Appendix K

FHI Maintenance & Inspection Policy

FESTIVAL HYDRO INSPECTION, TESTING AND MAINTENANCE POLICY

LAST REVISED: AUGUST 2023

Inspection, Testing and Maintenance Policy

1. OBJECTIVE

The objective of this policy is to establish guidelines and procedures for conducting regular maintenance, inspections, and testing to ensure the safety, functionality, and longevity of all Festival Hydro assets and facilities. All maintenance activities will adhere to applicable legislation, manufacturers' recommendations, and recognized utility best practices.

2. SCOPE

Maintenance and inspection cycles will be implemented based on the expected asset lifespan, actual usage, physical conditions, risk of failure, consequences of failure, and the safety of the public and workers. Whenever possible, these activities will be planned during winter months to minimize conflicts with ongoing capital projects. Efforts will be made to balance spending and distribute it evenly throughout each year.

3. RESPONSIBILITY

Festival Hydro's Engineering, Operations, and Stations teams will have the primary responsibility for overseeing maintenance and inspection activities. All employees and contractors are expected to promptly report any maintenance or safety issues they observe.

4. MAINTENANCE PROCEDURES

Maintenance tasks will be conducted according to defined schedules and frequencies. The following assets will undergo specific maintenance procedures:

- Tree Trimming: Refer to the Tree Trimming policy.

Load Break Switches – 10 year cycle

This includes:

- verifying all connections
- Operating switch to ensure operability
- Lube moving parts as needed
- Cleaning of contact areas as needed

Substations (Seaforth) – 5 years

This includes:

- Transformer Tests
- Ground Grid Tests
- Lightning Arrestor tests
- Switchgear tests
- High voltage switch tests
- Oil Sampling/testing (this is to be done yearly)
- Riser cable tests

Transformer Station (Stratford) – 4 year cycle for entire station (1 transformer every two years)

This includes:

- Transformer and tap changer tests
- Ground Grid Tests
- Lightning Arrestor tests
- Switchgear tests
- High voltage switch tests
- Oil Sampling/testing (this is to be done yearly)
- Cable tests
- Battery tests
- Relay re-verification
- Infrared

Smart Switches/Reclosers – 10 year cycle

This includes:

- Relay re-verification
- Battery replacement (every 5 years)
- Verify Operation of switch/all connections

Vaults/manholes – quarterly

This includes:

- Visually and thermally inspect all connections, breakers, junction and splice points for electrical integrity
- Ensure all pumps, heaters and lighting are in working order

Padmount Transformers – as needed

This includes:

- Identifying 6-8 low profile single phase padmount transformers based on inspection results to complete sandblasting and painting of to extend the life of the transformer shell

Comprehensive electronic records must be maintained for all maintenance work, including testing results, photographs, and verification of completed tasks, as well as any noted deficiencies and confirmation of their rectification.

5. INSPECTION PROCEDURES

General inspections will be conducted on both overhead and underground assets. Internal staff will perform the following inspections:

Poles (completed by Power Line Maintainers yearly):

- Bent, cracked or broken poles
- Excessive surface wear or scaling
- Loose, cracked or broken cross arms and brackets
- Woodpecker or insect damage, bird nests
- Loose or unattached guy wires or stubs
- Guy strain insulators pulled apart or broken
- Guy guards out of position or missing
- Grading changes, or washouts
- Indications of burning
- Risers (including cable, cable guard, terminations and arrestors)

Aerial Transformers (completed by Power Line Maintainers yearly):

- Paint condition and corrosion
- Phase indicators and unit numbers match operating map (where used)
- Leaking oil
- Flashed or cracked insulators/bushings

Switching/Protective Devices (Completed by Power Line Maintainers yearly):

- Bent, broken bushings and cutouts
- Damaged lightning arresters

Conductors and Cables (Completed by Power Line Maintainers yearly):

- Low conductor clearance, and excessive or inadequate sag.

- Broken/frayed conductors or tie wires
- Tree conditions
- Exposed broken ground conductors
- Broken strands, bird caging,
- Insulation fraying on secondary

Hardware and attachments (Completed by Power Line Maintainers yearly):

- Loose or missing hardware
- Insulators unattached from pins
- Conductor unattached from insulators
- Insulators flashed over or obviously contaminated
- Tie wires unraveled
- Ground wire broken or removed
- Ground wire guards removed or broken
- Bird or animal nests
- Vegetation Growth interference

All yearly overhead general inspections will be reported on an as exception basis (i.e. no comment means no concerns noted). Inspections will have names of who completed the inspection and the date inspection was completed, and will have date and names of when deficiency was corrected in accordance with all applicable regulations.

General Inspections will be conducted by internal staff on the following Underground assets:

Low Profile Padmount Transformers and Switchgear (Completed by Utility Serviceperson yearly):

- Paint condition and corrosion
- Placement on pad or vault
- Check for lock and penta bolt in place
- Grading changes
- Access changes (Shrubs, trees, etc.)
- Phase indicators and unit numbers match operating map (where used)
- Leaking oil
- Lid/cabinet damage, missing bolts

All yearly underground general inspections will be reported on a graded basis for each installation. Each inspection type will be given a good or poor rating at each installation. Inspections will have names of who completed the inspection and the date inspection was completed, and will have date and names of when deficiency was corrected in accordance with all applicable regulations.

Detailed Inspections:

Yearly Infrared Inspections will be conducted by qualified external staff with the assistance of internal staff on all overhead distribution system plant, all three phase padmount transformers and all pad mount switchgear. A report of all issues will be compiled by the external staff for Festival Hydro's reference. Date, names and description of fix for each deficiency noted will be completed in accordance with all applicable regulations.

Yearly underground cable testing will be conducted by qualified external staff with the assistance of internal staff. This cable testing will be done over two or three days on either recently decommissioned cable or on isolated, existing cable installed in the field. Engineering and Operations will work together to identify cable to be tested. A report will be completed on each piece of cable tested identifying overall health of cable. This will be done to assist in developing an asset health score for cable in Festival Hydro's service territory.

Monthly inspections will be completed at all Festival Hydro owned substations and transformer stations. Inspections will be completed on most recent inspection spreadsheets with the name and date of the individual who has completed them. Deficiences will be noted and fixed in a prioritized manner.

Wood poles will undergo detailed inspections on a 5 year cycle by qualified external staff. These inspections will include detailed condition recorded for:

- Bent, cracked or broken poles
- Excessive surface wear, scaling or decay
- Pole top rot/feathering
- Loose, cracked or broken cross arms and brackets
- Woodpecker or insect damage, bird nests
- Loose or unattached guy wires or stubs
- Guy strain insulators pulled apart or broken
- Guy guards out of position or missing
- Grading changes, or washouts
- Indications of burning
- Out of plumb
- Accompanying hardware condition (anchors, transformers, guy wire, insulators, etc.)
- Testing of pole to determine remaining strength

Concrete poles will undergo detailed inspections on a 10 year cycle by qualified external staff. These inspections will include detailed condition recorded for:

- Cracks or fractures
- Out of plumb
- Spalling
- Rust
- Rebar exposure
- Accompanying hardware condition (anchors, transformers, guy wire, insulators, etc.)
- Loose or unattached guy wires or stubs
- Guy strain insulators pulled apart or broken
- Guy guards out of position or missing
- Grading changes, or washouts

6. REPORTING AND COMMUNICATION

Any inspection that reveals immediate safety concerns must be reported immediately to the relevant Manager in charge. Reports for all inspections and maintenance activities should be submitted to the respective Manager for review.

7. TRAINING AND EDUCATION

Power Line Maintainers will be considered qualified based on their experience and knowledge of equipment and the distribution system. Utility Servicemen will receive training and visual aids to ensure consistency in inspection grades. External staff involved in testing and inspections must possess appropriate qualifications and training, as well as well-maintained and calibrated equipment. They will also receive safety training as required for their work with Festival Hydro.

8. CONTINUOUS IMPROVEMENT

This policy will be reviewed periodically to ensure its continued relevance and effectiveness. The following aspects will be assessed for updates:

- List of items being inspected

- List of items being maintained

- Frequency of inspection cycles

- Compliance with new regulations or standards

Regular reviews and updates will help ensure the policy remains in line with industry standards, regulatory requirements, and best practices.

Festival Hydro Inc.

Inspection, Testing and Maintenance Policy

Appendix L

Trilliant Focus Meter End-of-Life Notice

Evolution of SecureMesh® Network Products
April 12, 2022

End of Life Notice

Trilliant and its partners occasionally end the sale or support of older SecureMesh® products and SecureMesh certified devices. Specific details with respect to purchased products and new orders are provided in this document.

Affected Products and New Model Numbers

The end-of-life notice pertains to the following products, with the associated new model numbers listed.

Affected Products		Replacement Products	
Product Number	**Description**	**Product Number**	**Description**
RES-3000-Focus-P	Landis+Gyr FOCUS ALF SecureMesh Residential Electric Meter	1. L+G RES-4000-FocusAXe 2. Aclara RES-4000-I210+c 3. Trilliant LIBRA	Landis+Gyr FOCUS AXe SecureMesh Residential Electric Meter
			Aclara I210+c SecureMesh Residential Electric Meter
			Trilliant LIBRA SecureMesh Electric Meter

Background

L+G recently announced the end of sale for the Focus ALF electric meters.

As a result of the Focus ALF end of sale announcement, Trilliant is discontinuing the listed affected third generation SecureMesh modules.

Focus ALF users will have the option to migrate to the L+G Focus AXe, the Aclara I-210+c, or in late 2022, the Trilliant Libra meter.

All indicated replacement products will contain Trilliant's fourth generation SecureMesh module, significantly improving network efficiency, performance, and reliability.

Affected customers are encouraged to leverage the last time buy opportunity provided to avoid delay in product delivery.

Effective Date

Last time buy: September 1, 2022

Last time ship: December 15, 2022

Purchased Products

A customer with any of the affected products will be supported per the terms of any warranty currently in effect. If a replacement product is required, the customer will be supplied with the corresponding migration path product at no additional charge.

New Orders

Product availability is limited and will be available on a first come, first served basis. Trilliant will confirm availability prior to the acceptance of any new purchase orders placed for the affected product. Trilliant reserves the right to reject or partially fulfill purchase orders in the event there is insufficient product availability to fulfill any specific purchase order(s).

Contact your Trilliant representative if you have questions or if you would like to discuss how the transition to the new network product versions will be managed for your network.

Appendix M

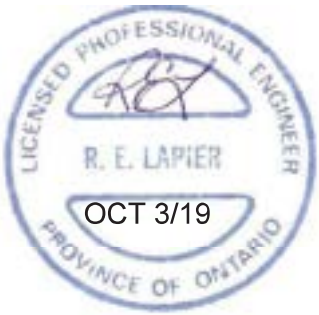
Seaforth Substation Assessment

Festival Hydro Inc.
Substation Condition Assessments
Seaforth, Ontario
Report

19121

costello
Utility Consultants

REV 4 FINAL October 3, 2019



Prepared By: _____
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Document Control

Version/ Revision	Prepared By/ Date	Reviewed By/ Date	Senior Reviewed By/ Date	Comments
0	R. LaPier P.Eng. 19/07/2019	Chris Lane P.Eng July 19, 2019		Issued for DRAFT Client Review
1	R. LaPier P.Eng. 31/07/2019			Issued Final
2	Ron LaPier P.Eng. 03/09/2019			Revised as per client comments
3	Revised by Chris Lane P.Eng. on behalf of Ron LaPier P.Eng.			Revised as per additional client comments for client review
4			Ron LaPier P.Eng. October 3, 2019	

1 – Executive Summary

Festival Hydro Inc. has retained Costello Utility Consultants to assist with a comprehensive review of the two substations (Chalk DS and Welsh DS) in Seaforth Ontario and to provide a recommendation on the merits of replacement of these assets or to invest in a voltage conversion program to ultimately phase these stations out of service.

Each substation was visually inspected with a focus on:

- Adherence to the Ontario Electrical Safety Code (OESC) as it relates to substation fences and associated grounding, and the IEEE Standard 80-2000, which pertains to substation grounding.
- Condition of the equipment and foundations

In addition to the visual inspections, Festival Hydro had KPC Power staff on site performing maintenance activities. The test reports from KPC were also reviewed as part of the scope of work and were factored into the recommendations.

During the course of the inspections a check list form was completed and site photos taken. This data was catalogued and is contained in appendices to this report.

Upon reviewing the photos, inspection sheets, and test reports, it would appear that both stations need immediate attention with respect to grounding to be compliant with current electrical code and IEEE standard practices. This effort might be expected to approach $160K-$200K each, depending on the outcome of a more detailed investigation.

The cost of replacing each station in the existing location can be estimated at approximately $1.6M each. The Chalk Street site is known to have experienced low-level flooding in the spring due to the surrounding grades. Replacement in situ at this location may not be the preferred option if rebuilding is the path chosen.

We recommend the replacement of the Welsh DS transformer within 2-3 years based on the age (53). Although the annual oil analysis results are acceptable, the age of the unit is well beyond the typical expectations of forty years.

We recommend that the Chalk DS transformer be slated for replacement in the 5-10 years range. The oil testing results for this unit indicate that it has been overheated at some point in its past and it is approaching its statistical end of life based on age (32).

It might be prudent to begin regular Furan testing and to develop an emergency temporary replacement plan for both transformers. Furan testing will provide an indication of the extent of the paper insulation degradation and may improve, or confirm, the outlook related to the remaining life of both units.

With regard to the possible plans to perform a full voltage conversion, the costs of a voltage conversion have not been estimated in this report. Festival Hydro should complete an estimate of the remaining costs of voltage conversion so that the cost comparison between conversion and rebuilding the station assets can be completed. The town currently has approximately:

- 1045.2m (7%) of the existing feeders (both 3ph and 1ph) framed at 27.6/16kV spacing, but not insulated.
- 3804.2m (27%) of the existing feeders (both 3ph and 1ph) framed and insulated at 27.6/16kV.
- 9250m (66%) of the existing feeders are legacy framing and are neither framed nor insulated to 27.6kV standards.
- 1300m approximately of existing underground circuit with 300m (23%) insulated for 28kV

The existing legacy single phase framing might be adapted to 16kV framing through the use of post top extensions, but the remaining legacy three phase framing will very likely require pole replacements. The previously completed work will serve to reduce the voltage conversion costs, but the remaining effort is still significant in costs, time, and coordination.

When considering voltage conversion, Festival Hydro should also consider the following factors:

Festival Hydro should review the operational and reliability impacts of the single HONI supply feeder into Seaforth. Both supply points into the Seaforth system are supplied from the same HONI feeder. An investigation with HONI to see if this situation can be altered to improve the supply situation is strongly recommended.

The impact of a full voltage conversion on the reliability performance indicators has not been evaluated as part of this scope of work but should be considered before a final decision is made on a move to full 27.6kV conversion.

The logistics of the voltage conversion should also be reviewed as a factor in the decision process as well. The transition period of the conversion could possibly cause limited switching and supply options for some customers.

The revenue impacts of the loss reductions inherent in a voltage upgrade have not been reviewed as part of this scope, but are not expected to be significant, and given the fact that system losses are currently passed on through customer billing, it may be a moot point.

The replacement of the stations would allow for the upgrade of the feeder protection technology. This would be a great improvement over the fuse protections currently in place. This upgrade in feeder protection technology would allow for much better sensitivity for fault detection, faster clearing, better coordination with downstream devices, and provide better outage notification and response times for restoration efforts through the application of SCADA interfaces. The improved technology would also provide Festival Hydro with an improved ability to deal with any distributed generation applications that may arise in the future. A move to a 27.6kV system,

which would rely on the HONI TS breakers for these functions, would possibly be less robust in these aspects.

We have identified several concerns with the age and condition of the existing station transformers and associated equipment, along with the more immediate concerns regarding the current state of the fence grounding systems and overall GPR of both stations. Apart from the complete costs of voltage conversion, the table below summarizes the estimated costs and timeframes for each possible course of action. More difficult to quantify are the potential impacts of either option on the reliability indices for Seaforth. Addressing the single HONI feeder supply situation would have the largest positive impact on these performance measures, but the voltage conversion to 27.6kV (versus a multi-feeder 4.16kV system) will also have to be considered. Somewhat independent of the duration required to complete the voltage conversion, emergency plans for the temporary back up of the two transformers should be developed. This plan, and any associated equipment developed, may also be able to serve in other service areas within the FHI system.

Table 1.1 Summary - Actions and Estimated Costs

Option/Action	**Estimated Cost**	**Timeframe Possible**
Grounding Remedial action at both stations	$320K-$400K	Recommended ASAP for public and worker safety
Substation replacement/ technology upgrades at both stations	$3.2M	Would require a minimum of 2 years to complete both stations
Full overhead and underground voltage conversion to 27.6/16kV	To be determined by FHI	To be determined by FHI

2 – Introduction

Costello Associates has been retained by Festival Hydro Inc. (FHI) to assist with a comprehensive review of the two substations (Chalk DS and Welsh DS) in Seaforth Ontario and to provide a recommendation on the merits of replacement of these assets or to invest in a voltage conversion program to ultimately phase these stations out of service.

Each station was visited by Costello staff and observations and photos were recorded. Once the field work was completed, and the test reports provided by KPC Power were reviewed, the findings were recounted, and recommendations for replacement or phasing out of service were provided.

Many of the stations we perform condition assessments on are supplied from the 44kV sub-transmission system. This forces the Local Distribution Company (LDC) to keep 4kV as their distribution voltage or go through a wholesale voltage conversion, but not be able to eliminate their substations from the list of distribution assets.

Given that the supply voltage from Hydro One (HONI) is 27.6kV, which is used by many LDCs in Ontario as a distribution voltage, Festival has the option of converting the entire system in Seaforth to 27.6kV and eliminating the two stations entirely. However, it was noted that the 27.6kV supply for both substations is currently the same HONI feeder. This fact has major impacts on any discussion of reliability and supply options for the Town of Seaforth.

There are some factors to be considered other than the cost of replacing the substations versus rebuilding for 27.6kV distribution. These factors include impacts on reliability/reliability performance indices, and limitations on switching options for repairs and maintenance.

This report will review the visual condition assessment, most recent equipment test records, and review the potential impacts on the other factors mentioned above. This review and report are intended to provide FHI with short and long recommendations regarding replacement or phase out of service through voltage conversion.

3 – Field Work Inspections – Findings and Concerns

3.1 – Welsh DS

Please refer to *Appendix A* for the site inspection forms and *Appendix B* for the associated photos taken during the site visit.

3.1.1 General Findings

The Welsh St substation consists of a single 5000kVA transformer (vintage 1966) feeding 4.16kV outdoor metalclad switchgear. The primary 27.6kV comes to the station from an overhead line, through the pole mounted revenue metering, and to the old steel lattice structure. This steel lattice structure appears to be original and straddles an existing concrete pad that would have held the original station transformer. At some point in the past, the station was rebuilt in its current configuration most likely using the original transformer and adding the metalclad switchgear.

The steel lattice structure consisting of an air break switch and lightning arrestors supports the 28kV cables that connect to a second 34.5kV metal enclosed fused load break switch cell close coupled to the transformer primary.

The 4.16kV metalclad switchgear is connected to the transformer secondary via enclosed bus. This enclosure also houses a set of potential transformers that provide voltage metering information to the meters located on the exterior of the switchgear. Each feeder cell is equipped with a load break switch, fuse, and a set of current transformers that also provide metering information to the exterior of the switchgear.

With the exception of the steel lattice structure mounted switch and riser cables to the transformer, all substation equipment is metal-enclosed with no exposed energized components.

The substation is bordered by a parking lot/commercial building to the east, a grassy field to the north, and a chain link fence, some 10m to the west. The south side of the station faces Welsh St and is mostly a grass/gravel parking area for the substation. Much of the interior area of the substation is covered with wood pallets and is used for the storage of both new and used transformers.

The station fence, approximately 1.8m (6') tall, with three strands of barbed wire above meets the Ontario Electrical Safety Code (OESC) fence requirements. Although not the standard approach, the barbed wire is turned toward the interior of the station. The tension wire at the base of the fence appeared to be tight and there is little or no gap from the bottom of the fence to the surface stone making access for animals and the public sufficiently difficult.

The general condition and appearance of the equipment, paint finish, and concrete foundations is satisfactory with the exception of the steel lattice structure. The steel tower, hardware and components such as insulator bases are showing signs of significant rusting.

3.1.2 Specific Findings and Concerns

The HONI 28kV feeder neutral is not routed into the station 28kV incoming tower structure and is not connected to the station ground grid.

The adequacy of the station ground grid to meet the OESC GPR, step and touch voltage limits is doubtful. The fall of potential test results from the KPC 2019 maintenance report indicate a theoretical ground grid resistance of approx. 10 ohms. Evaluation of the F.O.P. test data using the slope method indicates the ground grid resistance to be 8.2 ohms. Since the station ground grid is not connected to the 28kV neutral and the grid resistance is high, the station has the potential for excessive GPR and step/touch potentials in the event of a ground fault.

There appears to be no grounding conductors external to the station fence or gates, and there is no crushed stone external to the station. The possible exception to this is the east side of the substation where crushed stone covers the area from the fence to the building on the adjoining property. The OESC requires the station ground electrode to be located 1 meter outside of the station fence with a crushed stone surface covering extending one meter beyond the ground electrode.

The existing crushed stone surface cover inside the station appears to be insufficient as substantial organic content is visible inside the station perimeter. A surface covering depth of 150 mm is required.

The existing substation fence and gate grounding is inadequate and does not conform to the OESC. All corner, gate and intermediate posts at intervals not exceeding 12m intervals are to be grounded to the station ground electrode.

The substation east side fence appears to be located just inside the property line with the adjacent property owner. The adjacent property has a building with a door located in close proximity to the east substation fence (within 2.4 m). Potential step and touch voltage issues exist with persons entering or exiting this door if the station ground electrode exists outside of the fence perimeter. Metal objects on the adjacent property in close proximity to the station also pose a potential hazard to the public.

The substation metal lighting standards located inside the substation perimeter are not bonded to the substation ground grid.

The substation is used to store electrical equipment in multiple locations with some equipment in close proximity to the station fence. The metal electrical equipment enclosures are not bonded to the station grid. Storage of items external to, and in close proximity to, the station fence appears to be an issue as well.

The HV metal enclosed switchgear, transformer tank, and LV metal enclosed switchgear are connected directly to the station ground grid in one location only.

Exposed LV wiring connections at the base of the tower structure could pose a potential hazard

It was noted after the site inspection, that there is a municipal water system well head within 200m of the substation. This issue was factored into the substation assessments related to the lack of existing secondary oil containment at the station.

3.2 – Chalk DS

Please refer to *Appendix A* for the site inspection forms and *Appendix B* for the associated photos taken during the site visit.

3.2.1 General Findings

The Chalk St substation consists of a single 5000kVA transformer (vintage 1987) feeding 4.16kV outdoor metalclad switchgear. The primary 27.6kV primary feeder enters the station overhead to a terminal pole located in the substation. The terminal pole is complete with a load break switch, fuses, and arresters and feeds the station transformer via underground cables.

The four-bay lineup of 4.16kV metalclad switchgear is connected to the transformer secondary via metal enclosed bus. The switchgear lineup consists of different sections with various build dates spread over different manufacturing periods. Each of the three feeder sections consists of a switch, fuse, and a set of current transformers for metering external to the switchgear.

The transformer with top side bushings has been fitted with a metal hood to enclose the HV bushings, arresters and primary cable connections. With the exception of the 28kV primary terminal pole there are no exposed energized components.

The substation is bordered by Chalk Street on the west side, green space to Gouinlock Street on the north and green space to a residential property to the east. A residential property is located directly to the south of the station.

The station fence, approximately 1.8m (6’) tall, with three strands of barbed wire above meets the Ontario Electrical Safety Code (OESC) fence requirements. The barbed wire is turned toward the interior of the station. The tension wire at the base of the fence appeared to be tight and there is little or no gap from the bottom of the fence to the surface stone making access for animals and the public sufficiently difficult.

The general condition and appearance of the equipment, paint finish and concrete foundations is satisfactory.

It was after the site inspection, that the Chalk station has been subject to some flooding in the past. The area of the station sits below the grade of the surrounding roadways, and the neighbour’s lot to the south of the station is situated lower than the station currently.

Although not present at the time of the inspection, water could be expected to accumulate in the base of the switchgear foundations and cable conduits positioned below grade. This information was added to the evaluation criteria.

3.2.2 Specific Findings and Concerns

The HONI 28kV neutral is not routed to the 28kV primary switch pole and is not connected to the station ground grid.

The adequacy of the station ground grid to meet OESC GPR, step and touch voltage limits requires further evaluation of the existing grid. The fall of potential test results from the KPC 2019 maintenance report indicate a theoretical ground grid resistance of approx. 2 ohms. Evaluation of the F.O.P. test data using the slope method indicates the current test probe distance to the station was insufficient to get a valid resistance value. Since the station ground grid is not connected to the 28kV neutral and the station grid resistance is not confirmed, the station has the potential for excessive GPR and step/touch potentials in the event of a ground fault.

There appears to be no grounding conductors external to the station fence or gates and there is no crushed stone external to the station. The OESC requires the station ground electrode to be located 1 meter outside of the station fence with a crushed stone surface covering extending one meter beyond the ground electrode.

