As such, the remaining depreciation life of electric generation plant assets is the lesser of the physical life expectation of the asset or the period to the end of the life span of the generation plant as a whole.

The use of life span dates for determining depreciable lives for regulated electric generation plant is common throughout many North American regulatory jurisdictions. The basis for the determination of the life span date is usually based on one or more of the following:

- the physical life estimation of the major and vital components of the generating plant;
- the duration of operating licenses;
- precedent and policy of the regulatory jurisdiction;
- expiration of the supply source for which the generation plant is dependent; and
- expiration of market demand upon which the generation plant is dependent.

Through periodic DRC reviews, OPG regularly assesses if there are any potential indicators of changes in life span dates for each of the regulated nuclear plants. The life span dates are primarily determined through a review of the expected life of the significant components at each nuclear site, taking into account regulatory licensing and other requirements. Additionally, the life span dates are influenced by the period through to any required major unit refurbishment, as the plant's continued operation is dependent upon the ability to economically refurbish it for continued use. It is the experience of Concentric that the depreciation schedules for most North American nuclear generation plants are dependent upon appropriately developed life span dates, and it continues to be Concentric's view that the use of life span dates is appropriate for the OPG nuclear generation plants. OPG's practice of using a single life span date for all generating units at each nuclear station is consistent with that of other nuclear operators in North America.[12]

The most recent change in the life span dates of OPG's regulated nuclear generation plants at the time of writing was implemented at the end of 2017, following the DRC's conclusion that there was sufficient confidence to extend the life span dates for the Pickering NGS to December 31, 2022 for Units 5-8 (formerly Pickering A) and December 31, 2024 for Units 1 and 4 (formerly Pickering B).[13] In making this conclusion, the DRC considered, among others, the technical confidence associated with the programs and provisions in place to assure fitness-for-service of life-limiting fuel channel components, as well as the status of work in support of obtaining regulatory approvals from the Canadian Nuclear Safety Commission ("CNSC").

At the time of this depreciation study, OPG has announced a plan to further optimize the shutdown dates of the Pickering NGS, such that Unit 1 and 4 would operate to 2024 and Units 5-8 through to the end of 2025. For the 2019 year-end, the DRC concluded that there was insufficient confidence to affect a change in the depreciation life span dates based on this plan, taking into account the status of the associated technical and regulatory work. In particular, the 2019 DRC considered the status of the technical work to confirm the applicable units' fitness-for-service to achieve the additional life

[12] OPG maintains separate life span dates for Pickering Units 1 and 4 and Pickering Units 5-8, which were formerly considered and known as the Pickering A and Pickering B stations
[13] Units 2 and 3 of Pickering NGS are permanently shut down.

beyond 2024. Additionally, it is noted that operation of the Pickering units after December 31, 2024 is subject to CNSC's regulatory approval. Finally, the 2019 DRC observed that while the operation of Units 1 and 4 to 2024 does not require further regulatory approvals from the CNSC and falls within the design of the current programs and provisions in place to assure the fitness-for-service for fuel channel components, sufficient technical confidence related to the continued fitness-for-service of certain steam generators at Unit 4 had not yet been achieved.

Concentric has reviewed the 2019 and prior DRC's analysis in establishing the above life span dates and concludes that they are reasonable for use in this study. Concentric is also of the view that the factors considered and methods used by the DRC in the assessment of life span dates remain appropriate and consistent with common regulatory practices and should continue to be used in future reviews. Concentric understands that there is an ongoing review of the Pickering NGS life span dates by the DRC for the 2020 year-end following the same approach, and that it has not yet concluded at the time of writing.

As recognized in the 2013 Report, a major refurbishment program is currently underway at the four-unit Darlington nuclear site. The four units are scheduled to return to service over the 2020 to 2026 period. It is expected that the refurbishment will allow the safe and reliable operation of the Darlington NGS units for another 30 years. On this basis, the DRC previously extended the station's average life span date until December 31, 2052.