The existing crushed stone surface cover inside the station appears to be insufficient as substantial organic content is visible inside the station perimeter. A surface covering depth of 150 mm is required.

The existing substation fence and gate grounding is inadequate and does not conform to the OESC. All corner, gate and intermediate posts at intervals not exceeding 12m intervals are to be grounded to the station ground electrode.

The substation metal lighting standards located inside the substation perimeter are not bonded to the substation ground grid.

The substation south side fence appears to be located on the property line with the adjacent property owner. The adjacent property owner has a trailer in close proximity to the south substation fence and has a snow fence post next to the substation south east corner post posing a potential hazard to the public.

The transformer neutral (Xo) is bonded to the internal switchgear ground bus and connected to the station ground grid in one location only with what appears to be 2/0 BSC.

4 – Review of Equipment Test Reports

The KPC 2019 substation maintenance reports for both stations were reviewed. With a few exceptions, the electrical inspection and testing indicated that the general condition of the electrical equipment is acceptable for continued use. Lightning arrester replacement and switch repairs are required in both stations as recommended in the reports. It is recommended that these repairs/replacements be performed regardless of the future status of these stations.

The dissolved gas in oil test results for the Welsh station transformer indicate that all key gas levels are within normal limits. The Chalk Street station transformer results show elevated levels of CO and CO2 since the earliest year (2013) that test results were provided. These elevated levels could indicate that the transformer was overheating at some point in the past, previous to 2013. From 2013 (earliest year results were provided) through 2018 the CO and CO2 levels continued to trend upward. 2019 results indicate the upward trend has ended which may indicate that the transformer loading has been reduced.

More frequent gas in oil testing for the Chalk Street station transformer may be prudent during the time required to eliminate or replace this station.

Substation transformer assets are typically expected to have forty-year life expectancy. The Welsh DS unit is now fifty-three years old and the Chalk DS unit is now thirty-two years old. Paper insulation degradation is an inevitable process in a transformer, and is primarily associated with age, but can be made worse through overheating. The Welsh DS unit is well beyond its normally expected life span, and as noted above from the dissolved gas analysis, the Chalk DS unit appears to have been subjected to overheating at some point in it's past. It is never possible to know when a transformer is going to fail, but given the age and test results for these units, it would be prudent to have a plan for either replacement or temporary/portable back up for each unit.

5 – Other Factors for Consideration

5.1 Festival Hydro has provided information outlining how much of the existing system has been upgraded to 27.6/16kV kV framing in anticipation of voltage conversion. The extent to which this is true will have an impact on the remaining costs of completing the voltage conversion.

From this information, the following approximate feeder assessment yielded:

- 1045.2m (7%) of the existing feeders (both 3ph and 1ph) framed at 27.6/16kV spacing, but not insulated.
- 3804.2m (27%) of the existing feeders (both 3ph and 1ph) framed and insulated at 27.6/16kV.

- 9250m (66%) of the existing feeders are legacy framing and are neither framed nor insulated to 27.6kV standards.
- 1300m approximately of existing underground circuit length with 300m (23%) insulated for 28kV.

The existing legacy single phase framing might be adapted to 16kV framing through the use of post top extensions. The legacy framing will most likely require pole replacements, new framing and insulation to 27.6kV standards.

5.2 Festival Hydro can expect to spend approximately $1.6M (including engineering) each to replace the existing stations in the same locations. However, the issues with grounding identified at both stations should be addressed even in the interim period between present and the commencement of any construction of the new stations.

We have participated in the design and implementation of these grounding upgrade projects with other LDC clients and the average costs of $160K-$200K including the engineering costs.

5.3 Reliability Impacts

5.3.1 When comparing the reliability of a new substation against that of the existing station, the expected use of reclosers instead of fuses for feeder protections can be expected to provide a significant improvement in fault detection, clearing, and restoration of the 4160V system. However, it must be noted that with fuse protections, many transient tree contacts may have simply burned clear before the fuses could detect and operate. With the increased sensitivity to ground faults, the reclosers will now be able to detect these faults. Many LDCs that have upgraded their feeder protections in this manner have had to review their tree trimming frequencies in order to mitigate the increased feeder protection sensitivity.

5.3.2 At present, the expected 27.6kV feeder configuration would be an extension from the two supply points (currently from the same HONI feeder) into the center of town, with a normally open tie switch.

If the above assumption is true, the current configuration provides fewer customers per feeder than any 27.6kV feeder configuration could offer. The current multiple 4160V feeder configuration will inherently have better reliability in this regard in that for any feeder event, fewer customers are impacted.

Also, the multi-feeder 4160V configuration allows for more switching options to minimize the number of customers impacted by planned outages for work on the system.

Festival Hydro should review the feeder supply options with HONI to see if another feeder connection at 27.6kV is possible. The current arrangement of only one 27.6kV feeder supply is not optimal with respect to reliability.

5.3.3 The replacement of the stations would allow for the installation of electronic reclosers as feeder protections. This would be a great improvement over the fuse protections currently in place. This upgrade in feeder protection technology would allow for much better sensitivity for fault detection, faster clearing, better coordination with downstream devices, and also provide better outage notification and response times for restoration efforts. The improved technology would also provide Festival Hydro with an improved ability to deal with any distributed generation applications that may arise in the future.

If FHI is considering a “Like-For-Like” replacement of the stations, the continued use of fuse protections on the 4.16kV feeders would not be in keeping with the industry standard trends towards smart-grid technologies. We know of no LDCs that are renewing station assets and keeping fuse technology at the feeder protection level.

A move to a 27.6kV system, which would rely on the HONI TS breakers for these functions, could possibly be less robust in these aspects.

6 – Conclusions

6.1 The transformer at Welsh DS is thirteen years beyond it's industry standard life expectancy. Although the oil test reports indicate no immediate concerns, the age of the unit cannot be ignored.

The oil analysis of the Chalk DS transformer shows signs of some overheating in its past, and it is now within 10 years of the industry standard life expectancy.

6.2 Both stations need immediate attention with respect to grounding to be compliant with current electrical code and the IEEE standards

This effort might be expected to be in the $160K-$200K range each, depending on the outcome of a more detailed investigation.

6.3 The cost of replacing each station in the existing location can be estimated at approximately $1.6M each (including engineering).

6.4 The costs of a full voltage conversion have not been estimated, but currently, the town has approximately 14.1km of overhead circuits. Of that total, there is approximately 9.25km of overhead circuit (both 3ph and 1ph) to be rebuilt or insulated to 27.6.16kV.

6.5 The impact of a full voltage conversion on the reliability performance indicators has not been evaluated as part of this scope of work but should be considered before a final decision is made on a move to full 27.6kV conversion.

6.6 The revenue impacts of the loss reductions inherent in a voltage upgrade have not been reviewed as part of this scope, but since system losses are currently passed through to the customer, this has no financial impact under the current regulatory regime.

6.7 The replacement of the stations would provide for improved relay protections, better fault sensing, clearing, and coordination.

6.9 The new relay technology would also provide SCADA access for notifications and remote restoration, as well as the improved ability to accept any DG applications in the future.

7 – Recommendations

7.1 The Welsh transformer should be slated for replacement within the two to three years based on age.

Likewise, the Chalk transformer should be slated for replacement within the next five to ten years.

It would be prudent to have Furan testing done on the insulating oils of both units. The level of Furans is an indication of the level of paper insulation degradation. Regular monitoring of this, along with the continued gas in oil testing is recommended.

At least, FHI should develop an emergency replacement strategy for both units should either fail. Without an emergency back plan, the loss of either unit could place additional stress on the remaining transformer. This situation would serve to further age the remaining unit.

7.2 Both stations need immediate attention to the grounding systems to ensure public and worker safety. It is recommended that Festival Hydro review the findings of this report and implement remedial action on the grounding systems at both stations.

7.3 Festival Hydro should complete an estimate of the remaining work to finish a full voltage conversion to a 27.6/16kV system. After knowing the full estimated costs of conversion, a comparison to the estimated costs of renewing the station assets can be used in the decision process to replace station assets or not.

In addition, FHI should complete an inventory of the underground primary cables in town to determine the extent of the capital investment required for voltage conversion of these items.

7.4 Festival Hydro should immediately review the operational and reliability impacts of the HONI single supply situation and take steps to investigate improving this situation for Seaforth.

Appendix A – Assessment Checklists

Costello Associates

Substation Risk Assessment Form

Station ____Chalk St DS_____ Year Built _____

Section 1: Public Safety – conditions that impact public safety at the station:

Area of Concern	Check		
	1	2	3
Perimeter Security	X		
Fence Grounding and Bonding			X
Station Yard	X		
Station Building			
Station Setting – Proximity		X	
Station Setting - Encroachments		X	
Overall public safety condition		X	

1 = Acceptable

2 = Some deficiencies

3 = Needs attention soon

Section 2: Worker Safety – conditions that impact worker safety at the station:

Area of Concern	Check		
	1	2	3
Grounding and Bonding		X	
Safe limits of approach	X		
Working clearances	X		
Switching access	X		
Multiple sources of voltage	X		
Porcelain	X		
Operational Issues	X		
Maintenance Issues		X	
Overall worker safety condition	X		

1 = Acceptable

2 = Some deficiencies

3 = Needs attention soon

Maintenance issues that can be quickly rectified may be eliminated from risk assessment.

Inspected by: __R LaPier_____ Date:_March 2019_____

Costello Associates

Substation Risk Assessment Form

Section 3: Risks of Major Equipment Failure

A. Condition of Equipment

Area of Concern	Check		
	1	2	3
Power Transformers		X	
High-side switchgear	X		
Distribution-side switchgear	X		
Protection and Control Equipment	X		
Underground cables	X		
Structures	X		
Overall equipment condition	X		

1 = Acceptable

2 = Some deficiencies

3 = Needs attention soon

B. Factors that may impact the consequences of major equipment failure

Concern	Impact of Consequence		
	L	M	H
Station setting – proximity	More than 100m	Between 100m and 10m	10m or less
Station setting – watercourses	None	Storm sewers/drains	Open water
Lack of backup supply	<2 hours switching	Between 2 – 24h outage	No backup
Critical loads (hospitals etc)	None	With generators	No generators
Grounding and bonding	Today's code	Some deficiencies	Poor
Oil containment	Yes	Partial	None
Explosion barriers	Yes	Partial	None
Fire fighting capability	Hydrants	Storage Tanks	None
Presence of PCB's	None	Storage Only	In-service
Overall equipment condition	**L**	**M**	**H**

C. Based on the equipment condition and consequences, state the risk rating for a major equipment failure:

Overall Failure Risk Rating	**Blue**	**Purple**	**Yellow**	**Orange**	**Red**
	20+ Years	11-20 years	4-10 years	2-3 years	1 year
			X		

Section 4: Overall Substation Risk Assessment

Station Risk Assessment	**Blue**	**Purple**	**Yellow**	**Orange**	**Red**
	20+ Years	11-20 years	4-10 years	2-3 years	1 year
			X		

Comments: Provided that the transformer is not overloaded for significant duration, we have no reason to believe that the station equipment will not last 5-10 years.
We are not sure if this time is adequate to complete a voltage conversion required.

Inspected by: ___ R LaPier _____ Date:__March 2019_____

costello
Utility Consultants

4096 Meadowbrook Dr.
Unit 112
London, ON N6L 1G4
Phone (519)203-1222

Festival Hydro – Chalk Street DS

The HONI 28kV neutral is not connected to the station ground grid. The neutral is not taken to the 28kV switch pole.

There appears to be no grounding conductors external to the station fence or gates.

There is no crushed stone external to the station fence or gates.

The existing crushed stone inside the station appears to be inadequate/insufficient with substantial organic content.

The adequacy of the station ground grid requires evaluation. The fall of potential test results from the KPC 2019 maintenance report indicate a theoretical ground grid resistance of approx. 2 ohms. Evaluation of the F.O.P. test data using the slope method indicates the current test probe distance to the station was insufficient to get a valid resistance value.

The substation south side fence appears to be located on the property line with the adjacent property owner. The adjacent property owner has a trailer in close proximity to the south substation fence and has a snow fence post next to the substation south east corner post.

The substation metal lighting standards located inside the substation perimeter are not bonded to the substation ground grid.

The existing substation fence and fabric grounding is inadequate. All corner, gate and intermediate posts at intervals not exceeding 12 meter intervals are to be grounded to the station ground electrode.

The transformer neutral (Xo) is bonded to the internal switchgear ground bus and connected to the station ground grid in one location only with what appears to be 2/0 BSC.

Substation equipment repairs/replacements are required as recommended in KPC 2019 Substation maintenance report.

Replacement of substation transformer manufactured in 1987.

Replacement of substation switchgear estimated to be of similar vintage to the transformer.

Costello Associates

Substation Risk Assessment Form

Station ____Welsh St DS_____ Year Built _____

Section 1: Public Safety – conditions that impact public safety at the station:

Area of Concern	Check		
	1	2	3
Perimeter Security		X	
Fence Grounding and Bonding		X	
Station Yard			X
Station Building			
Station Setting – Proximity		X	
Station Setting - Encroachments			X
Overall public safety condition			X

1 = Acceptable

2 = Some deficiencies

3 = Needs attention soon

Section 2: Worker Safety – conditions that impact worker safety at the station:

Area of Concern	Check		
	1	2	3
Grounding and Bonding		X	
Safe limits of approach	X		
Working clearances	X		
Switching access difficult	X		
Multiple sources of voltage	X		
Porcelain		X	
Operational Issues		X	
Maintenance Issues		X	
Overall worker safety condition		X	

1 = Acceptable

2 = Some deficiencies

3 = Needs attention soon

Maintenance issues that can be quickly rectified may be eliminated from risk assessment.

Inspected by: __R. LaPier_____ Date:__March 2019_____

Costello Associates

Substation Risk Assessment Form

Section 3: Risks of Major Equipment Failure

A. Condition of Equipment

Area of Concern	Check		
	1	2	3
Power Transformers	X		
High-side switchgear	X		
Distribution-side switchgear		X	
Protection and Control Equipment	X		
Underground cables			
Structures		X	
Overall equipment condition		X	

1 = Acceptable

2 = Some deficiencies

3 = Needs attention soon

B. Factors that may impact the consequences of major equipment failure

Concern	Impact of Consequence		
	L	M	H
Station setting – proximity	More than 100m	Between 100m and 10m	10m or less
Station setting – watercourses	None	Storm sewers/drains	Municipal Well Head within 100m
Lack of backup supply	<2 hours switching	Between 2 – 24h outage	No backup
Critical loads (hospitals etc)	None	With generators	No generators
Grounding and bonding	Today's code	Some deficiencies	Poor
Oil containment	Yes	Partial	None
Explosion barriers	Yes	Partial	None
Fire fighting capability	Hydrants	Storage Tanks	None
Presence of PCB's	None	Storage Only	In-service
Overall equipment condition	**L**	**M**	**H**

Overall Failure Risk Rating	Blue	Purple	Yellow	Orange	Red
	20+ Years	11-20 years	4-10 years	2-3 years	1 year
				X	

C. Based on the equipment condition and consequences, state the risk rating for a major equipment failure:

Station Risk Assessment	Blue	Purple	Yellow	Orange	Red
	20+ Years	11-20 years	4-10 years	2-3 years	1 year
				X	

Section 4: Overall Substation Risk Assessment

Comments:

Inspected by: ___R LaPier_____ Date:___March 2019_____

costello
Utility Consultants

4096 Meadowbrook Dr.
Unit 112
London, ON N6L 1G4
Phone (519)203-1222

Festival Hydro – Welsh Street DS

The HONI 28kV neutral is not connected to the station ground grid. The neutral is not taken to the 28kV incoming tower structure.

There appears to be no grounding conductors external to the station fence or gates.

There is no crushed stone external to the station fence or gates.

The existing crushed stone inside the station appears to be inadequate/insufficient with substantial organic content.

The adequacy of the station ground grid is doubtful. The fall of potential test results from the KPC 2019 maintenance report indicate a theoretical ground grid resistance of approx. 10 ohms. Evaluation of the F.O.P. test data using the slope method indicates the ground grid resistance to be 8.2 ohms. Since the station ground grid is not connected to the 28kV neutral and the grid resistance is high, the station has the potential for excessive GPR and step/touch potentials in the event of a ground fault.

The substation is used to store electrical equipment in multiple locations with some equipment in close proximity to the station fence. The metal electrical equipment enclosures are not bonded to the station grid.

The substation metal lighting standards located inside the substation perimeter are not bonded to the substation ground grid.

The existing substation fence and gate grounding is inadequate and does not conform to the OESC. All corner, gate and intermediate posts at intervals not exceeding 12 meter intervals are to be grounded to the station ground electrode.

The transformer tank is connected directly to the station ground grid in one location only.

The HV metal enclosed switchgear ground bus is connected to the station ground grid in one location only.

The LV metal enclosed switchgear ground bus is connected directly to the station ground grid in one location only.

Substation equipment repairs/replacements are required as recommended in the KPC 2019 substation maintenance report.

Replacement of substation transformer manufactured in 1966.

Replacement of substation switchgear estimated to be of slightly newer vintage to the transformer.

Appendix B – Site Photos

Appendix B1: Chalk DS Site Photos and Field Sketches

Seguth Chalk DS April 11/2019

Festival Hydro

Fence/Grounding

- ground are all in good condition
- don't appear to be 12m min spacing (re check for Welsh too!)
- no gravel outside the fence
- gates properly gndd Check mangates?
- Street lights inside the station are not visibly gnd.

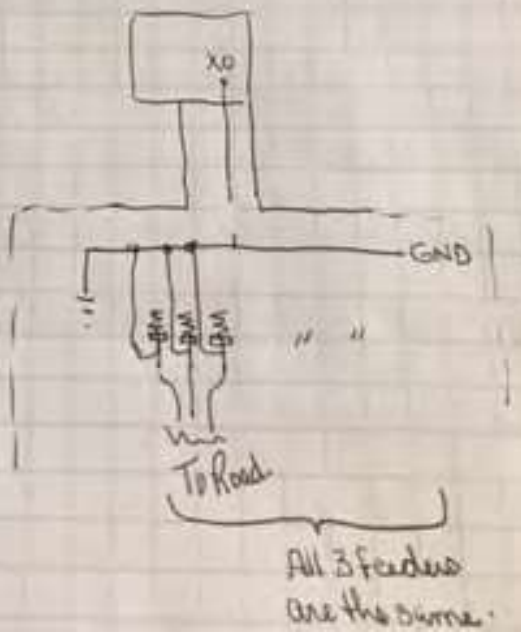
Neutral/Ground

* HONI 27.6kV Neutral stops on Gainbeck St and does not enter the station or connect to the Station ground grid.

HV cables: CN and LA's are gnd to grid tie wrapped to duct.

LV Swgr

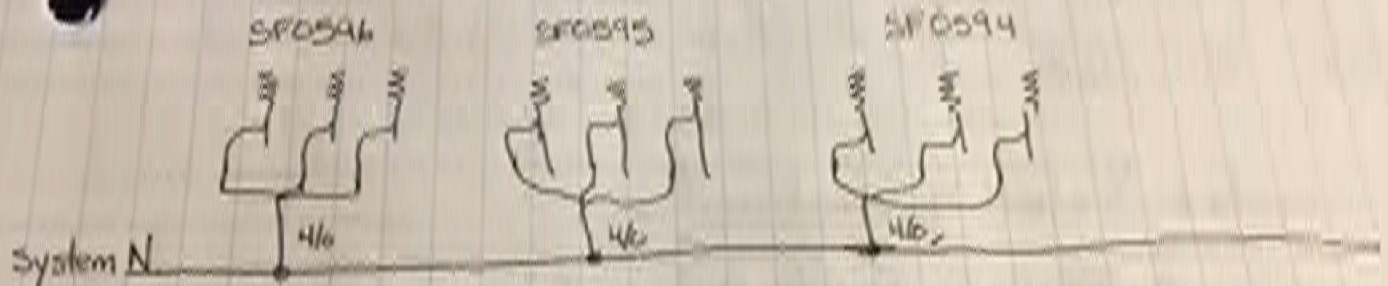
- no external gnds to grid
- one visible connection GND bus to grid ??
- 2 fuse holders appear to have been smoked but no evidence of damage in the cell.



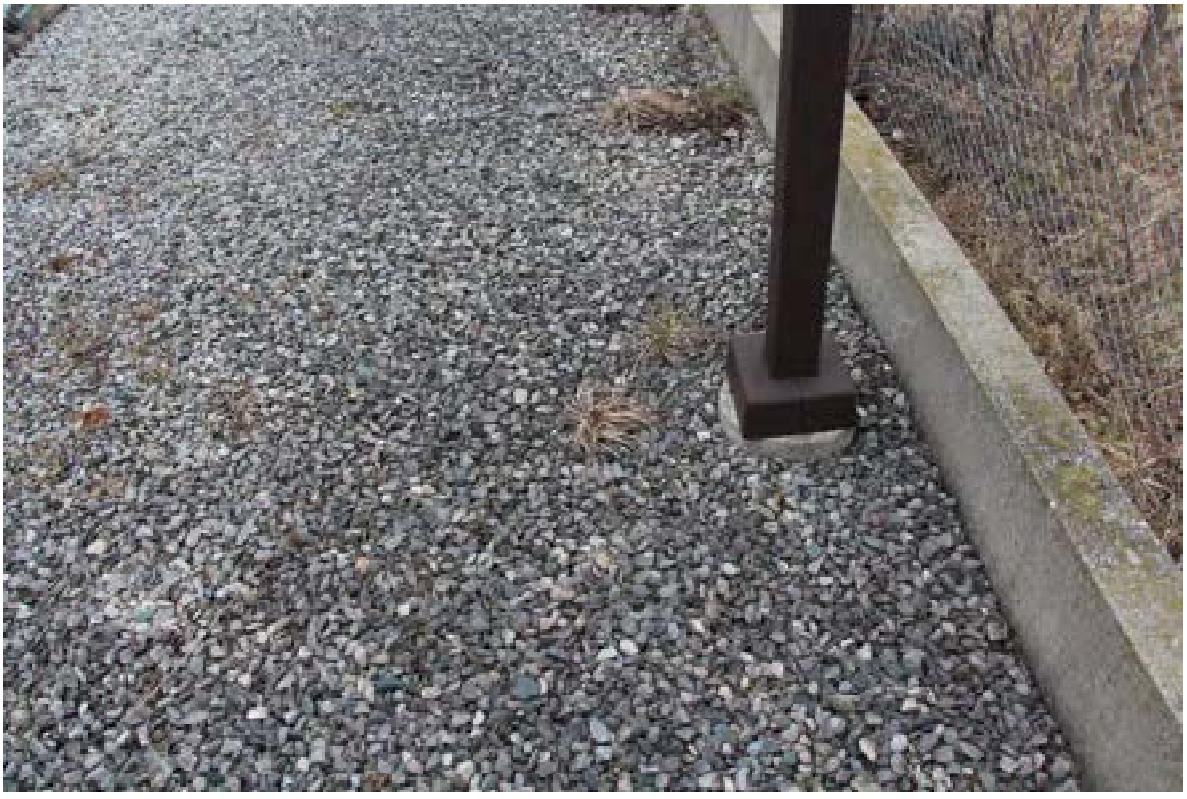
All 3 feeders are the same.

Festival Hydro Apr. 18 11/19
Chalk St D.S.

Feeder Neutral Grounding



Appendix B2: Welsh DS Site Photos and Field Sketches




02
98

Festival Hydro

- Seaforth - Welsh St D.S.

- KPC present for Mtce — Alan Derek Joe — Eric - FHI

276KV Cables - CN directly to grid

276KV SB - ground not buried

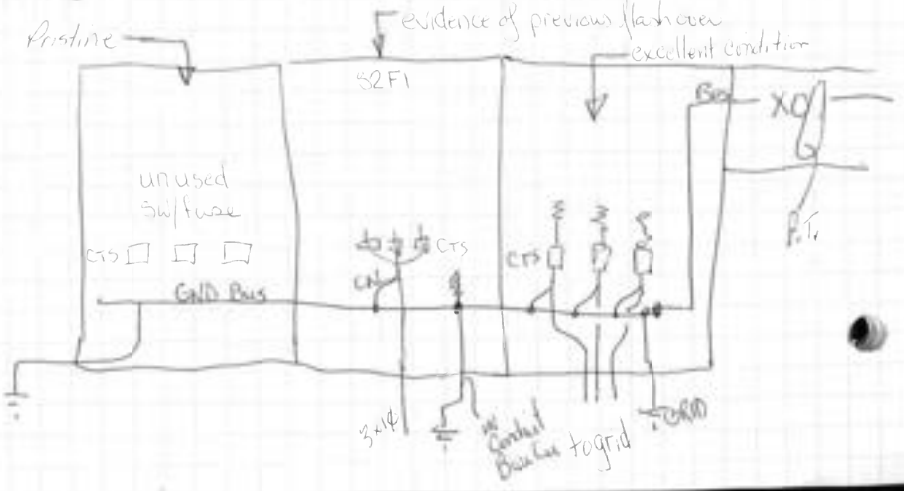
Old structure lights wiring ?

Street lights inside station
↳ properly grid ? - not visibly grn

276 Swgr only one physical chassis ground
↳ tied to Tx chassis

Transformer - 2 chassis grounds present.
- XO only to swgr gnd bus.

SKV Swgr - no visible external chassis grds.

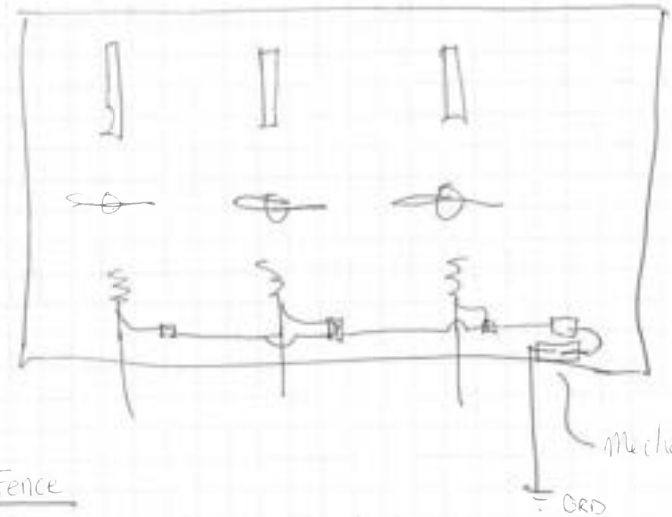


SKV LA's grounded to chassies then to gnd Bus

276KV Swgr - CN taken to gnd then to chassis then out.

(34.5KV Rated.)

- no acknowledgement on intrusion page.



Fence

6' Tall + 3 barbs turned inside

Fabric tight and/or buried

Corner post grds ?

Insp can't every corner and many other locns

main gates not grided

fence/barb grd exceeds 12m

val Hydro

outh - Welsh St D.S.

esent for Mtce — Nov Derek Joe — Eric - FHI

KV Cables - CN directly to grid

KV SB - ground mat buried

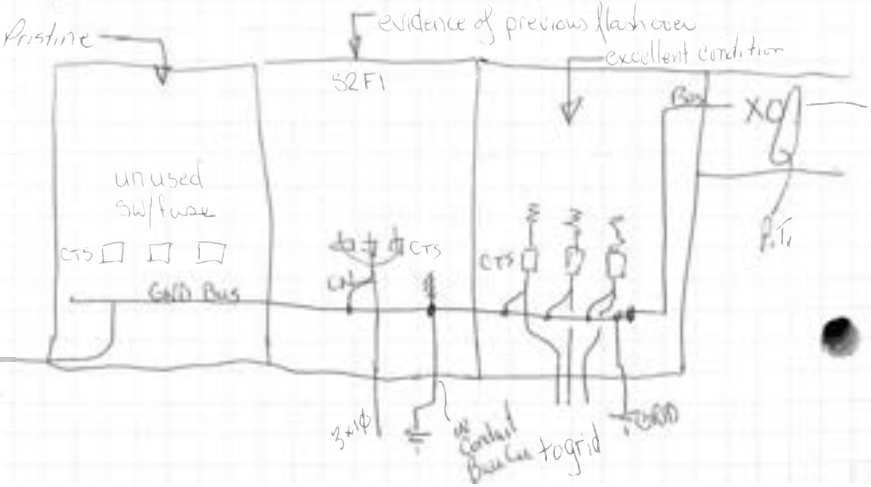
structure lights wiring ?

t lights inside station
↳ properly gnd ? - not visibly gnd

Swgr only one physical chassis ground
↳ tied to Tx chassis

nsformer - 2 chassis grounds present.
- XO only to swgr gnd bus.

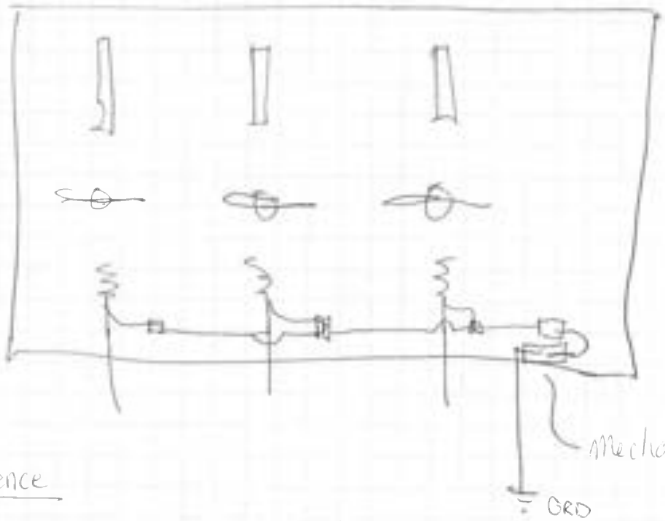
Swgr - no visible external chassis gnds.



SKV LA's grounded to chassies then to gnd Bus

276KV Swgr (345KV Rated.) - CN taken to gnd then to chassis then out

- no anticondensation on interior surf.



Fence

6' Tall + 3 barb turned inside

Fabric tight and/or buried

Corner post gnds ?

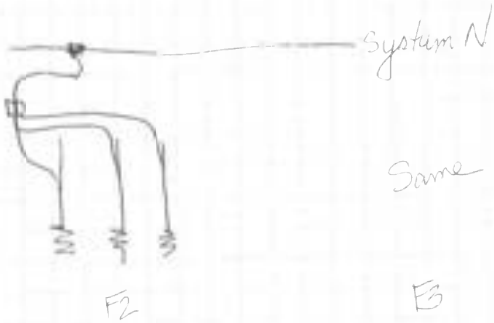
Insp can't every corner and many other locns

main gates not gnded

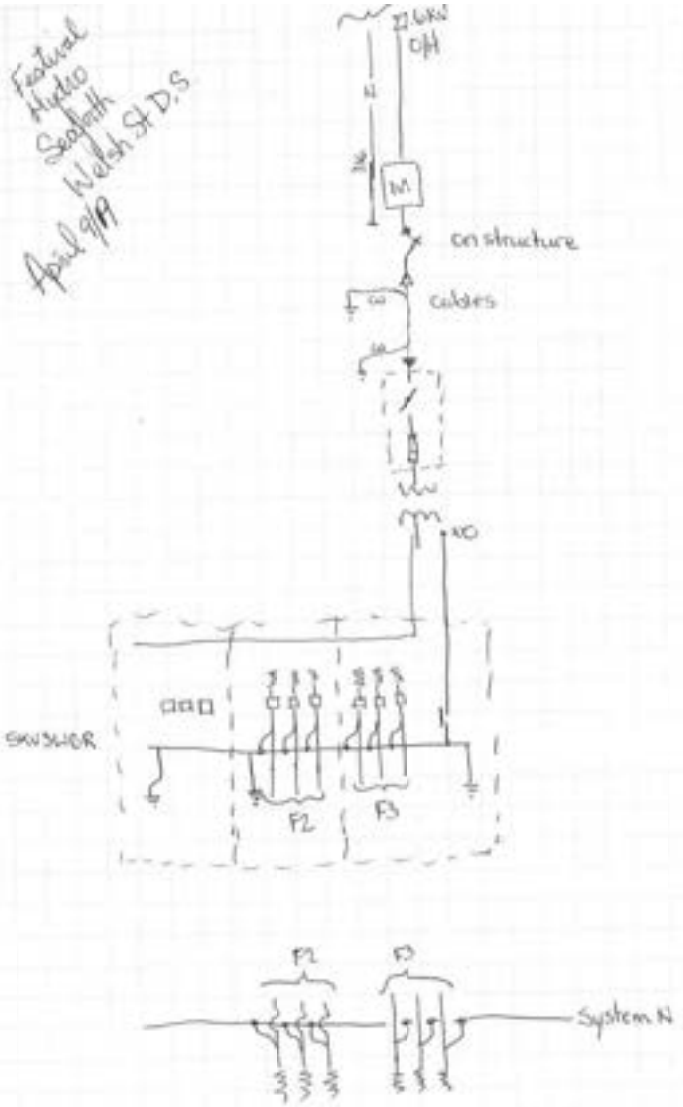
fence/barb gnd exceeds 12m

Old T-bar / barb fence within 8' of stn fence
Outside guard?

Riser Poles

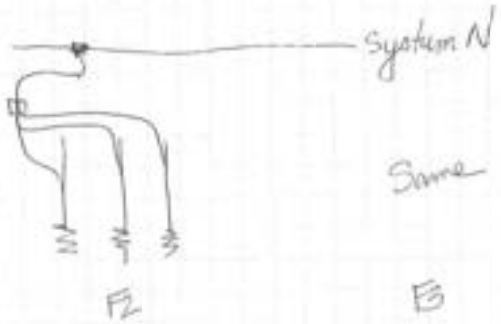


Festival
Hydro
Seaforth
Welsh St D.S
April 9/19

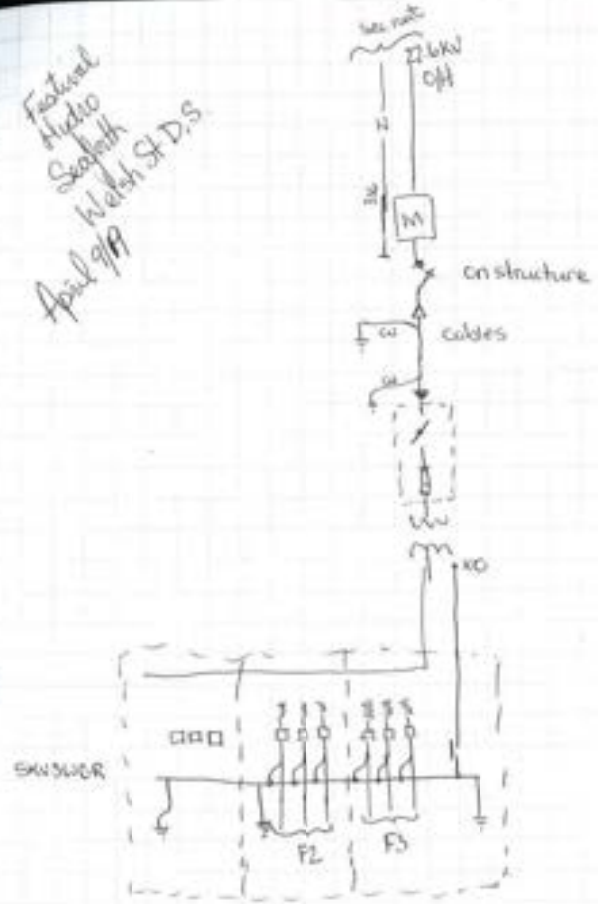


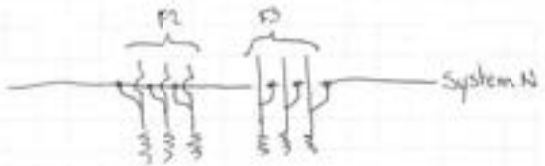
d T-bar/barb fence within 8' of stm fence
tside gnd?

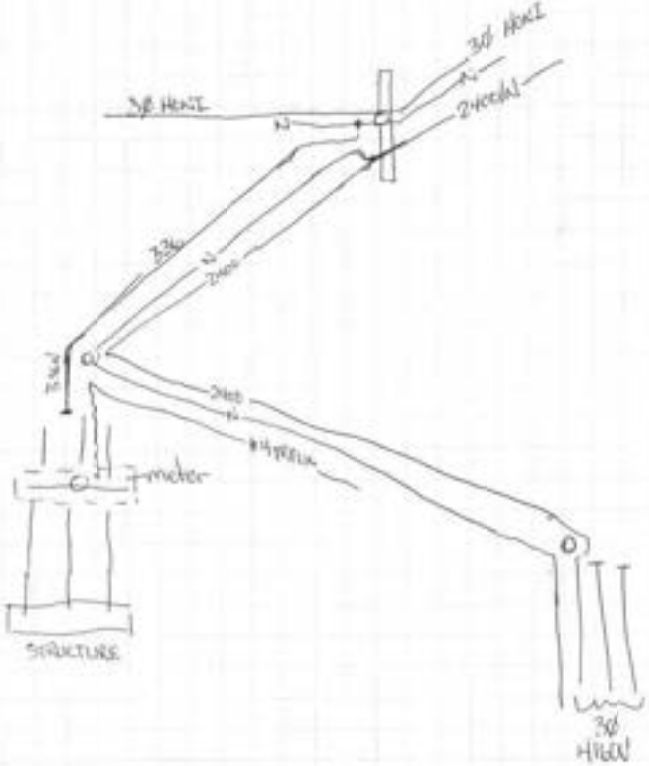
Poles



Festival
Audio
Seaforth
Welsh St D.S
April 9/19



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3Ø HOT
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3 HOT
2 HOT
3 HOT
2 HOT
2 HOT
METER
STRUCTURE
3Ø
HIGH

Appendix C – Equipment Test Reports

2019 Substation Maintenance Report

Welsh Station

26 Welsh Street, Seaforth, ON

Eric Cameron
Fetival Hydro
P.O. Box 397
Stratford, ON

K.P.C. POWER ELECTRICAL LTD. 1111 Burns Street East, Unit 1
Whitby, ON CANADA L1N 6A6
T 905.665.0676
F 905.665.0675
kpcpower.com

April 18, 2019

Festival Hydro
P.O. Box 397
Stratford, On N5A 6T5

ATTENTION: Mr. Eric Cameron
Subject: Welsh Station – Substation Maintenance
Location: 36 Welsh Street, Seaforth, ON
Our Reference: **# 19IM-5103**

Dear Eric,

K.P.C. Power Electrical Ltd. (KPC) completed the Substation Maintenance program at the Welsh Substation located at 36 Welsh Street, Seaforth on April 9, 2019. Please find enclosed our report for your review and comments.

The following sections detail our observations, recommendations and test results, the oil analysis results will follow.

Please feel at liberty to contact our office, should you have any questions or concerns. Thank you for the opportunity to have been of service.

Yours Truly,

Alan See
Substation Technician
K.P.C. Power Electrical Ltd. (KPC)

Table of Contents

DEFICIENCIES AND RECOMMENDATIONS

Festival Hydro – Welsh Substation Preliminary Deficiency Lists

Service date: April 9, 2019

Location: 36 Welsh St, Seaforth, ON

1) Feeder F1 - 5KV switch – evident of flashed over marks:
   - Recommend Phase barriers / Top barrier replacement
   - Carbon marks required thorough cleaning

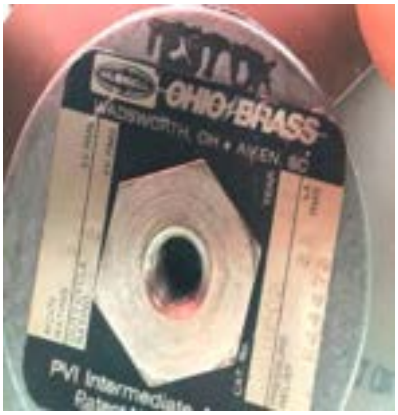
2) Feeders - Lightning Arrestors:
   - No LA's on F1 Feeder.
   - LA's on F2 Feeder - Low insulation reading – around 2 MΩ.
   - LA's on Spare Feeder - Low insulation reading – around 2 MΩ.

3) 27.6 KV Incoming structure
   - Arcing mechanism sluggish – H1 & H3 remained on 'close' position Recommend replacement all (3) Arcing contacts.
   - Nameplate on switch-handle worn – not legible.

4) 27.6 KV LIS Switchgear:
   - Recommend replacement of (3) porcelain LA's
   - Recommend tar on top of switchgear
   - Touch-up of rust surfaces & paint
   - Spare Fuses (3) recommend on site

5) Substation Yard Inspection:
   - Hole in Fence – require repair
   - '1' ground connection on fence required (Building side gate)
   - Barb-wires needs re-tightening
   - Barb-wires corner arm broken

Photos:




CANADIAN BRIDGE COMPANY LTD
NIAGARA FALLS, ONTARIO, CANADA

INSPECTION SHEETS

Client Information

Customer	Festival Hydro			**Date Tested**	04/09/2019		
File Number	19IM-5103	**Customer Ref.**	Eric Cameron	**Ambient Temp**	8	**°C**	
Location	36 Welsh St, Seaforth, ON			**Tested By**	DM		
Substation	Welsh Substation			**Approved By**	VG		
Equipment I.D.	Incoming 27.6 KV Tower						

Lightning Arrester Inspection

Nameplate Data						
Manufacturer	GE			**Voltage**	30	**kVolts**
Cat #	Thyrite Magne-valve Arrestor			**MCOV**	NA	**kVolts**
Serial #	9LA2H16	9LA2H16	9LA2H16	**Duty Cycle Rating**	30	**kVolts**

Capacitance and Power Factor Test							
				Power factor			
Insulation Tested	**Test Mode**	**kV**	**Cap (pF)**	**Measured**	**Cor. to 20°C**	**mA**	**Watts**
CH-G - Aϕ	**GrndST**	NA	NA	NA	NA	NA	NA
CH-G - Bφ	**GrndST**	NA	NA	NA	NA	NA	NA
CH-G - Cφ	**GrndST**	NA	NA	NA	NA	NA	NA

Insulation Resistance (GΩ)				
@	**kVDC**			
Ins. Type	**Solid** / **Oil**	**φ A**	**φ B**	**φ C**
Insulation Res.	**@ 8 °C**	2.3	2.4	2.1
Corrected to 20°C		N/A	N/A	N/A

Mechanical Inspections		
Description of Inspection	**Status**	**Comments**
	OK/FAIR/POOR/NA	
Insulator Surface Condition	OK	Cleaned, Inspected
Connector Condition	OK	Tightened, Inspected
Grounding	OK	Inspected
Support Structure	OK	Sturdy, Inspected

Test Conditions	Disconnected
Results Satisfactory	OK
Test Equipment	AEMC 10KV Megger

Notes:

Client Information

Customer	Festival Hydro			**Date Tested**	04/09/2019	
File Number	19IM-5103	**Customer Ref.**	Eric Cameron	**Ambient Temp**	8	°C
Location	36 Welsh St, Seaforth, ON			**Tested By**	DM/JV	
Substation	Welsh Substation			**Approved By**	VG	
Equipment I.D.	Primary 27.6 KV Switchgear					

Switchgear Assembly Inspection

Nameplate Data				
Manufacturer	S & C	**Voltage**	34.5	**kVolts**
Type	Metal-Enclosed	**Current**	40000	**Amps**
Style/Cat #	CDT-3452456	**B.I.L**	200	**kVolts**
Phase/Wire	3	**Serial #**	NA	

Mechanical Inspections		
Description of Inspection	**Status**	**Comments**
	OK/FAIR/POOR/NA	
Identification / Warning Signs	POOR	Faded. Recommended new switchgear nameplate
Lightning Arresters	OK	Cleaned, tested, inspected
Grounding	OK	Inspected
Bus Support Insulators	OK	Cleaned, Inspected
Bus Torque	OK	Cleaned, torgued
Phase Barriers	NA	
Compartment Barriers	OK	Cleaned, inspected
C.T. Wiring	OK	Inspected
P.T. Wiring	OK	Inspected
Indicating Meters	NA	
Control Wiring	OK	Inspected
Paint Condition	FAIR	Touch-up loose paint some rust.
Mechanical Integrity of Enclosure	OK	Inspected
Heaters	OK	Inspected
Interior Dry	OK	Inspected

Electrical Tests							
Test Description		**φ A**	**φ B**	**φ C**	**A/B**	**B/C**	**C/A**
Insulation Resistance @ 10 kV	**GΩ**	2.535	2.322	2.003	6.2	6.64	8.05
AC Hi-Pot @ kV	**µA**	NA	NA	NA	NA	NA	NA

Test Conditions	Cloudy 8 deg C
Results Satisfactory	OK
Test Equipment	AEMC 10KV Megger

Notes: *1) Some rust - touch up paint (grey). 2) Recommend tar membrance on top of switchgear.

Client Information

Customer	Festival Hydro			**Date Tested**	04/09/2019	
File Number	19IM-5103	**Customer Ref.**	Eric Cameron	**Ambient Temp**	8	**°C**
Location	36 Welsh St, Seaforth, ON			**Tested By**	DM/JV	
Substation	Welsh Substation			**Approved By**	VG	
Equipment I.D.	27.6 KV Primary Switchgear Load Break Switch					

High Voltage Air/Load Break Switch

Nameplate Data				
Manufacturer	S & C	**Voltage**	34.5/38	**kVolt**
Type	Fused Load Interrupter	**Current**	600	**Amps**
Style #	NA	**B.I.L.**	200	**kVolt**
Cat #	QA-48474R9-T2	**Serial #**	NA	

Mechanical Inspections		
Description of Inspection	**Status**	**Comments**
	OK/FAIR/POOR/NA	
Operating Mechanism	OK	Cleaned, grease, inspected.
Stationary Contact Surfaces	OK	Cleaned, grease, inspected.
Moving Contact Surfaces	OK	Cleaned, grease, inspected.
Arcing Contact Surfaces	OK	Cleaned, inspected.
Contact Alignment	OK	Inspected
Arcing Interrupter	OK	Operated and Inspected
Connector Condition	OK	Inspected
Insulator Condition	OK	Cleaned, inspected.
Phase Barrier Condition	NA	NA
Grounding	OK	Inspected
Lightning Arrester	OK	Cleaned, tested, inspected
Gradient Mat	NA	
Key Interlock	OK	Operated, inspected
Heaters & Thermostat	OK	Inspected
Support Structure Condition	NA	
Potential Indicators	NA	

Electrical Tests							
Test Description		**φ A**	**φ B**	**φ C**	**A/B**	**B/C**	**C/A**
Insulation Resistance @ 10 kV	**GΩ**	2.535	2.322	2.003	6.2	6.64	8.05
Contact Resistance @ 10 A	**μΩ**	75	80	79			
NA	**NA**	NA	NA	NA			

Test Conditions	Cloudy 8 deg C
Results Satisfactory	OK
Test Equipment	10KV AEMC Megger, 10A AEMC Micro ohmeter

Notes: Nameplate at switch handle worn- Not legible

Client Information

Customer	Festival Hydro			**Date Tested**	04/09/2019	
File Number	19IM-5103	**Customer Ref.**	Eric Cameron	**Ambient Temp**	8	°C
Location	36 Welsh St, Seaforth, ON			**Tested By**	DM/JV	
Substation	Welsh Substation			**Approved By**	VG	
Equipment I.D.	27.6 KV Primary Switchgear -Fused Protection					

High Voltage Power Fuse

Fuse Holder Nameplate Data				
Manufacturer	S & C	**Max Voltage**	38/34.5	**kVolt**
Type	SM-5C Indoor	**Max Current**	300E	**Amps**
Style/Cat #	86694	**Serial #**	NA	
Fuse Link Nameplate Data				
Type	SM-5	**TCC**	119-4	
Style/Cat #	264275 R3	**Amps**	175E	

Mechanical Inspections

Description of Inspection	**Status**	**Comments**
	OK/FAIR/POOR/NA	
Operating Mechanism	OK	Operated, inspected
Contact Surfaces	OK	Cleaned, greased, inspected
Contact Penetration	OK	Inspected
Contact Alignment	OK	Inspected
Expulsion-Limiting Filters	OK	Inspected
Fuse Barrel Condition	OK	Cleaned, inspected
Connecter Condition	OK	Inspected
Insulator Condition	OK	Cleaned, inspected
Phase Barrier Condition	NA	
Support Structure	OK	Sturdy, inspected
Heaters & Thermostat	OK	inspected
Spare Fuse Quality	NA	
Spare Fuse Quantity	*Note	

Electrical Tests

Test Description		**φ A**	**φ B**	**φ C**	**A/B**	**B/C**	**C/A**
Insulation Resistance @ 10 kV	**GΩ**	2.353	2.322	2.003	6.2	6.64	8.05
Contact Resistance @ 10 A	**μΩ**	540	550	547			

Test Conditions	Cloudy 8 deg C
Results Satisfactory	OK
Test Equipment	10KV AEMC Megger, 10A AEMC Micro ohmeter

Notes: * Recommend (3) spare fuses on site.