At the time of this depreciation study, the refurbishment of the first unit, Unit 2, has been completed and the refurbishment of the second unit, Unit 3, has commenced. OPG has indicated that there were no findings during the Unit 2 refurbishment process that would indicate any physical or economical reasons to change the current average life span date of December 31, 2052. As such, Concentric believes that continued use of the December 31, 2052 date for the Darlington NGS remains reasonable for depreciation purposes. As part of continued surveillance, Concentric recommends that the station's average life span date be re-confirmed after the four-unit refurbishment project has been completed.

3.3 Average Service Life Assessments

3.3.1 Plant Accounts as of 2019 Year-End

Concentric has reviewed the average service life estimates for all regulated nuclear generation plant and asset categories, based on December 31, 2019 asset values. The service life estimates recommendations were based on informed professional judgment, which incorporated a review of management's plans, policies and outlook, and a general knowledge of the electric industry.

Based on the review, Concentric supports continued use of the average service lives as set out in Section 4, Table 1 of this study. This represents OPG's currently approved average service lives as of the date of writing, with recommended changes to the life estimates for the two accounts noted below and the three accounts identified in section 3.3.2 in the context of the Darlington Unit 2 refurbishment componentization review:

ACCOUNT 15352000 – NUCLEAR– SHUTDOWN COOLING SYSTEM HEAT EXCHANGERS - PICKERING

2019 Gross Book Value	Investment %	Previously Approved Life	Concentric Recommended Life
$2,729,204	0.05%	25	30

The 2013 Report recommended a 25-year average service life for this asset class. Due to its relatively small size, the DRC has not reviewed this account in recent years. The assets in this account are similar to the assets in Account 15352100 – Nuclear – Shutdown Cooling System Heat Exchangers – Darlington, which a 30-year life has. Concentric recommends lengthening the average service life of this account to 30 years to be in line with Account 15352100.

ACCOUNT 15530000 – NUCLEAR – BUILDING ELECTRICAL SERVICE SUPPLY – PICKERING 1&4 AND BRUCE

2019 Gross Book Value	Investment %	Previously Approved Life	Concentric Recommended Life
$2,392,224[14]	0.04%	40	55

The 2013 Report recommended a 40-year average service life. Due to its relatively small size, the DRC has not reviewed this account in recent years. The assets in this account are similar to the assets in Account 15531000 – Nuclear – Building Electrical Supply – Pickering and Darlington, which has a 55-year life5-8. Concentric recommends lengthening the average service life of this account to 55 years to be in line with Account 15531000.

3.3.2 Darlington Unit 2 Refurbishment

In June 2020, OPG returned to service Unit 2 of the Darlington NGS following refurbishment, placing in service approximately $4.8 billion of plant additions. The Darlington refurbishment program ("DRP") capital expenditures began in 2010 with the commencement of the definition phase, culminating in the completion of a detailed programmatic and first unit (Unit 2) execution schedule and budget and, in October 2016, commencement of the Unit 2 refurbishment outage. Concentric understands that the plant additions associated with the Unit 2 return-to-service include the full amount of definition phase capital costs incurred since project inception, as well as the Unit 2 execution expenditures.

In addition to refurbishment work on the units themselves, Concentric understands that the scope of the DRP includes certain discrete pre-requisite and other projects that are expected to remain useful to OPG's current and future operations irrespective of the refurbishment. As these projects were placed in service before the refurbishment of the first unit in recognition of their immediate benefit to the station, they do not form part of the $4.8 billion in capital additions upon Unit 2 completion.

As part of this assignment, Concentric reviewed the average service life estimates applied by OPG to the capital amounts placed in-service upon Unit 2 completion. In performing this part of the assignment, Concentric reviewed OPG's filed evidence in EB-2016-0152 related to the DRP, held discussions with OPG's operational staff to gain an understanding of the major components of the

[14] Value shown is for Pickering NGS only, as the Bruce nuclear generation stations are not rate regulated

refurbishment work, and held discussions with OPG's finance staff to gain an understanding of the process used to componentize the Unit 2 capital in-service amount. Concentric also considered the stated objective of the refurbishment, which is to enable each of the generation units to operate for approximately 30 additional years. This expectation is embedded in the station's average life span date of December 31, 2052.