Client Information

Customer	Festival Hydro			**Date Tested**	04/09/2019		
File Number	19IM-5103	**Customer Ref.**	Eric Cameron	**Ambient Temp**	8	**°C**	
Location	36 Welsh St, Seaforth, ON			**Tested By**	DM/JV		
Substation	Welsh Substation			**Approved By**	VG		
Equipment I.D.	27.6 KV Primary Switchgear -Surge Protection						

Lightning Arrester Inspection

Nameplate Data					
Manufacturer	Ohio Brass		**Voltage**	30	**kVolts**
Cat #	46719		**MCOV**		**kVolts**
Serial #	3DGPC649		**Duty Cycle Rating**		**kVolts**

Capacitance and Power Factor Test							
				Power factor			
Insulation Tested	**Test Mode**	**kV**	**Cap (pF)**	**Measured**	**Cor. to 20°C**	**mA**	**Watts**
CH-G - Aϕ	**GrndST**	NA	NA	NA	NA	NA	NA
CH-G - Bφ	**GrndST**	NA	NA	NA	NA	NA	NA
CH-G - Cφ	**GrndST**	NA	NA	NA	NA	NA	NA

Insulation Resistance (GΩ)				
@	**kVDC**			
Ins. Type	**X** Solid / Oil	**φ A**	**φ B**	**φ C**
Insulation Res.	**@ 8 °C**	0.8	0.788	0.577
Corrected to 20°C		NA	NA	NA

Mechanical Inspections		
Description of Inspection	**Status**	**Comments**
	OK/FAIR/POOR/NA	
Insulator Surface Condition	OK	Cleaned, inspected
Connector Condition	OK	Tightened, inspected
Grounding	OK	Inspected
Support Structure	OK	Sturdy, inspected

Test Conditions	Disconnected
Results Satisfactory	OK
Test Equipment	10KV AEMC Megger

Notes:

Client Information

Customer	Festival Hydro			**Date Tested**	04/09/2019
File Number	19IM-5103	**Customer Ref.**	Eric Cameron	**Ambient Temp**	8 °C
Location	36 Welsh St, Seaforth, ON			**Tested By**	AS
Substation	Welsh Substation			**Approved By**	VG
Equipment I.D.	Main Transformer				

Power Transformer - Electrical

Nameplate Data

Manufacturer	Westinghouse			**Vector Group**	DYN11		**NGR**		**Solid** X
Year Built	1966			**Serial #**	293394		**Res.**	NA	**Ω**
Type	ONS			**Liquid Type/Volume**	Mineral oil		4429		**L.**
Sealed		**Conservator**	X	**Dry Type**		**Total Weight**	15355		**Kg.**
Rating	5000		**kVA**			**Primary Voltage**	27.6		**kVolts**
Impedance	5.65		**%**			**Secondary Voltage**	4160Y/2402		**Volts**
Phase	3		**φ**			**BIL (Primary)**	200 **kV**	**BIL (Secondary)**	75 **kV**
Oil Temp	18 **°C**	**Max Oil Temp**	45 **°C**			**Winding Temp**	NA **°C**	**Max Winding Temp**	NA **°C**

Insulation Resistance

Test Voltage	**Hi**	**10**	**Low**	**5**	**kVdc**	**H to L + Grnd**	**L to H + Grnd**	**H to L**	**Core**
GΩ @ 8 °C						41.9	21.7	43.2	NA
Corrected to 20 °C						NA	NA	NA	NA

Capacitance & Dissipation Factor

Test Voltage	**High**		**Low**		$C_{H-L} + C_{H-G}$	C_{H-G}	C_{H-L}	C_{L-G}	$C_{L-H} + C_{L-G}$
Capacitance (pF)									
Current (mA)	PLEASE SEE OMICRON TEST REPORT								
Watts (W)									
Power Factor									
Corrected to 20 °C									

Turns Ratio Test

Tap	**Primary Volts**	**Calculated Ratio**	**H1-H2 X0-X1**			**H2-H3 X0-X2**			**H3-H1 X0-X3**		
			Ratio	**Dev%**	**mA**	**Ratio**	**Dev%**	**mA**	**Ratio**	**Dev%**	**mA**
1											
2			PLEASE SEE OMICRON TEST REPORT								
3											
4											
5											

Winding Resistance

Tap	**Current Scale**	**Resistance Unit**	**H1-H2**	**H2-H3**	**H3-H1**	**X0-X1**	**X0-X2**	**X0-X3**
			PLEASE SEE OMICRON TEST REPORT					

Tap Position Found & Left	2
Results Satisfactory	OK
Test Equipment	Omicron Testrano 600, AEMC 10KV Megger

Notes:

Client Information

Customer	Festival Hydro			**Date Tested**	04/09/2019	
File Number	19IM-5103	**Customer Ref.**	Eric Cameron	**Ambient Temp**	8	°C
Location	36 Welsh St, Seaforth, ON			**Tested By**	AS	
Substation	Welsh Substation			**Approved By**	VG	
Equipment I.D.	Main Transformer					

Power Transformer (Liquid Filled) - Mechanical

Mechanical Inspections								
Description of Inspection		**Status**				**Comments**		
		OK/FAIR/POOR/NA						
Breather & Silica Gel		NA						
Conservator Tank Gaskets		OK				Inspected		
Explosion Vent Gaskets		OK				Inspected		
Inspection Cover Gaskets		OK				Inspected		
Main Cover Gaskets		OK				Inspected		
Primary Bushing Gaskets		OK				Inspected		
Primary Bushing Porcelain		OK				Cleaned, Inspected		
Primary Bushing Connections		OK				Tightened, Inspected		
Primary Throat Gaskets		OK				Inspected		
Secondary Bushing Gaskets		OK				Inspected		
Secondary Bushing Porcelain		OK				Cleaned, Inspected		
Secondary Bushing Connections		OK				Tightened, Inspected		
Secondary Throat Gaskets		OK				Inspected		
Pressure Relief Device		OK				Inspected	**PSI**	NA
Gas Relay		NA				Not available for this transformer		
Fan Operation		NA				Not available for this transformer		
Control Wiring		OK				Inspected		
Tap Changer		OK				As Found & Left @ Tap 2		
Paint Condition		**POOR**				Roof is rusting	**Colour**	Grey
Pads		OK				Inspected		
Grounding		OK				Inspected		
Radiator		OK				Inspected		
Oil Level		OK				Inspected		
Pressure Gauge		NA						
Oil Temperature Gauge		FAIR				Condensation inside		
Winding Temperature Gauge		NA						
Oil Temperature	**Run | Max**	12	°C	45	°C			
Winding Temperature	**Run | Max**	NA	°C	NA	°C			

Results Satisfactory	FAIR
Test Equipment	NA

Notes: Samples taken sent to Weidmann Lab.

Client Information

Customer	Festival Hydro			**Date Tested**	04/09/2019	
File Number	19IM-5103	**Customer Ref.**	Eric Cameron	**Ambient Temp**	8	°C
Location	36 Welsh St, Seaforth, ON			**Tested By**	AS/JV	
Substation	Welsh Substation			**Approved By**	VG	
Equipment I.D.	F1 Feeder					

High Voltage Air/Load Break Switch

Nameplate Data				
Manufacturer	S & C	**Voltage**	4.8-5.5	**kVolt**
Type	MINI-RUPTER SWITCH	**Current**	600	**Amps**
Style #	NA	**B.I.L.**	200	**kVolt**
Cat #	255700R1-C	**Serial #**	NA	

Mechanical Inspections		
Description of Inspection	**Status**	**Comments**
	OK/FAIR/POOR/NA	
Operating Mechanism	OK	Cleaned, grease, inspected.
Stationary Contact Surfaces	OK	Cleaned, grease, inspected.
Moving Contact Surfaces	OK	Cleaned, grease, inspected.
Arcing Contact Surfaces	OK	Cleaned, inspected.
Contact Alignment	OK	Inspected
Arcing Interrupter	OK	Operated and Inspected
Connector Condition	OK	Inspected
Insulator Condition	OK	Cleaned, inspected.
Phase Barrier Condition	POOR	*Recommend replacement of phase barriers etc
Grounding	OK	Inspected
Lightning Arrester	POOR	NO LA's present. Recommend LA's install.
Gradient Mat	NA	
Key Interlock	NA	
Heaters & Thermostat	NT	
Support Structure Condition	NA	
Potential Indicators	NA	

Electrical Tests							
Test Description		**φ A**	**φ B**	**φ C**	**A/B**	**B/C**	**C/A**
Insulation Resistance @ 5 kV	**GΩ**	2.05	2.15	1.92	3.5	3.65	2.85
Contact Resistance @ 10 A	**μΩ**	94	85	93			
NA	**NA**	NA	NA	NA			

Test Conditions	Cloudy 8 deg C
Results Satisfactory	OK
Test Equipment	10KV AEMC Megger, 10A AEMC Micro ohmeter

Notes: *Evident of flash-over marks on switch compartment. Recommend replacement of glastic barriers and thorough cleaning are required (glastic size 1/8)

Client Information

Customer	Festival Hydro			**Date Tested**	04/09/2019	
File Number	19IM-5103	**Customer Ref.**	Eric Cameron	**Ambient Temp**	8	°C
Location	36 Welsh St, Seaforth, ON			**Tested By**	DM/JV	
Substation	Welsh Substation			**Approved By**	VG	
Equipment I.D.	F1 Feeder					

High Voltage Power Fuse

Fuse Holder Nameplate Data				
Manufacturer	S & C	**Max Voltage**	4.8-5.5	**kVolt**
Type	SM-40	**Max Current**		**Amps**
Style/Cat #		**Serial #**	NA	
Fuse Link Nameplate Data				
Type	SMU-40	**TCC**	153-2	
Style/Cat #		**Amps**	300E	

Mechanical Inspections

Description of Inspection	Status	Comments
	OK/FAIR/POOR/NA	
Operating Mechanism	OK	Operated, inspected
Contact Surfaces	OK	Cleaned, greased, inspected
Contact Penetration	OK	Inspected
Contact Alignment	OK	Inspected
Expulsion-Limiting Filters	OK	Inspected
Fuse Barrel Condition	OK	Cleaned, inspected
Connecter Condition	OK	Inspected
Insulator Condition	OK	Cleaned, inspected
Phase Barrier Condition	NA	
Support Structure	OK	Sturdy, inspected
Heaters & Thermostat	NT	inspected
Spare Fuse Quality	OK	
Spare Fuse Quantity	3	

Electrical Tests

Test Description		φ A	φ B	φ C	A/B	B/C	C/A
Insulation Resistance @ 10 kV	**GΩ**	2.05	2.15	1.92	3.5	3.65	2.85
Contact Resistance @ 10 A	**μΩ**	419	412	416			
PT Fuses Resistance	**Ω**	7.3	7.4	7.4			

Test Conditions	Cloudy 8 deg C
Results Satisfactory	OK
Test Equipment	10KV AEMC Megger, 10A AEMC Micro ohmeter, Fluke Digital Meter

Notes: PT Fuse information: Cat # 270000, 4.8KV, 0.5E, TCC 159-9.
(One spare fuse in the PT's compartment)

Client Information

Customer	Festival Hydro			**Date Tested**	04/09/2019	
File Number	19IM-5103	**Customer Ref.**	Eric Cameron	**Ambient Temp**	8	°C
Location	36 Welsh St, Seaforth, ON			**Tested By**	AS/JV	
Substation	Welsh Substation			**Approved By**	VG	
Equipment I.D.	F2 Feeder					

High Voltage Air/Load Break Switch

Nameplate Data				
Manufacturer	S & C	**Voltage**	4.8-5.5	**kVolt**
Type	MINI-RUPTER SWITCH	**Current**	600	**Amps**
Style #	NA	**B.I.L.**	200	**kVolt**
Cat #	255700R1-C	**Serial #**	NA	

Mechanical Inspections		
Description of Inspection	**Status**	**Comments**
	OK/FAIR/POOR/NA	
Operating Mechanism	OK	Cleaned, grease, inspected.
Stationary Contact Surfaces	OK	Cleaned, grease, inspected.
Moving Contact Surfaces	OK	Cleaned, grease, inspected.
Arcing Contact Surfaces	OK	Cleaned, inspected.
Contact Alignment	OK	Inspected
Arcing Interrupter	OK	Operated and Inspected
Connector Condition	OK	Inspected
Insulator Condition	OK	Cleaned, inspected.
Phase Barrier Condition	OK	Cleaned , inspected
Grounding	OK	Inspected
Lightning Arrester	FAIR	Low IR reading. Recommend replacement existing 3 units
Gradient Mat	NA	
Key Interlock	NA	Operated, inspected
Heaters & Thermostat	NT	Inspected
Support Structure Condition	NA	
Potential Indicators	NA	

Electrical Tests							
Test Description		**φ A**	**φ B**	**φ C**	**A/B**	**B/C**	**C/A**
Insulation Resistance @ 5 kV	**GΩ**	4.65	6.8	3.8	6.75	8.65	5.21
Contact Resistance @ 10 A	**μΩ**	92	96	98			
NA	**NA**	NA	NA	NA			

Test Conditions	Cloudy 8 deg C
Results Satisfactory	OK
Test Equipment	10KV AEMC Megger, 10A AEMC Micro ohmeter

Notes:

Client Information

Customer	Festival Hydro			**Date Tested**	04/09/2019	
File Number	19IM-5103	**Customer Ref.**	Eric Cameron	**Ambient Temp**	8	°C
Location	36 Welsh St, Seaforth, ON			**Tested By**	DM/JV	
Substation	Welsh Substation			**Approved By**	VG	
Equipment I.D.	F2 Feeder					

High Voltage Power Fuse

Fuse Holder Nameplate Data				
Manufacturer	S & C	**Max Voltage**	4.8-5.5	**kVolt**
Type	SM-40	**Max Current**		**Amps**
Style/Cat #		**Serial #**	NA	
Fuse Link Nameplate Data				
Type	SMU-40	**TCC**	153-2	
Style/Cat #		**Amps**	300E	

Mechanical Inspections

Description of Inspection	Status	Comments
	OK/FAIR/POOR/NA	
Operating Mechanism	OK	Operated, inspected
Contact Surfaces	OK	Cleaned, greased, inspected
Contact Penetration	OK	Inspected
Contact Alignment	OK	Inspected
Expulsion-Limiting Filters	OK	Inspected
Fuse Barrel Condition	OK	Cleaned, inspected
Connecter Condition	OK	Inspected
Insulator Condition	OK	Cleaned, inspected
Phase Barrier Condition	NA	
Support Structure	OK	Sturdy, inspected
Heaters & Thermostat	NT	inspected
Spare Fuse Quality	OK	
Spare Fuse Quantity	3	

Electrical Tests

Test Description		φ A	φ B	φ C	A/B	B/C	C/A
Insulation Resistance @ 10 kV	**GΩ**	4.65	6.8	3.8	6.75	8.65	5.21
Contact Resistance @ 10 A	**μΩ**	221	218	238			

Test Conditions	Cloudy 8 deg C
Results Satisfactory	OK
Test Equipment	10KV AEMC Megger, 10A AEMC Micro ohmeter

Notes:

Client Information

Customer	Festival Hydro			**Date Tested**	04/09/2019		
File Number	19IM-5103	**Customer Ref.**	Eric Cameron	**Ambient Temp**	8	**°C**	
Location	36 Welsh St, Seaforth, ON			**Tested By**	AS		
Substation	Welsh Substation			**Approved By**	VG		
Equipment I.D.	F2 Feeder						

Lightning Arrester Inspection

Nameplate Data					
Manufacturer	Ohio Brass	**Voltage**	5	**kVolts**	
Cat #	300002	**MCOV**	2.55	**kVolts**	
Serial #		**Duty Cycle Rating**	3	**kVolts**	

Capacitance and Power Factor Test							
				Power factor			
Insulation Tested	**Test Mode**	**kV**	**Cap (pF)**	**Measured**	**Cor. to 20°C**	**mA**	**Watts**
CH-G - Aϕ	**GrndST**	NA	NA	NA	NA	NA	NA
CH-G - Bφ	**GrndST**	NA	NA	NA	NA	NA	NA
CH-G - Cφ	**GrndST**	NA	NA	NA	NA	NA	NA

Insulation Resistance (GΩ)				
@ 5 kVDC				
Ins. Type	**X Solid / Oil**	**φ A**	**φ B**	**φ C**
Insulation Res.	**@ 8 °C**	0.002133	0.002171	0.00206
Corrected to 20°C		NA	NA	NA

Mechanical Inspections		
Description of Inspection	**Status**	**Comments**
	OK/FAIR/POOR/NA	
Insulator Surface Condition	***POOR**	Polymer Surfaces degrading. Recommend replacement
Connector Condition	OK	Inspected
Grounding	OK	Inspected
Support Structure	OK	Inspected

Test Conditions	Cloudy 8 deg C
Results Satisfactory	**POOR**
Test Equipment	10KV AEMC Megger, 10A AEMC Micro ohmeter

Notes: * Recommend replacement of (3) Lightning Arrestors

Client Information

Customer	Festival Hydro			**Date Tested**	04/09/2019	
File Number	19IM-5103	**Customer Ref.**	Eric Cameron	**Ambient Temp**	8	**°C**
Location	36 Welsh St, Seaforth, ON			**Tested By**	AS/JV	
Substation	Welsh Substation			**Approved By**	VG	
Equipment I.D.	Spare Feeder					

High Voltage Air/Load Break Switch

Nameplate Data				
Manufacturer	S & C	**Voltage**	4.8-5.5	**kVolt**
Type	MINI-RUPTER SWITCH	**Current**	600	**Amps**
Style #	NA	**B.I.L.**	200	**kVolt**
Cat #	255700R1-C	**Serial #**	NA	

Mechanical Inspections		
Description of Inspection	**Status**	**Comments**
	OK/FAIR/POOR/NA	
Operating Mechanism	OK	Cleaned, grease, inspected.
Stationary Contact Surfaces	OK	Cleaned, grease, inspected.
Moving Contact Surfaces	OK	Cleaned, grease, inspected.
Arcing Contact Surfaces	OK	Cleaned, inspected.
Contact Alignment	OK	Inspected
Arcing Interrupter	OK	Operated and Inspected
Connector Condition	OK	Inspected
Insulator Condition	OK	Cleaned, inspected.
Phase Barrier Condition	OK	Cleaned , inspected
Grounding	OK	Inspected
Lightning Arrester	FAIR	Low IR reading. Recommend replacement existing 3 units
Gradient Mat	NA	
Key Interlock	NA	Operated, inspected
Heaters & Thermostat	NT	Inspected
Support Structure Condition	NA	
Potential Indicators	NA	

Electrical Tests							
Test Description		**φ A**	**φ B**	**φ C**	**A/B**	**B/C**	**C/A**
Insulation Resistance @ 5 kV	**GΩ**	4.85	5.8	4.6	6.47	8.38	5.4
Contact Resistance @ 10 A	**μΩ**	88	94	96			
NA	**NA**	NA	NA	NA			

Test Conditions	Cloudy 8 deg C
Results Satisfactory	OK
Test Equipment	10KV AEMC Megger, 10A AEMC Micro ohmeter

Notes:

Client Information

Customer	Festival Hydro			**Date Tested**	04/09/2019		
File Number	19IM-5103	**Customer Ref.**	Eric Cameron	**Ambient Temp**	8	**°C**	
Location	36 Welsh St, Seaforth, ON			**Tested By**	AS		
Substation	Welsh Substation			**Approved By**	VG		
Equipment I.D.	Spare Feeder						

Lightning Arrester Inspection

Nameplate Data					
Manufacturer	Ohio Brass	**Voltage**	5	**kVolts**	
Cat #	300002	**MCOV**	2.55	**kVolts**	
Serial #		**Duty Cycle Rating**	3	**kVolts**	

Capacitance and Power Factor Test							
				Power factor			
Insulation Tested	**Test Mode**	**kV**	**Cap (pF)**	**Measured**	**Cor. to 20°C**	**mA**	**Watts**
CH-G - Aϕ	**GrndST**	NA	NA	NA	NA	NA	NA
CH-G - Bφ	**GrndST**	NA	NA	NA	NA	NA	NA
CH-G - Cφ	**GrndST**	NA	NA	NA	NA	NA	NA

Insulation Resistance (GΩ)				
@ 5 kVDC				
Ins. Type	**X Solid / Oil**	**φ A**	**φ B**	**φ C**
Insulation Res.	**@ 8 °C**	0.002133	0.002116	0.002163
Corrected to 20°C		NA	NA	NA

Mechanical Inspections		
Description of Inspection	**Status**	**Comments**
	OK/FAIR/POOR/NA	
Insulator Surface Condition	***POOR**	Polymer Surfaces degrading. Recommend replacement
Connector Condition	OK	Inspected
Grounding	OK	Inspected
Support Structure	OK	Inspected

Test Conditions	Cloudy 8 deg C
Results Satisfactory	**POOR**
Test Equipment	10KV AEMC Megger, 10A AEMC Micro ohmeter

Notes: * Recommend replacement of (3) Lightning Arrestors

Client Information

Customer	Festival Hydro			**Date Tested**	04/09/2019	
File Number	19IM-5103	**Customer Ref.**	Eric Cameron	**Ambient Temp**	8	°C
Location	36 Welsh St, Seaforth, ON			**Tested By**	DM	
Substation	Welsh Substation			**Approved By**	VG	
Equipment I.D.	Varied					

Power Cable Inspection

Nameplate Data				
Manufacturer	NA	**Voltage**	NA	**kVolts**
Insulation Type	NA	**Ambient Temp**	8	**°C**
Conductor Type	NA	**Humidity**	60	**%**

Electrical Tests

Feeder Identification	**Cables Per φ**	**Insulation Resistance (GΩ)** Aφ	Bφ	Cφ	A/B	B/C	**Tested @** Varied **kV** C/A
Tower Primary Cables	1	2.535	2.322	2.003	6.2	6.64	8.05
F1 Cables - 5KV	1	911	1.021	78.4	1206	538	523
F2 Cables - 5KV	1	163.7	210	156.6	3116	1400	515
5KV Sec-Bus-Bars	1	1757	924	149	753	1700	879

Test Conditions	Cloudy 8 deg C
Results Satisfactory	OK
Test Equipment	AEMC 10KV Megger

Notes: Cables information are not available - Faded

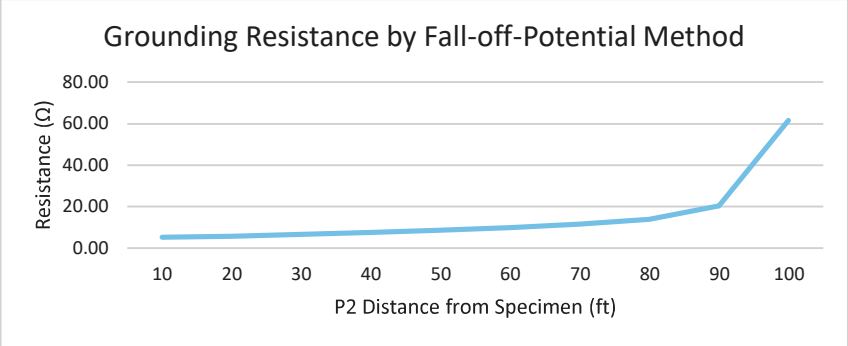
Client Information

Customer	Festival Hydro			**Date Tested**	04/09/2019	
File Number	19IM-5103	**Customer Ref.**	Eric Cameron	**Ambient Temp**	8	**°C**
Location	36 Welsh St, Seaforth, ON			**Tested By**	DM	
Substation	Welsh Substation			**Approved By**	VG	
Equipment I.D.	Substation Ground Resistance					

Equipment Ground Resistance

Test Conditions	
Soil Surface Type	Homogeneous
Ground Condition	wet (soaked)
Weather Condition	Cloudy 60% humidity

Electrical Tests



Distance of C2 from Specimen (ft)	Distance of P2 from Specimen (ft)	Resistance (Ω)
100	10	5.32
100	20	5.88
100	30	6.70
100	40	7.60
100	50	8.72
100	60	9.92
100	70	11.70
100	80	14.00
100	90	20.50
100	100	61.50

Results Satisfactory	OK
Test Equipment	Ground Tester

Notes:

Client Information

Customer	Festival Hydro			**Date Tested**	04/09/2019	
File Number	19IM-5103	**Customer Ref.**	Eric Cameron	**Ambient Temp**	8	**°C**
Location	36 Welsh St, Seaforth, ON			**Tested By**	DM	
Substation	Welsh Substation			**Approved By**	VG	
Equipment I.D.	Substation Equipment - Ground Resistance					

Equipment Ground Resistance

Electrical Tests			
Equipment Tested	**Points Tested**	**Measured Value (Ω)**	**Measured - Control (Ω)**
Transformer		7.68	
Primary Switchgear		7.67	
Secondary Switchgear		8.54	
Tower Switch handle		7.69	
Fence (Facing from Road)	Front Gate, Right side	9.95	
	Right side gate	8.1	
	Right side	2.85	
	Back side	2.9	
	Left side	2.5	
	Front side	2.54	
	Front gate Left side	2.9	

Test Conditions	Cloudy 8 deg C
Results Satisfactory	OK
Test Equipment	Ground Tester

Notes:

Client Information

Customer	Festival Hydro			**Date Tested**	04/09/2019	
File Number	19IM-5103	**Customer Ref.**	Eric Cameron	**Ambient Temp**	8	°C
Location	36 Welsh St, Seaforth, ON			**Tested By**	DM	
Substation	Welsh Substation			**Approved By**	VG	
Equipment I.D.	Substation General Inspection					

Substation Yard General Inspection

Mechanical Inspections		
Description of Inspection	**Status**	**Comments**
	OK/FAIR/POOR/NA	
Tower Structure	OK	Inspected
Metal Enclosed Switchgear	OK	Inspected
Identification Signs	OK	Inspected
Warning Signs	OK	Inspected
Yard Debris	Fair	* spare electrical equipment in Substation-Not grounded
Weed Control	Fair	
Ground Connections on Tower	OK	Inspected
Ground Connections on Switchgear	OK	Inspected
Ground Connections on Fence	Fair	*One needed - Building site gate
Ground Connections on Gates	OK	Inspected
Ground Connections on Arresters	OK	Inspected
Ground Connections on Transformer(s)	OK	2 points - Inspected
Ground Grid + Rods Intact	OK	Inspected
Gradient Mat	OK	Inspected
Fence Assembly	**POOR**	Holes in Fence - Require repair
Barbed Wire	Fair	Tighten barb wire, no rust present
Crushed Stone Depth	OK	Level off next maintenance

Lightning Arresters				
Manufacturer	General Electric	**Voltage**	30	**kVolts**
Type/Cat #	Thyrite Magne-valve Arrestor	**MCOV**	NA	**kVolts**