The in-service plant additions associated with the Unit 2 return to service (including definition phase costs) are grouped into two categories of components: Major Work Bundles and OPG Functional Support. Major Work Bundles are groupings of work scope, each consisting of a number of individual projects, defined by OPG for effectively contracting and managing the work. The work undertaken through the Major Work Bundles consists of the replacement and rehabilitation of components, inspections, and the completion of upgrades directly related to unit refurbishment. As noted in OPG's EB-2016-0152 rate filing, the Major Work Bundles are: (1) Retube and Feeder Replacement; (2) Turbine Generator; (3) Fuel Handling and Defueling; (4) Steam Generator; and (5) Balance of Plant.[15] OPG Functional Support refers to work carried out by groups within OPG's internal project support organizations, including oversight, coordination, and integration among contractors and ongoing station operations. Interest capitalized on the project is recorded directly to each of these components.

In determining the component breakdown into specific asset classes, OPG reviewed the individual projects within each Major Work Bundle against established asset classes based on the technical assessment of the costs incurred for each of the projects within the Major Work Bundle. OPG's accounting records provided the necessary detail to isolate and evaluate each project's costs. For example, Unit 2 Steam Generator EPC project work was analyzed and directly costed to 15351100 Nuclear – Steam Generators – Darlington asset class. As part this componentization process, OPG also assessed the need for any new asset classes to be established. The OPG Functional Support costs associated with the Unit 2 refurbishment were allocated to the asset classes proportionally to Major Work Bundle projects.

The technical assessments were undertaken by subject matter experts including by respective key refurbishment project managers, and were reviewed and ultimately approved by senior DRP executives and finance controllers.

Through this process and subject to the 2020 DRC confirmation, OPG has identified two asset class changes and two new asset classes in order to align with the expectation that certain components replaced through the refurbishment will be in service for the full 30-year lifespan of the Unit 2 reactor. Concentric has reviewed the basis for these changes and recommends that they be adopted by OPG going forward. The four changes are as follows:

ACCOUNT 15314000 – NUCLEAR – FUEL CHANNEL ASSEMBLIES - P5-8 and DG

2019 Gross Book Value	Unit 2 In Service Amount	Previously Approved Life	Concentric Recommended Life
nil	$555,129,636	28	30

[15] EB-2016-0152 Ex. D2-2-1, page 3

ACCOUNT 15323000 – NUCLEAR – CALANDRIA TUBES – P5-8 and DG

2019 Gross Book Value	Unit 2 In Service Amount	Previously Approved Life	Concentric Recommended Life
nil	$303,700,183	28	30

NEW ACCOUNT – NUCLEAR – INSTRUMENTATION AND CONTROL – DARLINGTON REFURBISHMENT

2019 Gross Book Value	Unit 2 In Service Amount	Previously Approved Life	Concentric Recommended Life
N/A	$107,140,898	N/A	30

NEW ACCOUNT – NUCLEAR – SERVICE WATER AND FIRE PROTECTION SYSTEM – DARLINGTON REFURBISHMENT

2019 Gross Book Value	Unit 2 In Service Amount	Previously Approved Life	Concentric Recommended Life
N/A	$98,709,243	N/A	30

Overall, Concentric finds the process used by OPG to componentize the Unit 2 capital in-service amount to result in reasonable and valid depreciation rates going forward. The process was based on sound principles and appropriate inputs, including technical assessments, sufficient granularity of cost records, consideration of overall project objectives and review of existing asset class applicability. Concentric also supports the rational approach taken to distribution of common project costs that were not directly tied to specific components.

Additionally, Concentric understands that the 2020 DRC review contemplates initiation of a process to identify and as necessary review any significant existing Darlington assets with remaining lives shorter than the 30-year post refurbishment life assumption for the reactors. The objective of this process is to confirm, over a period of time, that the depreciation periods for the assets expected to support post-refurbishment operations continue to be appropriately aligned with the station's life span date. While our review did not identify any changes necessary in this regard, Concentric supports this additional detailed validation exercise as part of ongoing surveillance given the significance of the refurbishment program to OPG's future nuclear operations.