Electrical Tests		
Test Description		
Ground Resistance	**Ω**	OK

Test Conditions	Cloudy 8 deg C
Results Satisfactory	**Poor** - see recommendations
Test Equipment	

Notes:

OMICRON TEST RESULTS

Festival Hydro -Welsh Substation

Client	Festival Hydro	4/9/2019 -36 Welsh St	
Execution date	4/9/2019	Reason of the job	Pre-maintenance
Tested by	AS	Location	36 Welsh St, Seaforth
Approved by	VG	Asset	Transformer
Report ID	1	Asset type	Two-winding
Report issue date	4/10/2019 2:39:01 PM	Asset serial number	293394
Work order	19IM-5103	Manufacturer	Westinghouse

Summary

As Found & Left @ Tap 2

Insulation Resistance :
H-G=41.9G @ 10KVDC
L-G=21.7G @ 5KVDC
H-L=43.2G@ 5KVDC

Polarization Index (PI):
H-G=41.9G / 6.2G = 6.75
L-G=21.7G / 5.5G = 3.94
H-L=43.2G / 8.65G =4.994

Performed tests	Assessment
Winding PF & CAP	Manual pass
Exciting Current	Manual pass
Turns Ratio test Prim-Sec	Pass
DC Winding Resistance Prim	Pass
DC Winding Resistance Sec	Pass

Overall Assessment	Satisfactory

Tested by:

AS

Approved by:

VG

Location & company information

Location	
Name	Welsh Substation
Region	
Division	
Area	
Plant	
Address	36 Welsh St,
City	Seaforth
State/Province	ON
Postal code	
Country	

Company	
Company	Festival Hydro
Department	
Address	
City	
State/Province	
Postal code	
Country	
Phone No.	
Fax No.	
E-mail	

Geo coordinates	

Contact person	
Name	Eric Cameron
Phone No. 1	519-274-3748
Phone No. 2	
Fax No.	
E-mail	

Comment
Tested as Found & Left @ Tap 2

Transformer nameplate data

Serial number	293394	Apparatus ID	
Manufacturer	Westinghouse	Feeder	
Manufacturing year	1966	No. phases	3
Manufacturer type		Vector group	Dyn11

Comment

As Found & Left @ Tap 2

Voltage ratings

Winding	Voltage L-L	Voltage L-N	Insul. level L-L
Prim	27.600 kV	kV	200 kV
Sec	4.160 kV	2.402 kV	75 kV

Power ratings

Rated power	Cooling class	Temp. rise wind.
MVA	ONAN	55

Current ratings at rated power

Winding		
Prim	Sec	Rated power
107.000 A	694.000 A	MVA

Short-circuit rating

Max. short-circuit current	kA	s

Impedances	
Ref. temp.	75 °C

Short-circuit impedance Prim - Sec					
uk[%]	Base power	Base voltage	Load losses Pk	OLTC position	DETC position
5.650 %	5.000 MVA	27.600 kV	W		

Zero sequence impedance	
Base power	5.00 MVA
Base voltage	27.600 kV
Description	Z0[%]
Secondary	5.65 %

Others	
Status	In operation
Tank type	Sealed conservator
Insulation medium	Mineral oil
Fluid insulation volume	4429 l
Fluid insulation weight	4559 kg
Total weight	15354 kg

Test set information

Model	Serial number	Calibration date
TESTRANO 600	DL325X	2018-12-06
CP TD1	RM229Z	2018-12-02

Global test conditions

Weather	Cloudy	Humidity	30 %
Unit location	Outside	Ambient temperature	10 °C

Winding PF & CAP

Ambient temperature	10 °C	Weather	Cloudy
Top oil temperature	10 °C	Humidity	30 %

Comments

Standard test

Block 1: injection at Prim

Corr. temperature	20 °C
Corr. factor	1

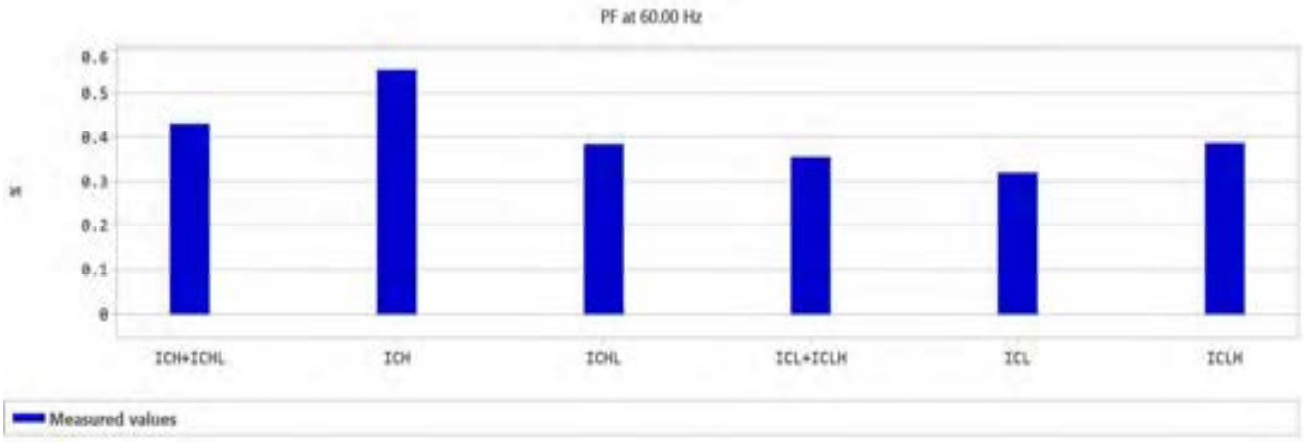
No.	Meas.	Test mode	Freq.	V out	I out	Watt losses	PF meas	PF corr	Cap. meas	Assessment
1	ICH+ICHL	GST	60.00 Hz	10.00 kV	29.66 mA	1276.10 mW	0.4303 %	0.4303 %	7864.7 pF	Pass
2	ICH	GSTg-A	60.00 Hz	10.00 kV	7.94 mA	438.95 mW	0.5530 %	0.5530 %	2102.9 pF	Man. pass
3	ICHL	UST-A	60.00 Hz	10.00 kV	21.72 mA	831.67 mW	0.3829 %	0.3829 %	5762.3 pF	Pass

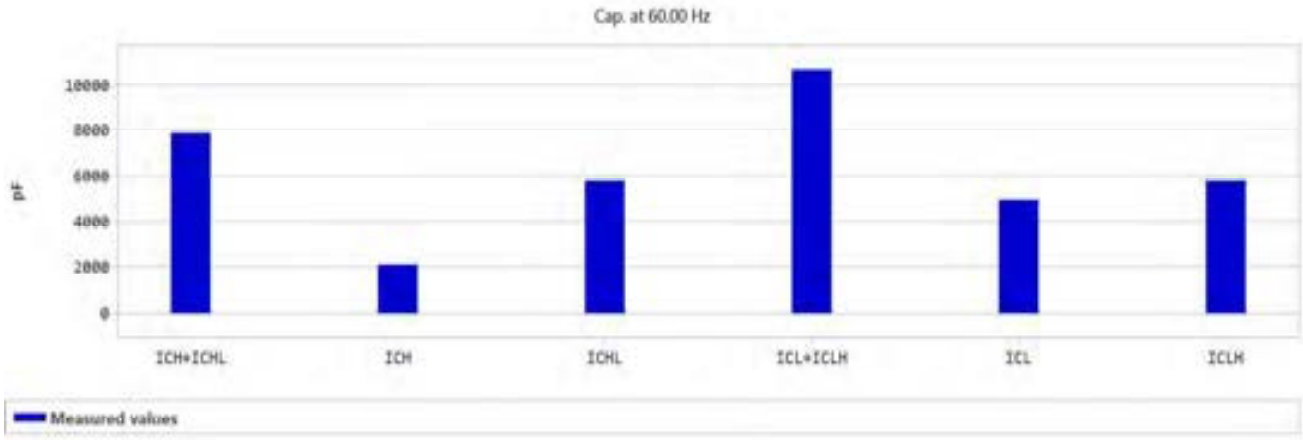
Block 2: injection at Sec

Corr. temperature	20 °C
Corr. factor	1

No.	Meas.	Test mode	Freq.	V out	I out	Watt losses	PF meas	PF corr	Cap. meas	Assessment
4	ICL+ICLH	GST	60.00 Hz	2.00 kV	8.07 mA	57.18 mW	0.3545 %	0.3545 %	10694.1 pF	Pass
5	ICL	GSTg-A	60.00 Hz	2.00 kV	3.72 mA	23.77 mW	0.3195 %	0.3195 %	4930.4 pF	Pass
6	ICLH	UST-A	60.00 Hz	2.00 kV	4.34 mA	33.51 mW	0.3857 %	0.3857 %	5763.7 pF	Pass

Graphs for standard test




Cap. at 60.00 Hz
pF
10000
8000
6000
4000
2000
0
ICH+ICHL
ICH
ICHL
ICL+ICLH
ICL
ICLH
Measured values

Test set information

Model	Serial number	Calibration date
TESTRANO 600	DL325X	2018-12-06
CP TD1	RM229Z	2018-12-02

Exciting Current

Comment

Measurement settings

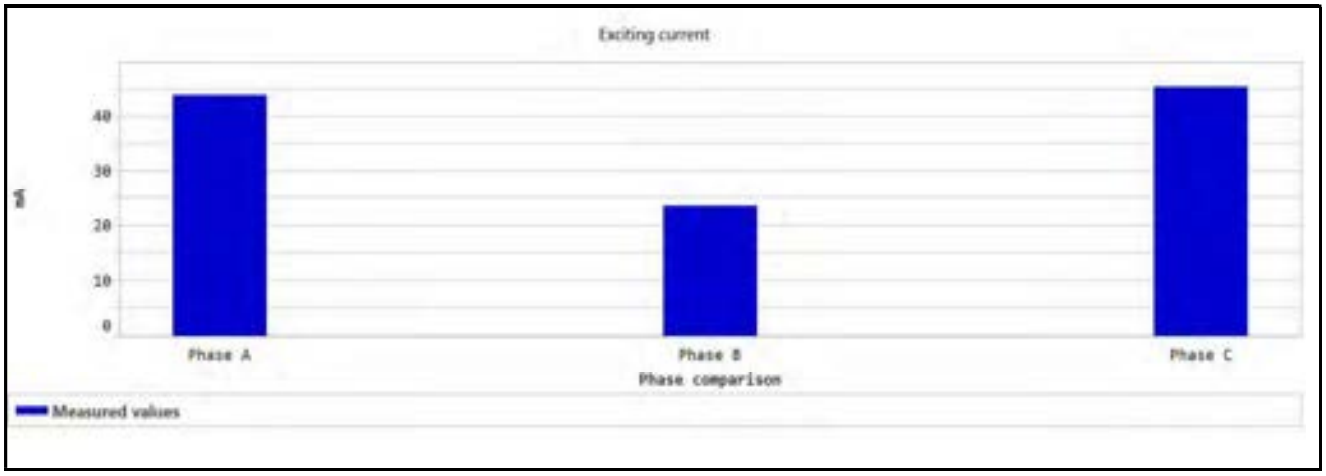
Test voltage	10 kV
Test frequency	60.00 Hz
Tap changer under test	DETC

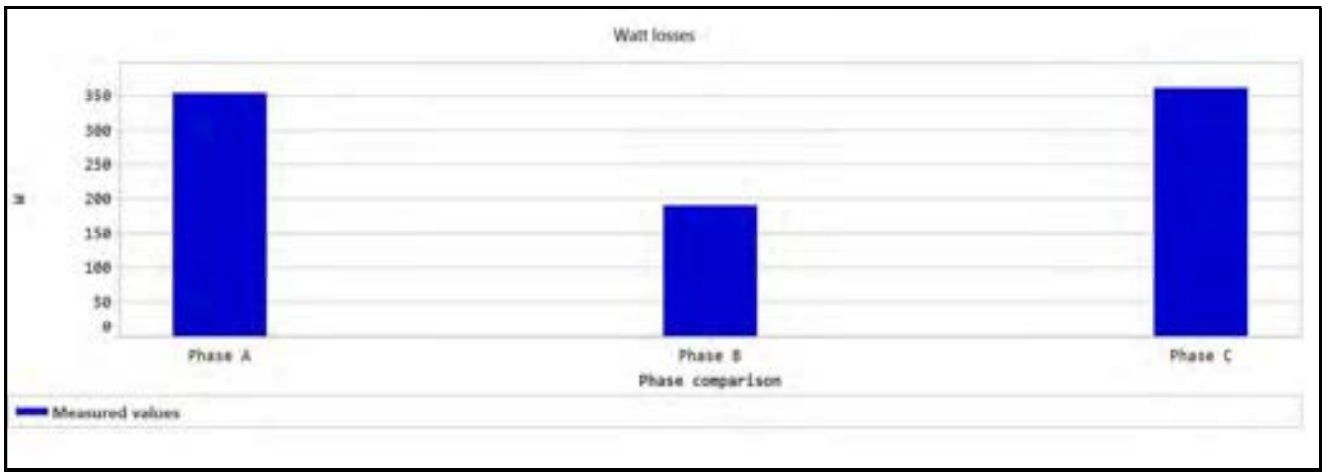
Averaging	2
Bandwidth	±20 Hz

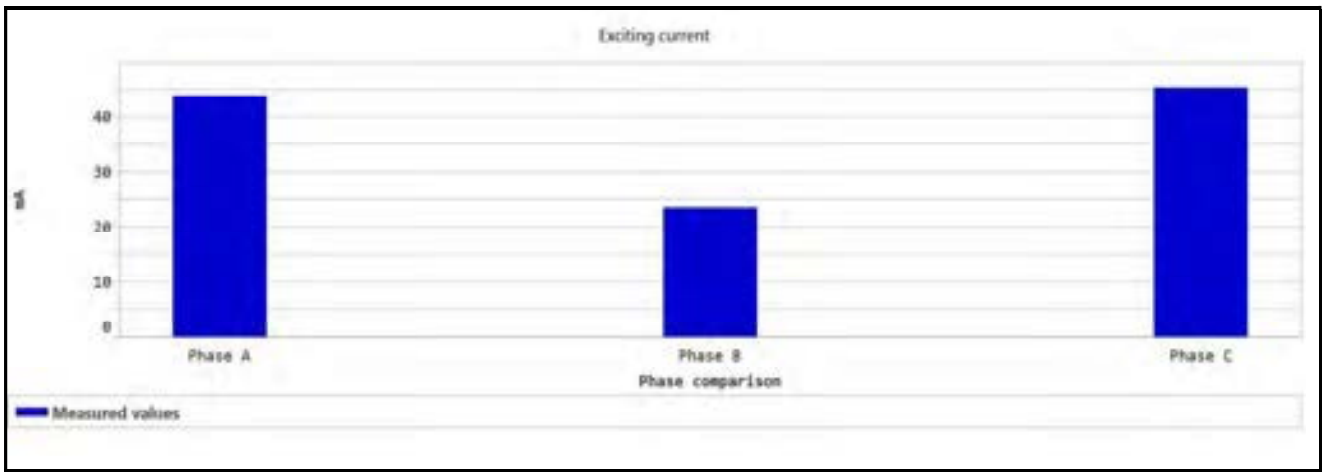
Use reference voltage	No

Measurements (sorted by tap)

Tap	*Phase*	*V out*	*I out*	*I phase*	*Watt losses*	*Reactance*	*Assessment*
2	A	10.00 kV	43.760 mA	-35.97 °	354.266 W	134.264 kΩ	Man. pass
2	B	10.00 kV	23.426 mA	-35.93 °	189.708 W	250.345 kΩ	Man. pass
2	C	10.00 kV	45.264 mA	-37.00 °	361.563 W	132.922 kΩ	Man. pass


Exciting current
40
30
20
10
0
mA
Phase A
Phase B
Phase C
Phase comparison
Measured values


Watt losses
350
300
250
200
150
100
50
0
W
Phase A
Phase B
Phase C
Phase comparison
Measured values


Exciting current
40
30
20
10
0
mA
Phase A
Phase B
Phase C
Phase comparison
Measured values

Test set information

Model	Serial number	Calibration date
TESTRANO 600	DL325X	2018-12-06

Turns Ratio test Prim-Sec

Comment

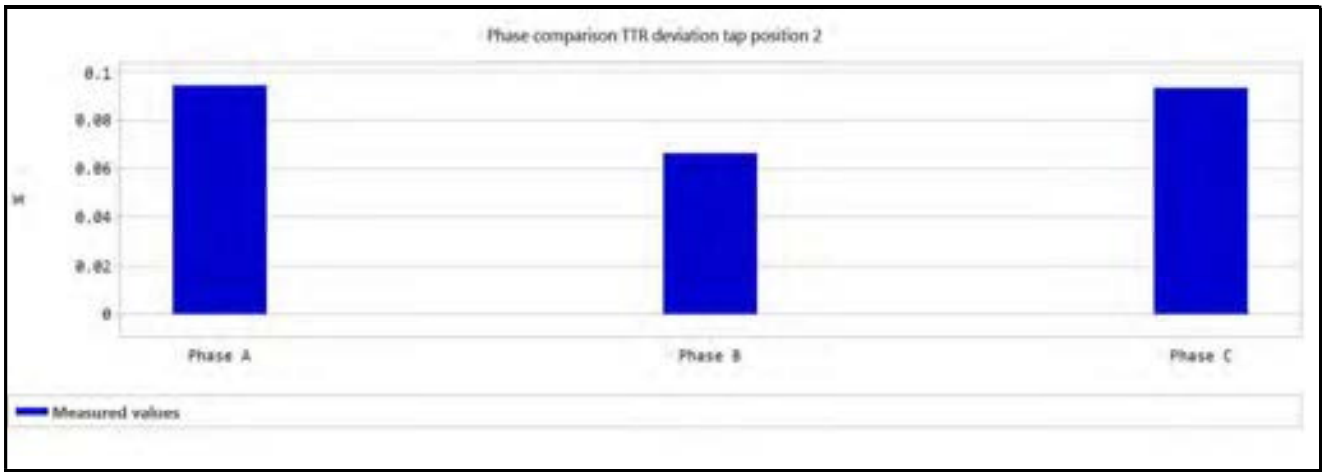
Measurement settings

Test voltage	120 V
Test frequency	60.00 Hz
Tap changer under test	DETC

Measurements (sorted by tap)

Tap	*Phase*	*Nom. Ratio*	*V prim (L-L)*	*I prim*	*V sec (L-L)*	*V phase*	*VTR*	*Ratio dev*	*Assessment*
2	A	6.4688	119.97 V	3.836 mA	18.53 V	329.99 °	6.4749	0.09 %	Pass
2	B	6.4688	119.96 V	2.875 mA	18.53 V	330 °	6.4730	0.07 %	Pass
2	C	6.4688	119.97 V	2.848 mA	18.53 V	330.01 °	6.4748	0.09 %	Pass

Graphs for standard test



Graph for low voltage exciting current

Test set information

Model	Serial number	Calibration date
TESTRANO 600	DL325X	2018-12-06

DC Winding Resistance Prim

Comment

Measurement settings

Test current	5 A	Tap changer under test	DETC
Output mode	16 A @ 340 V		
	1 ph.		

	Phase A			*Phase B*			*Phase C*		
Tap	*R meas*	*R dev*	*R corr*	*R meas*	*R dev*	*R corr*	*R meas*	*R dev*	*R corr*
2	578.004 mΩ	0.001 %	578.004 mΩ	578.807 mΩ	0.001 %	578.807 mΩ	579.075 mΩ	0.001 %	579.075 mΩ

Graphs for standard test

Test set information

Model	Serial number	Calibration date
TESTRANO 600	DL325X	2018-12-06

DC Winding Resistance Sec

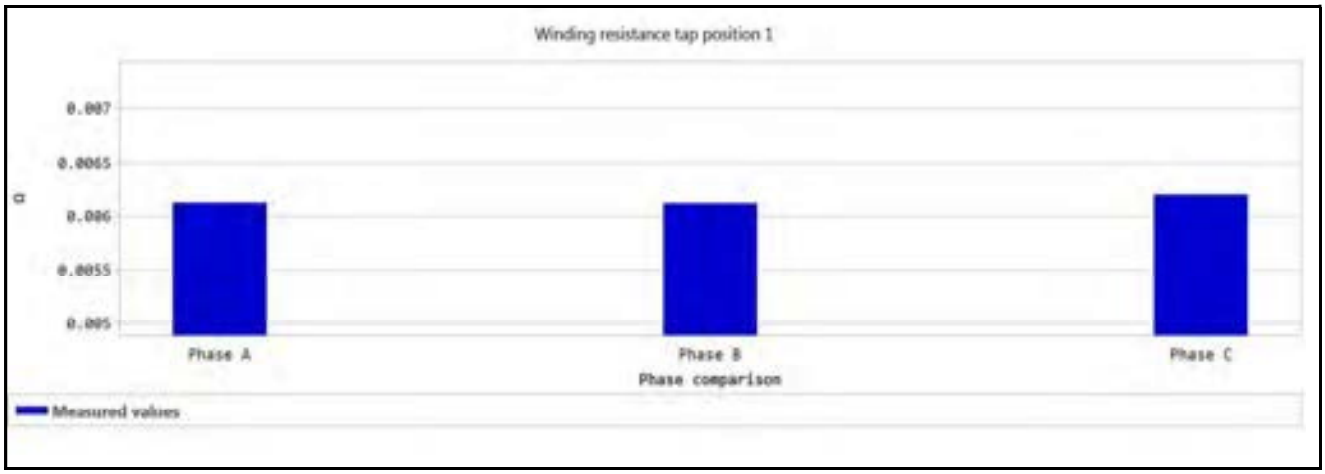
Comment

Measurement settings

Test current	5 A
Output mode	16 A @ 340 V
	1 ph.

Phase A			*Phase B*			*Phase C*		
R meas	*R dev*	*R corr*	*R meas*	*R dev*	*R corr*	*R meas*	*R dev*	*R corr*
6.124 mΩ	0.004 %	6.124 mΩ	6.118 mΩ	0.002 %	6.118 mΩ	6.200 mΩ	0.002 %	6.200 mΩ

Graphs for standard test



2019 Substation Maintenance Report - Oil Analysis

Welsh Station

26 Welsh Street, Seaforth, ON

Eric Cameron
Fetival Hydro
P.O. Box 397
Stratford, ON

K.P.C. POWER ELECTRICAL LTD. 395 Westney Road South
Ajax, ON CANADA L1S 6M6
T 905.683.6636 F 905.683.6668
kpcpower.com

June 3, 2019

Festival Hydro
P.O. Box 397
Stratford, On N5A 6T5

ATTENTION: Mr. Eric Cameron
Subject: Welsh Station – Substation Maintenance – Oil Analysis
Location: 36 Welsh Street, Seaforth, ON
Our Reference: **# 19IM-5103**

Dear Eric,

K.P.C. Power Electrical Ltd. (KPC) completed the Substation Maintenance program at the Welsh Substation located at 36 Welsh Street, Seaforth on April 9, 2019. Please find enclosed our oil analysis results.

Please feel at liberty to contact our office, should you have any questions or concerns. Thank you for the opportunity to have been of service.

Yours Truly,

Vern George
Field Supervisor
K.P.C. Power Electrical Ltd. (KPC)

WEIDMANN

WEIDMANN ELECTRICAL TECHNOLOGY
919 FRASER DR. UNIT 13 + BURLINGTON, ON + L7L 4X8
905-632-8697 + 905-632-8698
WWW.WEIDMANN-ELECTRICAL.COM

TEST REPORT
01-7235097-592778-00

KPC Power Electrical Ltd
1111 BURNS ST. E
UNIT 1
WHITBY, ON L1N 6A6 CA
ATTN: PAUL BECKMAN PO#:
19IM-5103
Project ID: FESTIVAL HYDRO
Customer ID: T1

Serial#: 293394
Location: 36 WELSH ST
Equipment: TRANSFORMER
Compartment: CONSERVATOR
Breathing: CONS
Bank: **Phase:** 3
Fluid: MIN **USGal:** 1170

Mfr: WESTINGHOUSE
kV: 27.6
kVA: 5000
Year Mf'd: 1966
Syringe ID:
Bottle ID:
Sampled By: JV

Control#: 7235097
Order#: 592778
Account: 6541
Received: 05/02/2019
Reported: 05/16/2019

	Lab Control Number:	7235097	7230956
	Date Sampled:	04/22/2019	04/09/2019
	Order Number:	592778	591648
	Oil Temp:	15	10
Dissolved Gas Analysis (DGA)	**Hydrogen (H2) (µL/L):**		9
ASTM	**Methane (CH4) (µL/L):**		1
D-3612	**Ethane (C2H6) (µL/L):**		<1
	Ethylene (C2H4) (µL/L):		3
	Acetylene (C2H2) (µL/L):		<1
	Carbon Monoxide (CO) (µL/L):		98
	Carbon Dioxide (CO2) (µL/L):		987
	Nitrogen (N2) (µL/L):		65587
	Oxygen (O2) (µL/L):		31415
	Total Dissolved Gas (TDG) (µL/L):		98100
	Total Dissolved Combustible Gas (TDCG) (µL/L):		111
	Equivalent TCG (%):		0.1055
DGA	**DGA Keys Gas / Interpretive Method:**		
Diagnostics	**PER IEEE C57.104-2008** (most recent sample)		
	DGA TDCG Rate Interpretive Method:		
	PER IEEE C57.104-2008 (two most recent sample)		
	DGA Cellulose (Paper) Insulation:		
Comment:			
General Oil Quality (GOQ)			
ASTM D-1533	**Moisture in Oil (mg/kg):**		9
ASTM D-971	**Interfacial Tension (mN/m):**		37.5
ASTM D-974	**Acid Number (mg KOH/g):**		0.019
ASTM D-1500	**Color Number (ASTM):**		L1.0
ASTM D-1524	**Visual Exam. (Relative):**		PASS
			CLR&BRIGHT
ASTM D-1524	**Sediment Exam. (Relative):**		TRACE
ASTM D-1816	**Dielectric Breakdown 2 mm (kV °C):**		39 (23°C)
ASTM D-924	**Power Factor @ 25°C (Routine) (%):**		0.004
ASTM D-4052	**Density @15°C (g/mL):**		0.8534
ASTM D-2668	**Oxidation Inhibitor (wt. %)**		0.248
Comment:			
Furanic Compound	**2-Furaldehyde (µg/L):**		< 10
ASTM D-5837	**5-Hydroxy-methyl-furaldehyde (µg/L):**		< 10
	2-Acetylfuran (µg/L):		< 10
	5-Methyl-2-furaldehyde (µg/L):		< 10
	2-Furyl alcohol (µg/L):		< 10
Furanic Compound Diagnostics (most recent sample):			

Notations: 1. Analysis is ISO/IEC 17025:2017 accredited, ANAB Accredited Certificate Number L2303 2. This test is conducted by a subcontracted laboratory. 3. Subcontracted laboratory has received ISO Standard 17025 accreditation for this test. 5. This test is conducted by Weidmann Laboratory other than Primary Lab. 6. Weidmann Laboratory has received ISO Standard 17025 accreditation for this test. 7. Imported Sample: WEIDMANN Electrical Technology accepts no responsibility for these results; accreditation status does not apply to these results. 8. Imported Equipment 10. mg/kg , µg/g, µg/mL, µL/L = ppm, µg/L = ppb, mN/m = dynes/cm, mm²/s = cSt

KPC Power Electrical Ltd	**Serial#:**	293394	**Mfr:**	WESTINGHOUSE	**Control#:** 7235097
1111 BURNS ST. E	**Location:**	36 WELSH ST	**kV:**	27.6	**Order#:** 592778
UNIT 1	**Equipment:**	TRANSFORMER	**kVA:**	5000	**Account:** 6541
WHITBY, ON L1N 6A6 CA	**Compartment:**	CONSERVATOR	**Year Mf'd:**	1966	**Received:** 05/02/2019
ATTN: PAUL BECKMAN PO#:	**Breathing:**	CONS	**Syringe ID:**		**Reported:** 05/16/2019
19IM-5103	**Bank:**	**Phase:** 3	**Bottle ID:**		
Project ID: FESTIVAL HYDRO	**Fluid:** MIN	**USGal:** 1170	**Sampled By:**	JV	

Customer ID: T1

Lab Control Number:	7235097	7230956
Date Sampled:	04/22/2019	04/09/2019
Order Number:	592778	591648
Oil Temp:	15	10

New insulation with a high degree of mechanical strength will typically have a Degree of Polymerization (DP) of 1000-1300. "Middle Aged" paper is approximately 500 and paper with less than 250 is in its "Old Age." Severely degraded insulation with a DP of 150 or less will have very little mechanical strength and may result in a transformer failure. The above estimations are based on a study by Chendong of GSU transformers filled with mineral oil.

Estimated Average Degree of Polymerization (DP):

Estimated Operating Age of the Equipment:

Notations:

Comment:

Particle Count	**>= 4 µm(c)/mL:**	770
ASTM D-6786[5]	**>= 6 µm(c)/mL:**	191
	>= 10 µm(c)/mL:	41
	>= 14 µm(c)/mL:	17
	>= 21 µm(c)/mL:	7
	>= 38 µm(c)/mL:	1
	>= 70 µm(c)/mL:	0
	ISO CODE:	17/15/>=11
	Diagnostics:	Particle count diagnostic only applicable to main tank of mineral oil transformers.

Comment:

End of Test Report

Authorized By:

JANET KAROLAT
SUPV CHEMIST

Notations: 1. Analysis is ISO/IEC 17025:2017 accredited, ANAB Accredited Certificate Number L2303 2. This test is conducted by a subcontracted laboratory. 3. Subcontracted laboratory has received ISO Standard 17025 accreditation for this test. 5. This test is conducted by Weidmann Laboratory other than Primary Lab. 6. Weidmann Laboratory has received ISO Standard 17025 accreditation for this test. 7. Imported Sample: WEIDMANN Electrical Technology accepts no responsibility for these results; accreditation status does not apply to these results. 8. Imported Equipment 10. mg/kg , µg/g, µg/mL, µL/L = ppm, µg/L = ppb, mN/m = dynes/cm, mm²/s = cSt

2019 Substation Maintenance Report

Chalk Station

44 Chalk Street, Seaforth, ON

Eric Cameron
Fetival Hydro
P.O. Box 397
Stratford, ON

K.P.C. POWER ELECTRICAL LTD. 1111 Burns Street East, Unit 1
Whitby, ON CANADA L1N 6A6
T 905.665.0676
F 905.665.0675
kpcpower.com

April 18, 2019

Festival Hydro
P.O. Box 397
Stratford, On N5A 6T5

ATTENTION: Mr. Eric Cameron
Subject: Chalk Station – Substation Maintenance
Location: 44 Chalk Street, Seaforth, ON
Our Reference: **# 19IM-5104**

Dear Eric,

K.P.C. Power Electrical Ltd. (KPC) completed the Substation Maintenance program at the Chalk Substation located at 44 Chalk Street, Seaforth on April 11, 2019. Please find enclosed our report for your review and comments.

The following sections detail our observations, recommendations and test results, the oil analysis results will follow.

Please feel at liberty to contact our office, should you have any questions or concerns. Thank you for the opportunity to have been of service.

Yours Truly,

Alan See
Substation Technician
K.P.C. Power Electrical Ltd. (KPC)

Table of Contents

DEFICIENCIES AND RECOMMENDATIONS

Festival Hydro – Chalk Substation Preliminary Deficiency List:

Service date: April 11, 2019

Location: 44 Chalk St, Seaforth, ON

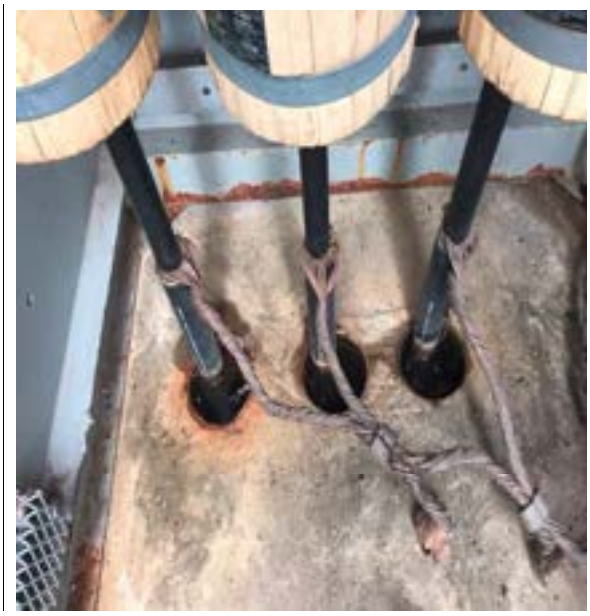
1) All Feeder (3) - 5KV switches:
   - Top barrier replacement – di-electric strength diminished (worn out)

2) All Feeders (Total 9 units) - Lightning Arrestors replacement.
   - Low insulation reading - > Low of 13 MΩ

3) All Feeders outgoing cables submerged with water in PVC housing.

4) F1 Feeder – Load Interrupter sluggish (jammed) on C ϕ:
   - Recommend replacement

Photos:



INSPECTION SHEETS

Client Information

Customer	Festival Hydro			**Date Tested**	04/11/2019	
File Number	19IM-5104	**Customer Ref.**	Eric Cameron	**Ambient Temp**	5	**°C**
Location	44 Chalk St S, Seaforth			**Tested By**	EW	
Substation	Chalk Substation			**Approved By**	VG	
Equipment I.D.	Incoming Pole					

High Voltage Air/Load Break Switch

Nameplate Data				
Manufacturer	S&C Electric	**Voltage**	34.5	**kVolt**
Type	Outdoor	**Current**	600	**Amps**
Style #	NA	**B.I.L.**	200	**kVolt**
Cat #	135744R2	**Serial #**	NA	

Mechanical Inspections		
Description of Inspection	**Status**	**Comments**
	OK/FAIR/POOR/NA	
Operating Mechanism	OK	Operated, grease, inspected
Stationary Contact Surfaces	OK	Cleaned, grease, inspected
Moving Contact Surfaces	OK	Cleaned, grease, inspected
Arcing Contact Surfaces	OK	Cleaned, grease, inspected
Contact Alignment	OK	Operated, Inspected
Arcing Interrupter	OK	Operated, Inspected
Connector Condition	OK	Inspected
Insulator Condition	OK	Cleaned, inspected
Phase Barrier Condition	N/A	
Grounding	OK	Inspected
Lightning Arrester	OK	Cleaned, Tested, Inspected
Gradient Mat	OK	Inspected
Key Interlock	OK	Operated, Inspected
Heaters & Thermostat	N/A	
Support Structure Condition	OK	Minor rusting
Potential Indicators	N/A	

Electrical Tests							
Test Description		**φ A**	**φ B**	**φ C**	**A/B**	**B/C**	**C/A**
Insulation Resistance @ 10 kV	**GΩ**	58.4	54.2	74.7	124.5	122.1	120.4
Contact Resistance @ 10 A	**μΩ**	61	60	48			
Arc Interrupter Resistance	**Ω**	NA	NA	NA			

Test Conditions	Outdoor 5 deg C
Results Satisfactory	OK
Test Equipment	10KV AEMC Megger, 10A AEMC Micro ohmeter

Notes:

Client Information

Customer	Festival Hydro			**Date Tested**	04/11/2019	
File Number	19IM-5104	**Customer Ref.**	Eric Cameron	**Ambient Temp**	5	°C
Location	44 Chalk St S, Seaforth			**Tested By**	EW	
Substation	Chalk Substation			**Approved By**	VG	
Equipment I.D.	27.6 KV Primary Switchgear -Fused Protection					

High Voltage Power Fuse

Fuse Holder Nameplate Data				
Manufacturer	S & C	**Max Voltage**	38	**kVolt**
Type	SM-5	**Max Current**	300E	**Amps**
Style/Cat #	86154R2	**Serial #**	NA	
Fuse Link Nameplate Data				
Type	SM-5	**TCC**	119-4	
Style/Cat #	264200 R3	**Amps**	125E	

Mechanical Inspections

Description of Inspection	Status	Comments
	OK/FAIR/POOR/NA	
Operating Mechanism	OK	Operated, inspected
Contact Surfaces	OK	Cleaned, greased, inspected
Contact Penetration	OK	Inspected
Contact Alignment	OK	Inspected
Expulsion-Limiting Filters	NA	
Fuse Barrel Condition	OK	Cleaned, inspected. (Porcelain type)
Connecter Condition	OK	Inspected
Insulator Condition	OK	Cleaned, inspected
Phase Barrier Condition	NA	
Support Structure	OK	Sturdy, inspected
Heaters & Thermostat	OK	inspected
Spare Fuse Quality	OK	
Spare Fuse Quantity	OK	

Electrical Tests

Test Description		φ A	φ B	φ C	A/B	B/C	C/A
Insulation Resistance @ 10 kV	GΩ	58.4	54.2	74.7	124.5	122.1	120.4
Contact Resistance @ 10 A	μΩ	631	611	600			

Test Conditions	Cloudy 5 deg C
Results Satisfactory	OK
Test Equipment	10KV AEMC Megger, 10A AEMC Micro ohmeter

Notes:

Client Information

Customer	Festival Hydro			**Date Tested**	04/11/2019		
File Number	19IM-5104	**Customer Ref.**	Eric Cameron	**Ambient Temp**	5	**°C**	
Location	44 Chalk St S, Seaforth			**Tested By**	EW		
Substation	Chalk Substation			**Approved By**	VG		
Equipment I.D.	Incoming 27.6 KV Pole						

Lightning Arrester Inspection

Nameplate Data						
Manufacturer	Ohio Brass			**Voltage**	30	**kVolts**
Cat #	300029			**MCOV**	29	**kVolts**
Serial #	60H45471	60H41122	60H45463	**Duty Cycle Rating**	36	**kVolts**

Capacitance and Power Factor Test							
				Power factor			
Insulation Tested	**Test Mode**	**kV**	**Cap (pF)**	**Measured**	**Cor. to 20°C**	**mA**	**Watts**
CH-G - Aϕ	**GrndST**	NA	NA	NA	NA	NA	NA
CH-G - Bφ	**GrndST**	NA	NA	NA	NA	NA	NA
CH-G - Cφ	**GrndST**	NA	NA	NA	NA	NA	NA

Insulation Resistance (GΩ)									
@		**kVDC**							
Ins. Type	**X**	**Solid**		**Oil**		**φ A**		**φ B**	**φ C**
Insulation Res.	@	**5**	**°C**			35.05		40.25	55.1
Corrected to 20°C						#VALUE!		#VALUE!	#VALUE!

Mechanical Inspections		
Description of Inspection	**Status**	**Comments**
	OK/FAIR/POOR/NA	
Insulator Surface Condition	OK	Cleaned, Inspected
Connector Condition	OK	Tightened, Inspected
Grounding	OK	Inspected
Support Structure	OK	Sturdy, Inspected

Test Conditions	Tested with cables
Results Satisfactory	OK
Test Equipment	AEMC 10KV Megger

Notes:

Client Information

Customer	Festival Hydro			**Date Tested**	04/11/2019
File Number	19IM-5104	**Customer Ref.**	Eric Cameron	**Ambient Temp**	5 °C
Location	44 Chalk St S, Seaforth			**Tested By**	AS
Substation	Chalk Substation			**Approved By**	VG
Equipment I.D.	Main Transformer				

Power Transformer - Electrical

Nameplate Data													
Manufacturer	CARTE			**Vector Group**	DYN11		**NGR**		**Solid**	X			
Year Built	1987			**Serial #**	P1480-1		**Res.**	NA	Ω				
Type	ONAN			**Liquid Type/Volume**	Mineral oil		3168		**L.**				
Sealed	X	**Conservator**		**Dry Type**		**Total Weight**	10886		**Kg.**				
Rating	5000	**kVA**		**Primary Voltage**	27.6		**kVolts**						
Impedance	6.47	%		**Secondary Voltage**	4160Y/2402		**Volts**						
Phase	3	φ		**BIL (Primary)**	200	**kV**	**BIL (Secondary)**	75	**kV**				
Oil Temp	0	°C	**Max Oil Temp**	40 °C	**Winding Temp**	NA	°C	**Max Winding Temp**	NA	°C			

Insulation Resistance													
Test Voltage	**Hi**	**10**	**Low**	**5**	**kVdc**	**H to L + Grnd**		**L to H + Grnd**		**H to L**		**Core**	
GΩ @ 8 °C						8.53		6.66		15.33		NA	
Corrected to 20 °C						NA		NA		NA		NA	

Capacitance & Dissipation Factor													
Test Voltage	**High**		**Low**		$C_{H-L} + C_{H-G}$		C_{H-G}		C_{H-L}		C_{L-G}		$C_{L-H} + C_{L-G}$	
Capacitance (pF)														
Current (mA)	PLEASE SEE OMICRON TEST REPORT													
Watts (W)														
Power Factor														
Corrected to 20 °C														

Turns Ratio Test												
Tap	**Primary Volts**	**Calculated Ratio**	**H1-H2 X0-X1**			**H2-H3 X0-X2**			**H3-H1 X0-X3**			
			Ratio	**Dev%**	**mA**	**Ratio**	**Dev%**	**mA**	**Ratio**	**Dev%**	**mA**	
1												
2			PLEASE SEE OMICRON TEST REPORT									
3												
4												
5												

Winding Resistance								
Tap	**Current Scale**	**Resistance Unit**	**H1-H2**	**H2-H3**	**H3-H1**	**X0-X1**	**X0-X2**	**X0-X3**
			PLEASE SEE OMICRON TEST REPORT					

Tap Position Found & Left	4
Results Satisfactory	OK
Test Equipment	Omicron Testrano 600, AEMC 10KV Megger

Notes:

Client Information

Customer	Festival Hydro			**Date Tested**	04/11/2019	
File Number	19IM-5104	**Customer Ref.**	Eric Cameron	**Ambient Temp**	5	°C
Location	44 Chalk St S, Seaforth			**Tested By**	AS	
Substation	Chalk Substation			**Approved By**	VG	
Equipment I.D.	Main Transformer					

Power Transformer (Liquid Filled) - Mechanical

Mechanical Inspections								
Description of Inspection		**Status**				**Comments**		
		OK/FAIR/POOR/NA						
Breather & Silica Gel		NA						
Conservator Tank Gaskets		NA						
Explosion Vent Gaskets		OK				Inspected		
Inspection Cover Gaskets		OK				Inspected		
Main Cover Gaskets		OK				Inspected		
Primary Bushing Gaskets		OK				Inspected		
Primary Bushing Porcelain		OK				Cleaned, Inspected		
Primary Bushing Connections		OK				Tightened, Inspected		
Primary Throat Gaskets		OK				Inspected		
Secondary Bushing Gaskets		OK				Inspected		
Secondary Bushing Porcelain		OK				Cleaned, Inspected		
Secondary Bushing Connections		OK				Tightened, Inspected		
Secondary Throat Gaskets		OK				Inspected		
Pressure Relief Device		OK				Inspected	**PSI**	NA
Gas Relay		NA				Not available for this transformer		
Fan Operation		NA				Not available for this transformer		
Control Wiring		OK				Inspected		
Tap Changer		OK				As Found & Left @ Tap 4		
Paint Condition		OK				Inspected	**Colour**	
Pads		OK				Inspected		
Grounding		OK				Inspected		
Radiator		OK				Inspected		
Oil Level		OK				Inspected		
Pressure Gauge		OK						
Oil Temperature Gauge		OK						
Winding Temperature Gauge		NA						
Oil Temperature	**Run | Max**	0	°C	40	°C			
Winding Temperature	**Run | Max**	NA	°C	NA	°C			

Results Satisfactory	OK
Test Equipment	NA

Notes: Samples taken sent to Weidmann Lab.

Client Information

Customer	Festival Hydro			**Date Tested**	04/11/2019		
File Number	19IM-5104	**Customer Ref.**	Eric Cameron	**Ambient Temp**	5	**°C**	
Location	44 Chalk St S, Seaforth			**Tested By**	AS		
Substation	Chalk Substation			**Approved By**	VG		
Equipment I.D.	Main Transformer 27.6 KV Lightning Arrestors						

Lightning Arrester Inspection

Nameplate Data					
Manufacturer	Ohio Brass	**Voltage**	36	**kVolts**	
Cat #	PVI Intermediate	**MCOV**	29	**kVolts**	
Serial #		**Duty Cycle Rating**	36	**kVolts**	

Capacitance and Power Factor Test

Insulation Tested	**Test Mode**	**kV**	**Cap (pF)**	**Power factor**		**mA**	**Watts**
				Measured	**Cor. to 20°C**		
CH-G - Aϕ	**GrndST**	NA	NA	NA	NA	NA	NA
CH-G - Bφ	**GrndST**	NA	NA	NA	NA	NA	NA
CH-G - Cφ	**GrndST**	NA	NA	NA	NA	NA	NA

Insulation Resistance (GΩ)

@ 10 kVDC			
Ins. Type	**X Solid**	**φ A**	**φ B**	**φ C**
Insulation Res.	**@ 5 °C**	507	401	417
Corrected to 20°C		NA	NA	NA

Mechanical Inspections

Description of Inspection	**Status**	**Comments**
	OK/FAIR/POOR/NA	
Insulator Surface Condition	OK	Cleaned, Inspected
Connector Condition	OK	Tightened, Inspected
Grounding	OK	Inspected
Support Structure	OK	Sturdy, Inspected

Test Conditions	OK
Results Satisfactory	OK
Test Equipment	AEMC 10KV Megger

Notes:

Client Information

Customer	Festival Hydro			**Date Tested**	04/11/2019	
File Number	19IM-5104	**Customer Ref.**	Eric Cameron	**Ambient Temp**	5	°C
Location	44 Chalk St S, Seaforth			**Tested By**	JV/AS	
Substation	Chalk Substation			**Approved By**	VG	
Equipment I.D.	S1-F1 Center Feeder					

High Voltage Air/Load Break Switch

Nameplate Data				
Manufacturer	S & C	**Voltage**	4.8-5.5	**kVolt**
Type	ALDUTI-RUPTER	**Current**	600	**Amps**
Style #	NA	**B.I.L.**	60	**kVolt**
Cat #	34560R6	**Serial #**	NA	

Mechanical Inspections		
Description of Inspection	**Status**	**Comments**
	OK/FAIR/POOR/NA	
Operating Mechanism	OK	Cleaned, grease, inspected.
Stationary Contact Surfaces	OK	Cleaned, grease, inspected.
Moving Contact Surfaces	OK	Cleaned, grease, inspected.
Arcing Contact Surfaces	OK	Cleaned, inspected.
Contact Alignment	OK	Inspected
Arcing Interrupter	FAIR	C' phase should be replaced- Sticking and not engaging
Connector Condition	OK	Inspected
Insulator Condition	OK	Cleaned, inspected.
Phase Barrier Condition	FAIR	See recommendation on top barrier replacement.
Grounding	OK	Inspected
Lightning Arrester	FAIR	Low Insulation Reading. Recommend replacement.
Gradient Mat	NA	
Key Interlock	NA	
Heaters & Thermostat	NT	
Support Structure Condition	NA	
Potential Indicators	NA	

Electrical Tests							
Test Description		**φ A**	**φ B**	**φ C**	**A/B**	**B/C**	**C/A**
Insulation Resistance @ 5 kV	**GΩ**	5.4	6.3	6.6	7.6	8.8	9.2
Contact Resistance @ 10 A	**μΩ**	76	95	88			
PT Fuses Resistance	**Ω**	7.7	7.8	7.7			

Test Conditions	Cloudy 5 deg C
Results Satisfactory	OK
Test Equipment	10KV AEMC Megger, 10A AEMC Micro ohmeter, Fluke Digital Meter

Notes: PT Fuses: S&C, Cat#271000,1/2E,TCC 159.9.