SECTION 4

4 RESULTS OF STUDY

4.1 Results

The following tables provides summaries, by each asset group, of the net book value as of December 31, 2019, and the recommended average service life of each asset group.

Ontario Power Generation Inc.

TABLE 1 - ESTIMATED SURVIVOR CURVE, ORIGINAL COST,

ANNUAL DEPRECIATION ACCRUALS RELATED TO UTILITY PLANT AS OF DECEMBER 31, 2019

DEPRECIATION RELATED TO RECOVERY OF ORIGINAL COST OF INVESTMENT

ASSET CLASS #	DESCRIPTION	DECEMBER 31, 2019 NBV	CURRENT	RECOMMENDED
15000110	Nuclear - Intangibles P5-8 and DG	$ 10,180,470	55	55
15100000	Nuclear - Land	$ 4,223,096	N/A	N/A
15110000	Nuclear - Site Improvement	$ 23,866,048	75	75
15120000	Nuclear - Yard Facilities	$ 6,079,470	50	50
15121000	Nuclear - Electronic Site Security System	$ 30,944,194	15	15
15122000	Nuclear - Security and Other Fencing	$ 32,131,786	20	20
15200000	Nuclear - Buildings and Structures	$ 362,953,986	55	55
15210000	Nuclear - Roofing	$ 22,545,181	25	25
15300000	Nuclear - Reactor Vessels - P1&4 and BG	$ 732,439	40	40
15311000	Nuclear - Fuel Channel Assemblies - Pickering	$ 34,670	25	25
15314000	Nuclear - Fuel Channel Assemblies - P5-8 and DG	-	28	100
15323000	Nuclear - Calandria Tubes - P5-8 and DG	-	28	100
15330000	Nuclear - Reactivity Control Units	$ 1,537,359	40	40
15340000	Nuclear - Process Systems	$ 651,945,512	55	55
15341100	Nuclear - Moderator Heat Exchangers - Pickering	$ 4,874,514	25	25
15352000	Nuclear - Shutdown Cooling System Heat Exchangers - Pickering	$ 283,357	25	30
15352100	Nuclear - Shutdown Cooling System Heat Exchangers - Darlington	$ 114,717,460	30	30
15360000	Nuclear - Irradiated Fuel Bays - P1&4 and BG	$ 90,009	40	40
15361000	Nuclear - Irradiated Fuel Bays - P5-8 and DG	$ 31,132,943	65	65
15370000	Nuclear - Tritium Removal Facility - DG	$ 20,023,054	30	30
15400000	Nuclear - Turbines, Auxiliary Equipment, Steam Reheater Tube - P1&4 and BG	$ 15,585,467	40	40
15411100	Nuclear - Turbines, Auxiliary Equipment, Steam Reheater Tube - P5-8 and DG	$ 9,945,089	55	55
15421000	Nuclear - Generator Rotors, Stators and Auxiliary Systems - P5-8 and DG	$ 11,907,444	55	55
15430000	Nuclear - Exciters	$ 17,080	30	30
15450000	Nuclear - Condenser Tubing	$ 13,485,680	30	30
15460000	Nuclear - Auxiliary Systems - P1&4 and BG	$ 17,013,750	40	40
15461000	Nuclear - Auxiliary Systems - P5-8 and DG	$ 27,786,078	55	55
15500000	Nuclear - Main Power Output System	$ 34,906,028	35	35
15501000	Nuclear - Revenue Metering - Main Power Output, Instrumentation and Control – PICK/DARL	$ 1,954,961	30	30
15510000	Nuclear - Station Service Main Transformers and AC Power Distribution Systems - P1&4 and BG	$ 4,304,778	40	40
15511000	Nuclear - Station Service Main Transformers and AC Power Distribution Systems - P5-8 and DG	$ 33,380,807	55	55
15521000	Nuclear - Station Service Main Transformers and Power Distribution Systems	$ 36,792,642	20	20
15530000	Nuclear - Building Electrical Service Supply - P1&4 and BG	$ 746,708	40	55
15531000	Nuclear - Building Electrical Service Supplies - P5-8 and DG	$ 11,070,621	55	55