Client Information

Customer	Festival Hydro			**Date Tested**	04/11/2019	
File Number	19IM-5104	**Customer Ref.**	Eric Cameron	**Ambient Temp**	5	°C
Location	44 Chalk St S, Seaforth			**Tested By**	JV	
Substation	Chalk Substation			**Approved By**	VG	
Equipment I.D.	S1-F1 Center Feeder					

High Voltage Power Fuse

Fuse Holder Nameplate Data				
Manufacturer	S & C	**Max Voltage**	4.8-5.5	**kVolt**
Type	SM-5C	**Max Current**	400E	**Amps**
Style/Cat #	86641-R1	**Serial #**	NA	
Fuse Link Nameplate Data				
Type	SM5	**TCC**	153-4	
Style/Cat #	132400ER4	**Amps**	250E	

Mechanical Inspections		
Description of Inspection	**Status**	**Comments**
	OK/FAIR/POOR/NA	
Operating Mechanism	OK	Operated, inspected
Contact Surfaces	OK	Cleaned, greased, inspected
Contact Penetration	OK	Inspected
Contact Alignment	OK	Inspected
Expulsion-Limiting Filters	OK	Inspected
Fuse Barrel Condition	OK	Cleaned, inspected
Connecter Condition	OK	Inspected
Insulator Condition	OK	Cleaned, inspected
Phase Barrier Condition	OK	Cleaned, inspected
Support Structure	OK	Sturdy, inspected
Heaters & Thermostat	NT	
Spare Fuse Quality	OK	
Spare Fuse Quantity	2	Inside Metering Cabinet

Electrical Tests							
Test Description		**φ A**	**φ B**	**φ C**	**A/B**	**B/C**	**C/A**
Insulation Resistance @ 10 kV	**GΩ**	5.4	6.3	6.6	7.6	8.8	9.2
Contact Resistance @ 10 A	**μΩ**	313	351	421			

Test Conditions	Cloudy 5 deg C
Results Satisfactory	OK
Test Equipment	10KV AEMC Megger, 10A AEMC Micro ohmeter

Notes: *Note: Found water in outgoing cable duct

Client Information

Customer	Festival Hydro			**Date Tested**	04/11/2019		
File Number	19IM-5104	**Customer Ref.**	Eric Cameron	**Ambient Temp**	5	**°C**	
Location	44 Chalk St S, Seaforth			**Tested By**	JV/AS		
Substation	Chalk Substation			**Approved By**	VG		
Equipment I.D.	S1-F1 Center Feeder						

Lightning Arrester Inspection

Nameplate Data						
Manufacturer	Ohio Brass			**Voltage**	5	**kVolts**
Cat #	217602			**MCOV**	2.55	**kVolts**
Serial #	NA	NA	NA	**Duty Cycle Rating**	NA	**kVolts**

Capacitance and Power Factor Test							
				Power factor			
Insulation Tested	**Test Mode**	**kV**	**Cap (pF)**	**Measured**	**Cor. to 20°C**	**mA**	**Watts**
CH-G - Aϕ	**GrndST**	NA	NA	NA	NA	NA	NA
CH-G - Bφ	**GrndST**	NA	NA	NA	NA	NA	NA
CH-G - Cφ	**GrndST**	NA	NA	NA	NA	NA	NA

Insulation Resistance (GΩ)				
@ 5 kVDC				
Ins. Type	**X Solid / Oil**	**φ A**	**φ B**	**φ C**
Insulation Res.	**@ 8 °C**	0.036	0.013	0.028
Corrected to 20°C		NA	NA	NA

Mechanical Inspections		
Description of Inspection	**Status**	**Comments**
	OK/FAIR/POOR/NA	
Insulator Surface Condition	*POOR	Low IR reading. Recommend replacement
Connector Condition	OK	Inspected
Grounding	OK	Inspected
Support Structure	OK	Inspected

Test Conditions	Cloudy 8 deg C
Results Satisfactory	POOR
Test Equipment	10KV AEMC Megger, 10A AEMC Micro ohmeter

Notes: * Recommend replacement of (3) Lightning Arrestors

Client Information

Customer	Festival Hydro			**Date Tested**	04/11/2019	
File Number	19IM-5104	**Customer Ref.**	Eric Cameron	**Ambient Temp**	5	**°C**
Location	44 Chalk St S, Seaforth			**Tested By**	JV/AS	
Substation	Chalk Substation			**Approved By**	VG	
Equipment I.D.	S1-F2 South Feeder					

High Voltage Air/Load Break Switch

Nameplate Data				
Manufacturer	S & C	**Voltage**	4.8-5.5	**kVolt**
Type	ALDUTI-RUPTER	**Current**	600	**Amps**
Style #	NA	**B.I.L.**	60	**kVolt**
Cat #	34560R6	**Serial #**	NA	

Mechanical Inspections		
Description of Inspection	**Status**	**Comments**
	OK/FAIR/POOR/NA	
Operating Mechanism	OK	Cleaned, grease, inspected.
Stationary Contact Surfaces	OK	Cleaned, grease, inspected.
Moving Contact Surfaces	OK	Cleaned, grease, inspected.
Arcing Contact Surfaces	OK	Cleaned, inspected.
Contact Alignment	OK	Inspected
Arcing Interrupter	OK	Cleaned, inspected.
Connector Condition	OK	Inspected
Insulator Condition	OK	Cleaned, inspected.
Phase Barrier Condition	FAIR	See recommendation on top barrier replacement.
Grounding	OK	Inspected
Lightning Arrester	FAIR	Low Insulation Reading. Recommend replacement.
Gradient Mat	NA	
Key Interlock	NA	
Heaters & Thermostat	NT	
Support Structure Condition	NA	
Potential Indicators	NA	

Electrical Tests							
Test Description		**φ A**	**φ B**	**φ C**	**A/B**	**B/C**	**C/A**
Insulation Resistance @ 5 kV	**GΩ**	4.6	5	6.2	6.2	8.8	6.4
Contact Resistance @ 10 A	**μΩ**	78	84	81			

Test Conditions	Cloudy 5 deg C
Results Satisfactory	OK
Test Equipment	10KV AEMC Megger, 10A AEMC Micro ohmeter.

Notes:

Client Information

Customer	Festival Hydro			**Date Tested**	04/11/2019	
File Number	19IM-5104	**Customer Ref.**	Eric Cameron	**Ambient Temp**	5	**°C**
Location	44 Chalk St S, Seaforth			**Tested By**	JV/AS	
Substation	Chalk Substation			**Approved By**	VG	
Equipment I.D.	S1-F2 South Feeder					

High Voltage Power Fuse

Fuse Holder Nameplate Data				
Manufacturer	S & C	**Max Voltage**	4.8-5.5	**kVolt**
Type	SM-5C	**Max Current**	400E	**Amps**
Style/Cat #	86641-R1	**Serial #**	NA	
Fuse Link Nameplate Data				
Type	SM5	**TCC**	153-4	
Style/Cat #		**Amps**	250E	

Mechanical Inspections		
Description of Inspection	**Status**	**Comments**
	OK/FAIR/POOR/NA	
Operating Mechanism	OK	Operated, inspected
Contact Surfaces	OK	Cleaned, greased, inspected
Contact Penetration	OK	Inspected
Contact Alignment	OK	Inspected
Expulsion-Limiting Filters	OK	Inspected
Fuse Barrel Condition	OK	Cleaned, inspected
Connecter Condition	OK	Inspected
Insulator Condition	OK	Cleaned, inspected
Phase Barrier Condition	OK	Cleaned, inspected
Support Structure	OK	Sturdy, inspected
Heaters & Thermostat	NT	inspected
Spare Fuse Quality	OK	
Spare Fuse Quantity	3	

Electrical Tests							
Test Description		**φ A**	**φ B**	**φ C**	**A/B**	**B/C**	**C/A**
Insulation Resistance @ 10 kV	**GΩ**	4.65	5	6.2	6.2	8.8	6.4
Contact Resistance @ 10 A	**μΩ**	344	345	341			

Test Conditions	Cloudy 5 deg C
Results Satisfactory	OK
Test Equipment	10KV AEMC Megger, 10A AEMC Micro ohmeter

Notes: *Note: Found water in outgoing cable duct

Client Information

Customer	Festival Hydro			**Date Tested**	04/11/2019		
File Number	19IM-5104	**Customer Ref.**	Eric Cameron	**Ambient Temp**	5	**°C**	
Location	44 Chalk St S, Seaforth			**Tested By**	JV/AS		
Substation	Chalk Substation			**Approved By**	VG		
Equipment I.D.	S1-F2 Center Feeder						

Lightning Arrester Inspection

Nameplate Data						
Manufacturer	Ohio Brass			**Voltage**	5	**kVolts**
Cat #	217600			**MCOV**	2.55	**kVolts**
Serial #	NA	NA	NA	**Duty Cycle Rating**	NA	**kVolts**

Capacitance and Power Factor Test							
				Power factor			
Insulation Tested	**Test Mode**	**kV**	**Cap (pF)**	**Measured**	**Cor. to 20°C**	**mA**	**Watts**
CH-G - Aϕ	**GrndST**	NA	NA	NA	NA	NA	NA
CH-G - Bφ	**GrndST**	NA	NA	NA	NA	NA	NA
CH-G - Cφ	**GrndST**	NA	NA	NA	NA	NA	NA

Insulation Resistance (GΩ)				
@ 5 kVDC				
Ins. Type	**X Solid / Oil**	**φ A**	**φ B**	**φ C**
Insulation Res.	**@ 8 °C**	0.036	0.013	0.028
Corrected to 20°C		NA	NA	NA

Mechanical Inspections		
Description of Inspection	**Status**	**Comments**
	OK/FAIR/POOR/NA	
Insulator Surface Condition	*POOR	Low IR reading. Recommend replacement
Connector Condition	OK	Inspected
Grounding	OK	Inspected
Support Structure	OK	Inspected

Test Conditions	Cloudy 8 deg C
Results Satisfactory	POOR
Test Equipment	10KV AEMC Megger, 10A AEMC Micro ohmeter

Notes: * Recommend replacement of (3) Lightning Arrestors

Client Information

Customer	Festival Hydro			**Date Tested**	04/11/2019	
File Number	19IM-5104	**Customer Ref.**	Eric Cameron	**Ambient Temp**	5	**°C**
Location	44 Chalk St S, Seaforth			**Tested By**	JV/AS	
Substation	Chalk Substation			**Approved By**	VG	
Equipment I.D.	S1-F3 Hospital Feeder					

High Voltage Air/Load Break Switch

Nameplate Data				
Manufacturer	S & C	**Voltage**	4.8-5.5	**kVolt**
Type	ALDUTI-RUPTER	**Current**	600	**Amps**
Style #	NA	**B.I.L.**	60	**kVolt**
Cat #	34560R6	**Serial #**	NA	

Mechanical Inspections		
Description of Inspection	**Status**	**Comments**
	OK/FAIR/POOR/NA	
Operating Mechanism	OK	Cleaned, grease, inspected.
Stationary Contact Surfaces	OK	Cleaned, grease, inspected.
Moving Contact Surfaces	OK	Cleaned, grease, inspected.
Arcing Contact Surfaces	OK	Cleaned, inspected.
Contact Alignment	OK	Inspected
Arcing Interrupter	OK	Cleaned, inspected.
Connector Condition	OK	Inspected
Insulator Condition	OK	Cleaned, inspected.
Phase Barrier Condition	FAIR	See recommendation on top barrier replacement.
Grounding	OK	Inspected
Lightning Arrester	FAIR	Low Insulation Reading. Recommend replacement.
Gradient Mat	NA	
Key Interlock	NA	
Heaters & Thermostat	NT	
Support Structure Condition	NA	
Potential Indicators	NA	

Electrical Tests							
Test Description		**φ A**	**φ B**	**φ C**	**A/B**	**B/C**	**C/A**
Insulation Resistance @ 5 kV	**GΩ**	4.6	5	6.2	6.2	8.8	6.4
Contact Resistance @ 10 A	**μΩ**	78	84	81			

Test Conditions	Cloudy 5 deg C
Results Satisfactory	OK
Test Equipment	10KV AEMC Megger, 10A AEMC Micro ohmeter.

Notes:

Client Information

Customer	Festival Hydro			**Date Tested**	04/11/2019	
File Number	19IM-5104	**Customer Ref.**	Eric Cameron	**Ambient Temp**	5	°C
Location	44 Chalk St S, Seaforth			**Tested By**	JV/AS	
Substation	Chalk Substation			**Approved By**	VG	
Equipment I.D.	S1-F3 Hospital Feeder					

High Voltage Power Fuse

Fuse Holder Nameplate Data				
Manufacturer	S & C	**Max Voltage**	4.8-5.5	**kVolt**
Type	SM-5C	**Max Current**	400E	**Amps**
Style/Cat #	86641-R1	**Serial #**	NA	
Fuse Link Nameplate Data				
Type	SM5	**TCC**	153-4	
Style/Cat #		**Amps**	250E	

Mechanical Inspections		
Description of Inspection	**Status**	**Comments**
	OK/FAIR/POOR/NA	
Operating Mechanism	OK	Operated, inspected
Contact Surfaces	OK	Cleaned, greased, inspected
Contact Penetration	OK	Inspected
Contact Alignment	OK	Inspected
Expulsion-Limiting Filters	OK	Inspected
Fuse Barrel Condition	OK	Cleaned, inspected
Connecter Condition	OK	Inspected
Insulator Condition	OK	Cleaned, inspected
Phase Barrier Condition	OK	Cleaned, inspected
Support Structure	OK	Sturdy, inspected
Heaters & Thermostat	NT	inspected
Spare Fuse Quality	OK	
Spare Fuse Quantity	2	In Metering Cabinet

Electrical Tests							
Test Description		**φ A**	**φ B**	**φ C**	**A/B**	**B/C**	**C/A**
Insulation Resistance @ 10 kV	**GΩ**	5.2	6.2	6.5	6.8	8.4	8.2
Contact Resistance @ 10 A	**μΩ**	331	334	352			

Test Conditions	Cloudy 5 deg C
Results Satisfactory	OK
Test Equipment	10KV AEMC Megger, 10A AEMC Micro ohmeter

Notes: *Note: Found water in outgoing cable duct

Client Information

Customer	Festival Hydro			**Date Tested**	04/11/2019		
File Number	19IM-5104	**Customer Ref.**	Eric Cameron	**Ambient Temp**	5	**°C**	
Location	44 Chalk St S, Seaforth			**Tested By**	JV/AS		
Substation	Chalk Substation			**Approved By**	VG		
Equipment I.D.	S1-F3 Hospital Feeder						

Lightning Arrester Inspection

Nameplate Data						
Manufacturer	Ohio Brass			**Voltage**	5	**kVolts**
Cat #	217600			**MCOV**	2.55	**kVolts**
Serial #	NA	NA	NA	**Duty Cycle Rating**	NA	**kVolts**

Capacitance and Power Factor Test							
				Power factor			
Insulation Tested	**Test Mode**	**kV**	**Cap (pF)**	**Measured**	**Cor. to 20°C**	**mA**	**Watts**
CH-G - Aϕ	**GrndST**	NA	NA	NA	NA	NA	NA
CH-G - Bφ	**GrndST**	NA	NA	NA	NA	NA	NA
CH-G - Cφ	**GrndST**	NA	NA	NA	NA	NA	NA

Insulation Resistance (GΩ)				
@ 5 kVDC				
Ins. Type	**X Solid / Oil**	**φ A**	**φ B**	**φ C**
Insulation Res.	**@ 8 °C**	0.036	0.013	0.028
Corrected to 20°C		NA	NA	NA

Mechanical Inspections		
Description of Inspection	**Status**	**Comments**
	OK/FAIR/POOR/NA	
Insulator Surface Condition	*POOR	Low IR reading. Recommend replacement
Connector Condition	OK	Inspected
Grounding	OK	Inspected
Support Structure	OK	Inspected

Test Conditions	Cloudy 5 deg C
Results Satisfactory	POOR
Test Equipment	10KV AEMC Megger, 10A AEMC Micro ohmeter

Notes: * Recommend replacement of (3) Lightning Arrestors

Client Information

Customer	Festival Hydro			**Date Tested**	04/11/2019	
File Number	19IM-5104	**Customer Ref.**	Eric Cameron	**Ambient Temp**	5	°C
Location	44 Chalk St S, Seaforth			**Tested By**	JV/AS	
Substation	Chalk Substation			**Approved By**	VG	
Equipment I.D.	Varied					

Power Cable Inspection

Nameplate Data				
Manufacturer	Varied	**Voltage**	NA	**kVolts**
Insulation Type	NA	**Ambient Temp**	5	**°C**
Conductor Type	NA	**Humidity**	60	**%**

Electrical Tests

Feeder Identification	**Cables Per φ**	**Insulation Resistance (GΩ)** Aφ	Bφ	Cφ	A/B	B/C	**Tested @** Varied **kV** C/A
Tower Primary Cables	1	35.05	40.25	55.1	84.6	94.8	96.4
Pirelli XLPE/AL/4/OAWG							
S1-F1 Center Feeder	1	1510	1420	1104	3330	3330	3330
BICC//500 KCMIL							
S1-F2 South Feeder	1	408	811	600	1450	904	1663
BICC//500 KCMIL							
S1-F3 South Feeder	1	331	936	258	1215	1313	1412
BICC//500 KCMIL							
5KV Sec-Bus-Bars	1	1273	811	600	1459	904	1663

Test Conditions	Cloudy 8 deg C
Results Satisfactory	OK
Test Equipment	AEMC 10KV Megger

Notes: Cables information are not available - Faded

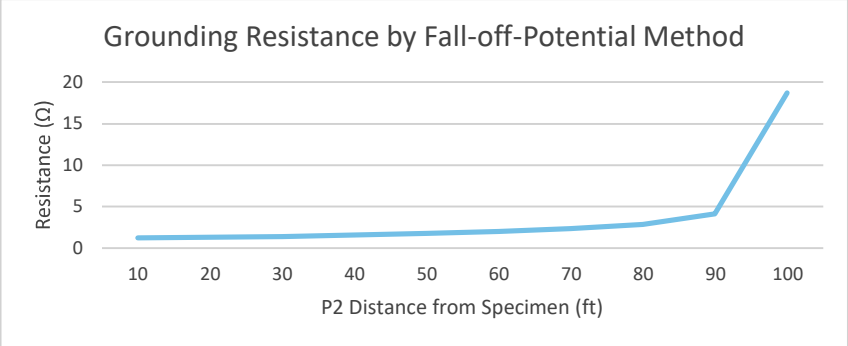
Client Information

Customer	Festival Hydro			**Date Tested**	04/11/2019	
File Number	19IM-5104	**Customer Ref.**	Eric Cameron	**Ambient Temp**	5	**°C**
Location	44 Chalk St S, Seaforth			**Tested By**	EW	
Substation	Chalk Substation			**Approved By**	VG	
Equipment I.D.	Substation Ground Resistance					

Equipment Ground Resistance

Test Conditions	
Soil Surface Type	Homogeneous
Ground Condition	wet (soaked)
Weather Condition	Cloudy 75% humidity

Electrical Tests



Distance of C2 from Specimen (ft)	Distance of P2 from Specimen (ft)	Resistance (Ω)
100	10	1.24
100	20	1.32
100	30	1.43
100	40	1.58
100	50	1.78
100	60	2.02
100	70	2.35
100	80	2.88
100	90	4.13
100	100	18.7

Results Satisfactory	OK
Test Equipment	Ground Tester

Notes:

Client Information

Customer	Festival Hydro			**Date Tested**	04/11/2019	
File Number	19IM-5104	**Customer Ref.**	Eric Cameron	**Ambient Temp**	5	**°C**
Location	44 Chalk St S, Seaforth			**Tested By**	EW	
Substation	Chalk Substation			**Approved By**	VG	
Equipment I.D.	Substation Equipment - Ground Resistance					

Equipment Ground Resistance

Electrical Tests			
Equipment Tested	**Points Tested**	**Measured Value (Ω)**	**Measured - Control (Ω)**
Control	NW FENCE	2.28	
NW FENCE	NE FENCE	2.39	2.39
NW FENCE	NE GATE (1)	2.35	
NW FENCE	NE GATE (2)	2.39	2.39
NW FENCE	27.6 KV SWITCH	2.3	
NW FENCE	SE FENCE	2.31	2.31
NW FENCE	DOG HOUSE	2.3	
NW FENCE	TX TAIL	2.31	2.31
NW FENCE	SWITCHGEAR	2.3	
NW FENCE	SW FENCE (1)	2.29	
NW FENCE	SW FENCE (2)	2.3	
NW FENCE	SW GATE	2.36	

Test Conditions	Cloudy 8 deg C
Results Satisfactory	OK
Test Equipment	Ground Tester

Notes:

Client Information

Customer	Festival Hydro			**Date Tested**	04/11/2019		
File Number	19IM-5104	**Customer Ref.**	Eric Cameron	**Ambient Temp**	5	**°C**	
Location	44 Chalk St S, Seaforth			**Tested By**	EW		
Substation	Chalk Substation			**Approved By**	VG		
Equipment I.D.	Substation General Inspection						

Substation Yard General Inspection

Mechanical Inspections		
Description of Inspection	**Status**	**Comments**
	OK/FAIR/POOR/NA	
Incoming Pole	OK	Inspected
Metal Enclosed Switchgear	OK	Inspected
Identification Signs	OK	Inspected
Warning Signs	OK	Inspected
Yard Debris	OK	Cleared
Weed Control	OK	Cleared
Ground Connections on Tower	OK	Inspected
Ground Connections on Switchgear	OK	Inspected
Ground Connections on Fence	OK	Inspected
Ground Connections on Gates	OK	Inspected
Ground Connections on Arresters	OK	Inspected
Ground Connections on Transformer(s)	OK	2 points - Inspected
Ground Grid + Rods Intact	OK	Inspected
Gradient Mat	OK	Inspected
Fence Assembly	OK	Inspected
Barbed Wire	OK	Inspected
Crushed Stone Depth	OK	Inspected

Lightning Arresters				
Manufacturer	Ohio Brass	**Voltage**	36	**kVolts**
Type/Cat #	PVI	**MCOV**	29	**kVolts**

Electrical Tests			
Test Description			
Ground Resistance	**Ω**	OK	

Test Conditions	Cloudy 5 deg C
Results Satisfactory	Satisfactory
Test Equipment	NA

Notes:

OMICRON TEST RESULTS

Festival Hydro - Chalk Substation

Client	Festival Hydro	4/10/2019 -44 Chalk St	
Execution date	4/11/2019	Reason of the job	Maintenance
Tested by	Alan See	Location	44 Chalk St, Seaforth
Approved by	Vern George	Asset	Transformer
Report ID	2	Asset type	Two-winding
Report issue date	4/12/2019 8:22:51 AM	Asset serial number	P1480-1
Work order	19IM-5104	Manufacturer	Westinghouse

Summary

As Found & Left @ Tap 4

Insulation Resistance :
H-G=8.53G @ 10KVDC
L-G=6.66G @ 5KVDC
H-L=15.33G@ 5KVDC

Polarization Index (PI):
H-G=8.53/2.55=3.34
L-G=6.66/1.5=4.44
H-L=15.33/4.65=3.29

LA's @ 27.6KV Incoming Pole:
A=35G @10KVDC
B=40.25G @10KVDC
C=55G @ 10KVDC

Performed tests	Assessment
Winding PF & CAP	Manual pass
Exciting Current	Manual pass
Turns Ratio test Prim-Sec	Pass
DC Winding Resistance Prim	Pass
DC Winding Resistance Sec	Pass

Overall Assessment	Satisfactory

Tested by:
Alan See

Approved by:
Vern George

Location & company information

Location	
Name	S/N: P1480-1
Region	
Division	
Area	
Plant	
Address	44 Chalk St,
City	Seaforth
State/Province	ON
Postal code	
Country	

Company	
Company	Festiva Hydro
Department	
Address	
City	
State/Province	
Postal code	
Country	
Phone No.	
Fax No.	
E-mail	

Geo coordinates	

Contact person	
Name	Eric Cameron
Phone No. 1	519-274-3748
Phone No. 2	
Fax No.	
E-mail	

Comment

Transformer nameplate data

Serial number	P1480-1	Apparatus ID	Main Transformer
Manufacturer	Carte	Feeder	
Manufacturing year	1987	No. phases	3
Manufacturer type		Vector group	Dyn11

Comment

As Found & Left @ Tap 4

Voltage ratings

Winding	Voltage L-L	Voltage L-N	Insul. level L-L
Prim	27.600 kV	kV	200 kV
Sec	4.160 kV	2.402 kV	75 kV

Power ratings

Rated power	Cooling class	Temp. rise wind.
MVA	ONAN	55

Current ratings at rated power

Winding		
Prim	Sec	Rated power
104.600 A	695.900 A	MVA

Short-circuit rating

Max. short-circuit current	kA	s

Impedances

Ref. temp.	65 °C

Short-circuit impedance Prim - Sec

uk[%]	Base power	Base voltage	Load losses Pk	OLTC position	DETC position
6.470 %	5.000 MVA	27.600 kV	W		4

Zero sequence impedance

Base power	5.00 MVA
Base voltage	27.600 kV
Description	Z0[%]
Secondary	6.47 %

Others

Status	In operation
Tank type	Sealed conservator
Insulation medium	Mineral oil
Fluid insulation volume	3168 l
Fluid insulation weight	2710 kg
Total weight	10886 kg

Test set information

Model	Serial number	Calibration date
TESTRANO 600	DL325X	2018-12-06
CP TD1	RM229Z	2018-12-02

Global test conditions

Weather	Cloudy- Drizzle	Humidity	80 %
Unit location	Outside	Ambient temperature	5 °C

Winding PF & CAP

Ambient temperature	5 °C	Weather	Cloudy
Top oil temperature	5 °C	Humidity	80 %

Comments

Test conditions:
Drizzle and lots of moisture during test.