15541000	Nuclear - Electrical Auxiliary System -P5-8 & DG	$ 651,454	55	55
15550000	Nuclear - Reactor Building Cabling -P1&4 and BG	$ 7,045,451	40	40
15560000	Nuclear - AC Standby Power - P1&4 and BG	$ 12,069,919	40	40
15561000	Nuclear - AC Standby Power - P5-8 and DG	$ 136,242,487	55	55
15600000	Nuclear - Instrumentation and Control	$ 213,589,174	15	15
15700000	Nuclear - Circulating Water - P1&4 and BG	$ 12,119,027	40	40
15701000	Nuclear - Service Water and Fire Protection System	$ 235,748,257	25	25
15710000	Nuclear - Water Treatment Plant	$ 5,478,533	20	20
15711000	Nuclear - Circulating Water - P5-8 and DG	$ 4,688,083	55	55
15720000	Nuclear - Common Service Systems	$ 311,585,332	35	35
15721000	Nuclear - Common Service Systems Air Compressors	$ 241,043	20	20
15990000	Nuclear - Alternate Spares	$ 1,267,185	100	100
15991000	Nuclear - Major / Strategic Spares	$ 113,952,520	100	100
15991200	Nuclear – Large Circulating Water Motors – Over 200 HP	$ 96,400,180	30	30
16210000	Administrative and Service Buildings - Permanent Buildings, Roads and Site Improvements	$ 185,788,281	50	50
16211000	Administrative and Service Buildings -Buildings - Leased	$ 1,889,511	10	10
16230000	Administrative and Service Buildings -Buildings - Frame & Metal Clad	$ 100,062,968	25	25
16310000	Administrative and Service Buildings -Nuclear Training Simulators	$ 25,346,777	45	45
16311000	Administrative and Service Buildings -Nuclear Simulators - Design Upgrades	-	10	10
16500000	Administrative and Service Buildings -Distribution Systems	$ 506,551	35	35
16540000	Administrative and Service Buildings -Administrative Telecom Equipment	$ 278,643	7	7
16550000	Administrative and Service Buildings -LAN Cable	$ 31,444	10	10
16551000	Administrative and Service Buildings -LAN Control Devices	$ 152,355	5	5
16560100	Administrative and Service Buildings - Intangibles Administration System Software	$ 9,938,035	5	5
16630000	Administrative and Service Buildings - Building Systems & Equipment	$ 3,658,916	20	20
18460000	Communications - Data Acquisition Equipment, Human Machine Interface Equipment	-	15	15
18500000	Communications - Radio Equipment	$ 193,636	15	15
18540000	Communications - Administrative Telecom Equipment	$ 13,966,420	7	7
18541000	Communications - Administrative Telecom Equipment - Revenue Metering	-	7	7
18630000	Communications - Optical Wire	$ 2,187	25	25
18633000	Communications - Optical Wire -Revenue Metering	$ 16,183	30	30
COMP1	Computers	$ 100,773	5	5
OFFICE1	Office Furniture and Fixtures	-	3	3
SERV1	Minor Fixed Assets - Service Equipment	$ 181,678,797	10	10
SERV2	Darlington Refurbishment Removal Tools	$ 51,041,782	10	10
T&WE1	Transportation and Work Equipment	$ 5,789,015	10	10
NEW	Nuclear – Instrumentation and Control – Darlington Refurbishment	-	N/A	30
NEW	Nuclear – Service Water and Fire Protection System – Darlington Refurbishment	-	N/A	30
TOTAL PLANT		**$ 3,268,713,600**		
Asset Retirement Costs (ARC)		$ 447,205,035		
Grand Total		**$ 3,715,918,635**		