Standard test

Block 1: injection at Prim

Corr. temperature	5 °C
Corr. factor	1

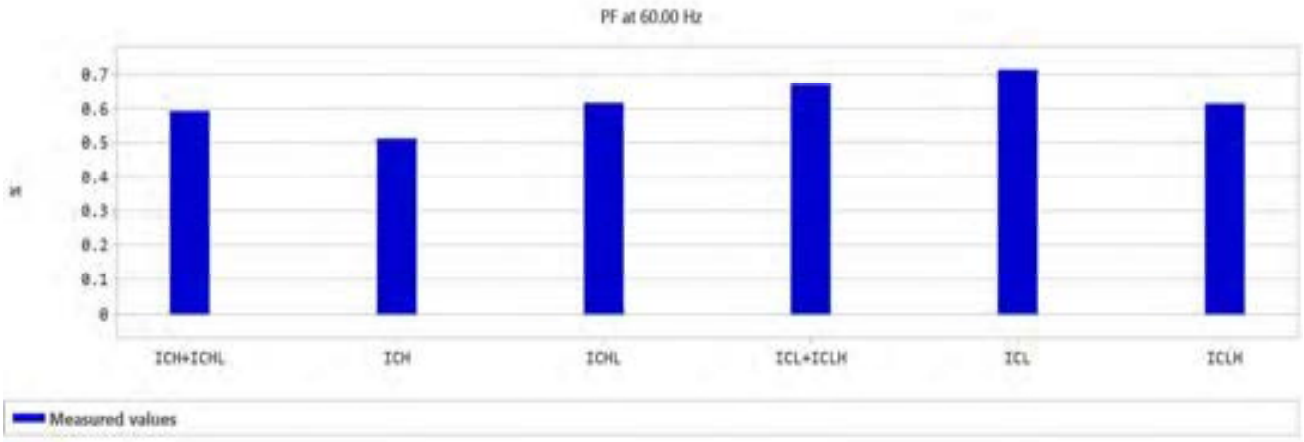
No.	Meas.	Test mode	Freq.	V out	I out	Watt losses	PF meas	PF corr	Cap. meas	Assessment
1	ICH+ICHL	GST	60.00 Hz	10.00 kV	45.41 mA	2689.42 mW	0.5923 %	0.5923 %	12043.7 pF	Man. pass
2	ICH	GSTg-A	60.00 Hz	10.00 kV	10.08 mA	513.14 mW	0.5092 %	0.5092 %	2670.4 pF	Man. pass
3	ICHL	UST-A	60.00 Hz	10.00 kV	35.34 mA	2178.53 mW	0.6165 %	0.6165 %	9373.3 pF	Man. pass

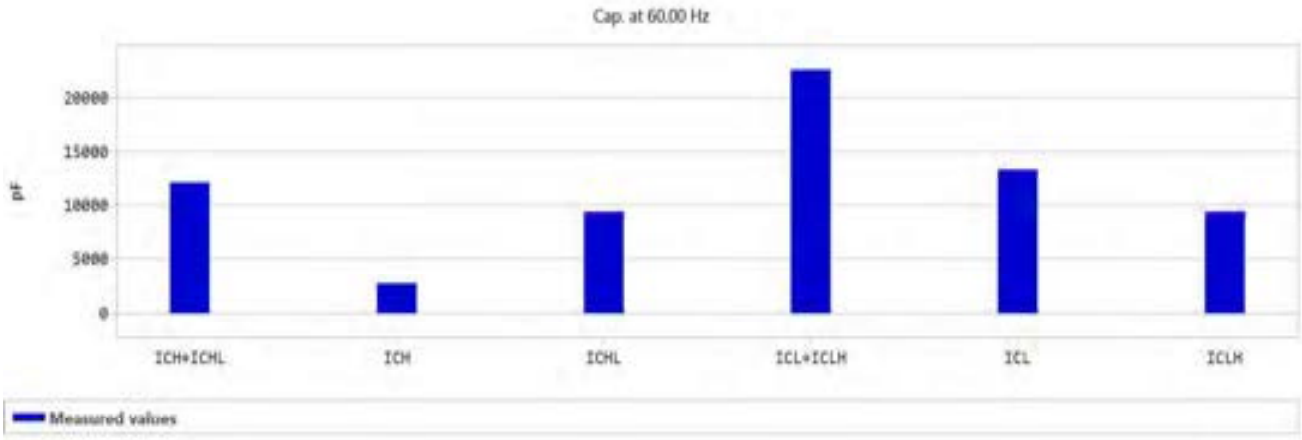
Block 2: injection at Sec

Corr. temperature	5 °C
Corr. factor	1

No.	Meas.	Test mode	Freq.	V out	I out	Watt losses	PF meas	PF corr	Cap. meas	Assessment
4	ICL+ICLH	GST	60.00 Hz	2.00 kV	17.11 mA	229.97 mW	0.6722 %	0.6722 %	22686.0 pF	Man. pass
5	ICL	GSTg-A	60.00 Hz	2.00 kV	10.04 mA	143.11 mW	0.7129 %	0.7129 %	13313.0 pF	Man. pass
6	ICLH	UST-A	60.00 Hz	2.00 kV	7.07 mA	86.89 mW	0.6145 %	0.6145 %	9377.0 pF	Man. pass

Graphs for standard test




Cap. at 60.00 Hz
pF
20000
15000
10000
5000
0
ICH+ICHL
ICH
ICHL
ICL+ICLH
ICL
ICLH
Measured values

Test set information

Model	Serial number	Calibration date
TESTRANO 600	DL325X	2018-12-06
CP TD1	RM229Z	2018-12-02

Exciting Current

Comment

Measurement settings

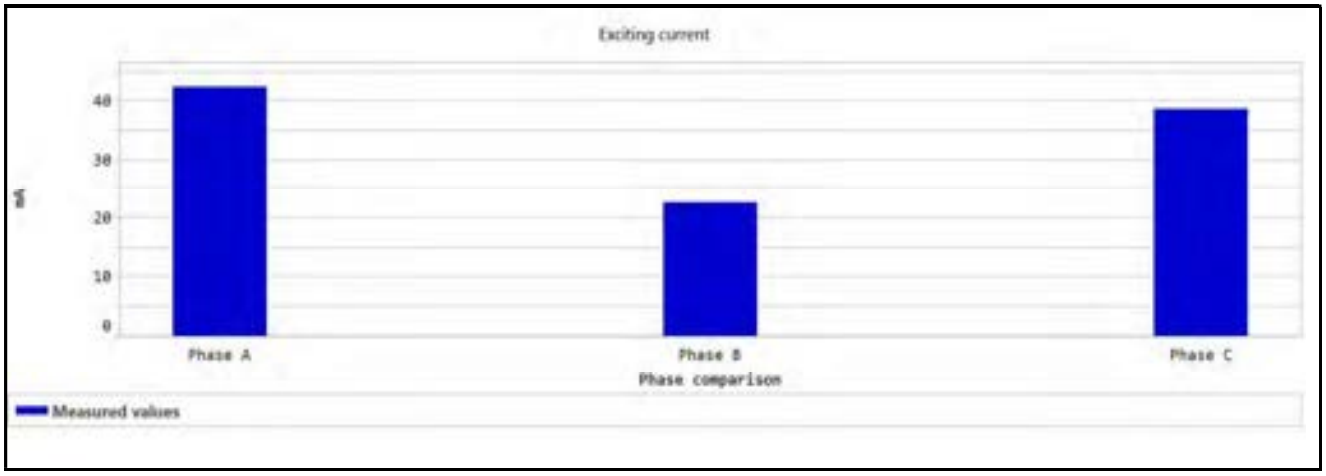
Test voltage	10 kV
Test frequency	60.00 Hz
Tap changer under test	DETC

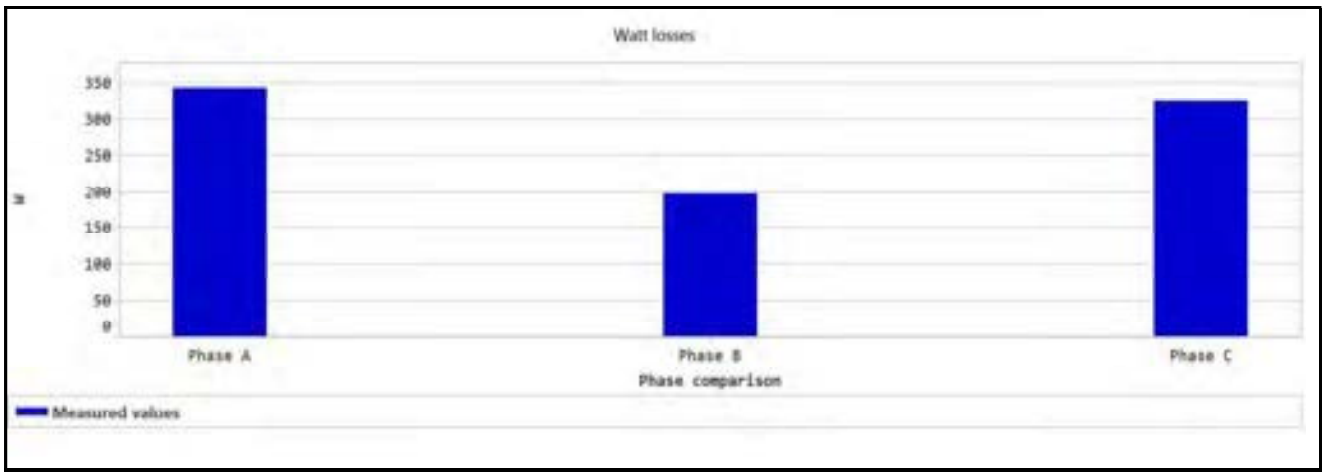
Averaging	2
Bandwidth	±20 Hz

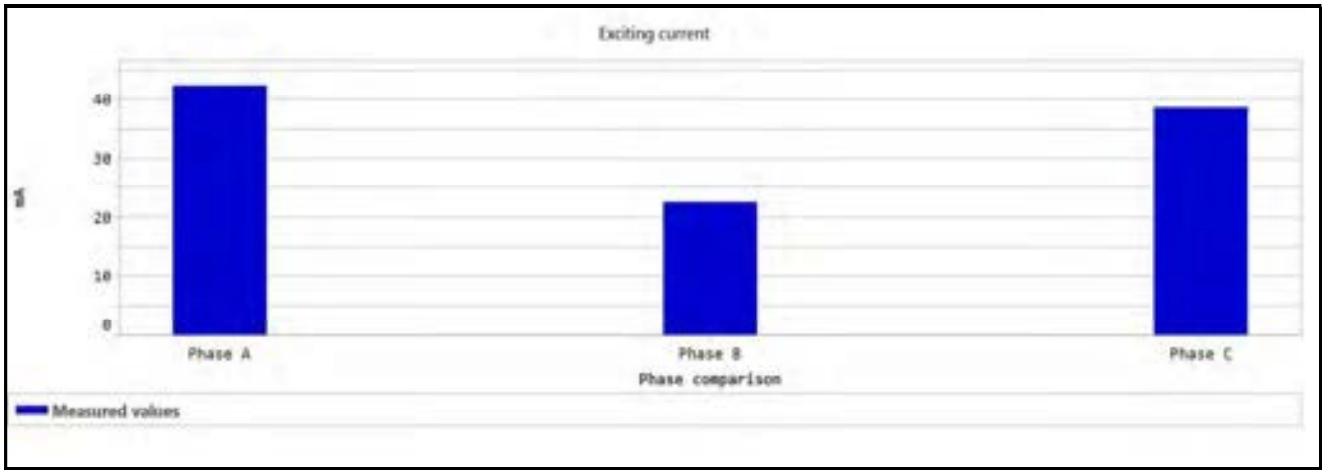
Use reference voltage	No

Measurements (sorted by tap)

Tap	*Phase*	*V out*	*I out*	*I phase*	*Watt losses*	*Reactance*	*Assessment*
4	A	10.00 kV	42.381 mA	-35.86 °	343.603 W	138.050 kΩ	Man. pass
4	B	10.00 kV	22.533 mA	-28.93 °	197.231 W	214.649 kΩ	Man. pass
4	C	10.00 kV	38.606 mA	-32.72 °	324.835 W	139.947 kΩ	Man. pass


Exciting current
40
30
20
10
0
mA
Phase A
Phase B
Phase C
Phase comparison
Measured values


Watt losses
350
300
250
200
150
100
50
0
W
Phase A
Phase B
Phase C
Phase comparison
Measured values


Exciting current
40
30
20
10
0
mA
Phase A
Phase B
Phase C
Phase comparison
Measured values

Test set information

Model	Serial number	Calibration date
TESTRANO 600	DL325X	2018-12-06

Turns Ratio test Prim-Sec

Comment

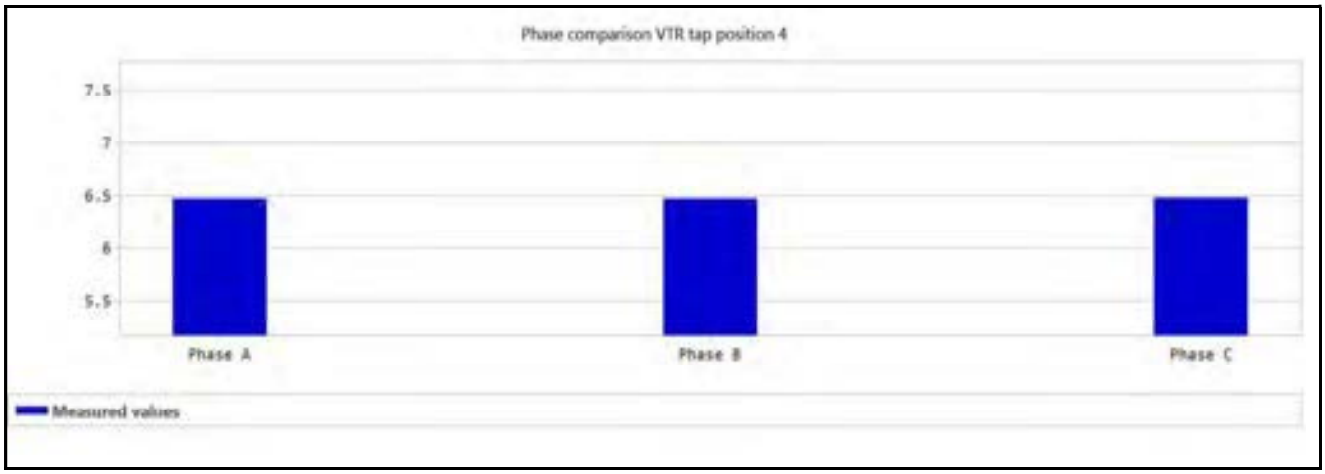
Measurement settings

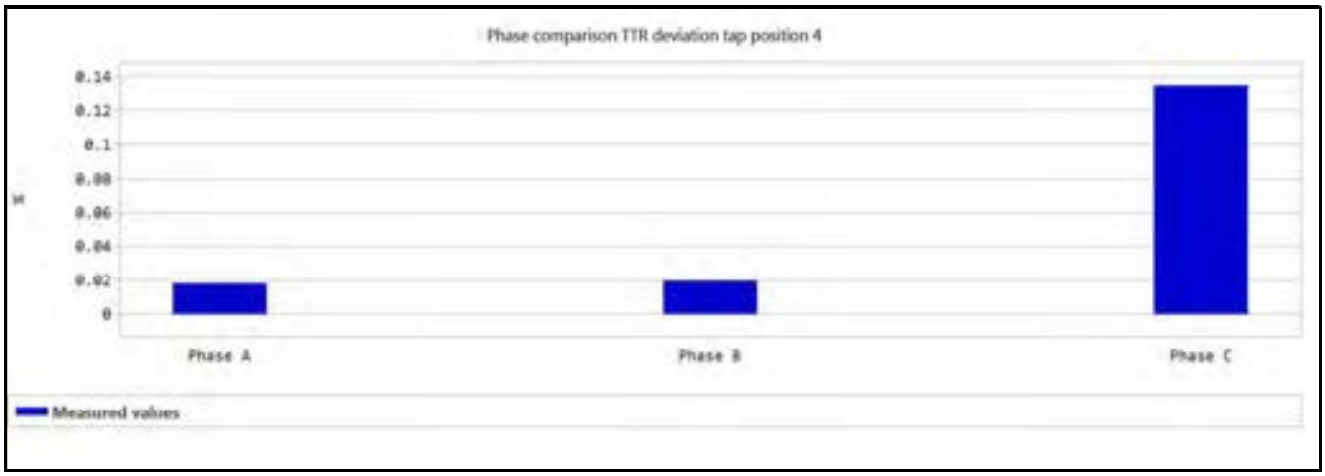
Test voltage	120 V
Test frequency	60.00 Hz
Tap changer under test	DETC

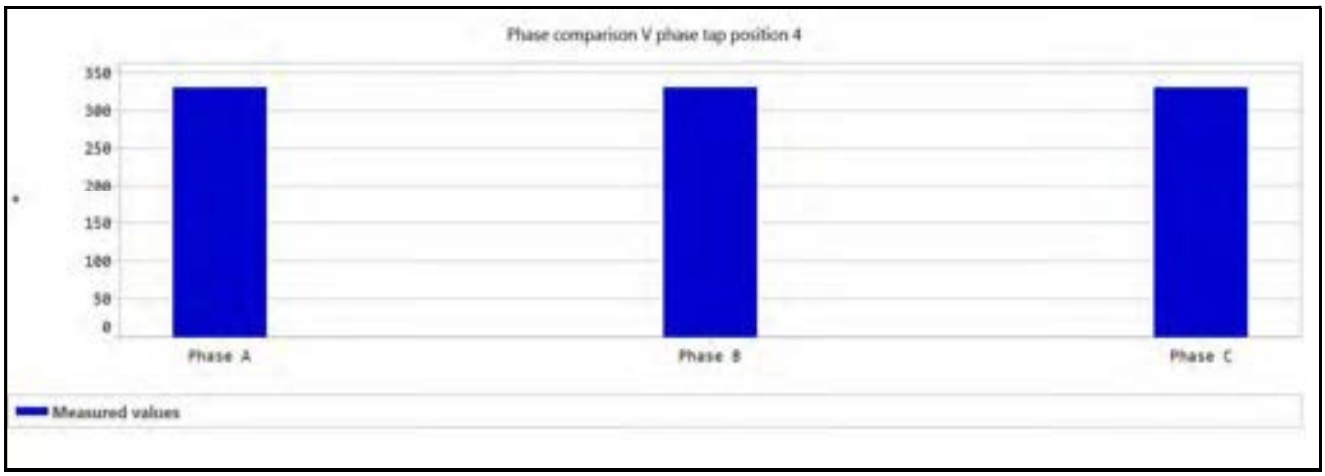
Measurements (sorted by tap)

Tap	*Phase*	*Nom. Ratio*	*V prim (L-L)*	*I prim*	*V sec (L-L)*	*V phase*	*VTR*	*Ratio dev*	*Assessment*
4	A	6.4688	119.92 V	4.930 mA	18.54 V	329.97 °	6.4699	0.02 %	Pass
4	B	6.4688	119.97 V	4.004 mA	18.54 V	330.04 °	6.4700	0.02 %	Pass
4	C	6.4688	119.96 V	3.332 mA	18.52 V	330.01 °	6.4775	0.13 %	Pass

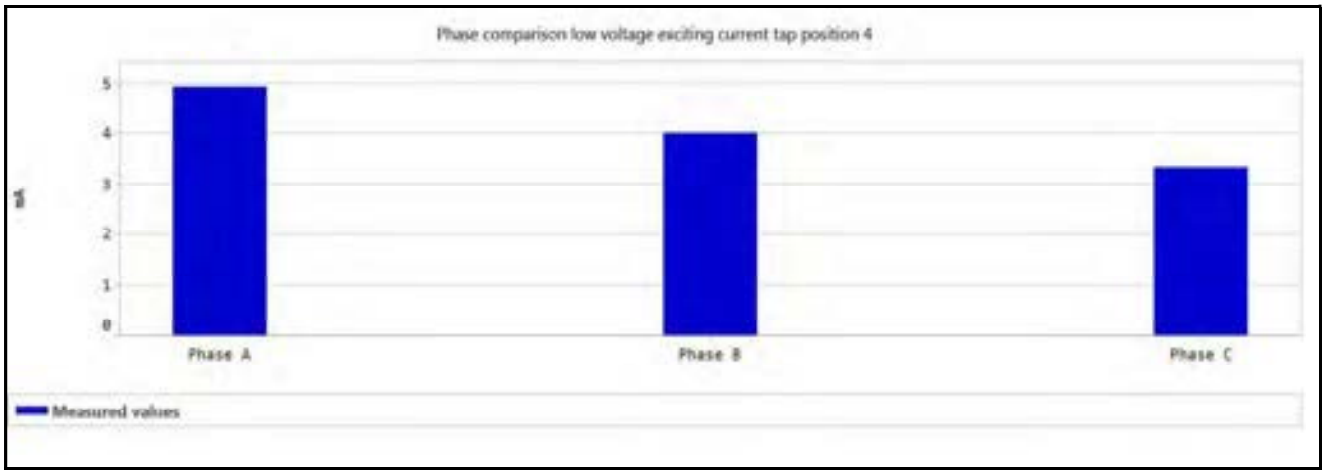
Graphs for standard test







Graph for low voltage exciting current



Test set information

Model	Serial number	Calibration date
TESTRANO 600	DL325X	2018-12-06

DC Winding Resistance Prim

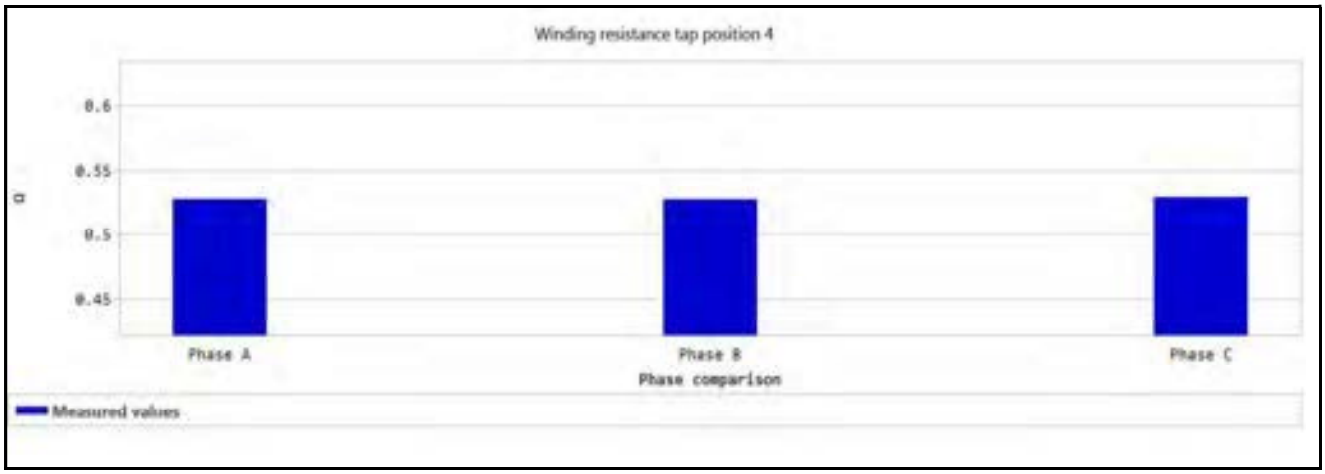
Comment

Measurement settings

Test current	5 A	Tap changer under test	DETC
Output mode	16 A @ 340 V		
	1 ph.		

	Phase A			*Phase B*			*Phase C*		
Tap	*R meas*	*R dev*	*R corr*	*R meas*	*R dev*	*R corr*	*R meas*	*R dev*	*R corr*
4	527.673 mΩ	0.000 %	527.673 mΩ	527.464 mΩ	0.001 %	527.464 mΩ	529.098 mΩ	0.001 %	529.098 mΩ

Graphs for standard test



Test set information

Model	Serial number	Calibration date
TESTRANO 600	DL325X	2018-12-06

DC Winding Resistance Sec

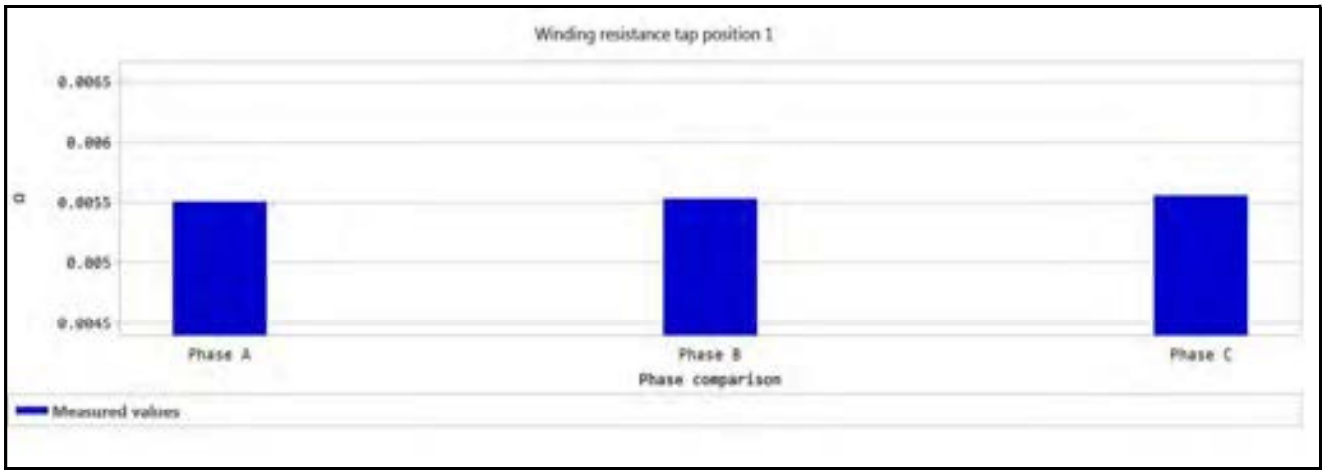
Comment

Measurement settings

Test current	5 A
Output mode	16 A @ 340 V
	1 ph.

Phase A			*Phase B*			*Phase C*		
R meas	*R dev*	*R corr*	*R meas*	*R dev*	*R corr*	*R meas*	*R dev*	*R corr*
5.506 mΩ	0.008 %	5.506 mΩ	5.531 mΩ	0.008 %	5.531 mΩ	5.556 mΩ	0.013 %	5.556 mΩ

Graphs for standard test



2019 Substation Maintenance Report - Oil Analysis

Chalk Station

44 Chalk Street, Seaforth, ON

Eric Cameron
Fetival Hydro
P.O. Box 397
Stratford, ON

K.P.C. POWER ELECTRICAL LTD. 395 Westney Road South
Ajax, ON CANADA L1S 6M6
T 905.683.6636 F 905.683.6668
kpcpower.com

June 3, 2019

Festival Hydro
P.O. Box 397
Stratford, On N5A 6T5

ATTENTION: Mr. Eric Cameron
Subject: Chalk Station – Substation Maintenance – Oil Analysis
Location: 44 Chalk Street, Seaforth, ON
Our Reference: **# 19IM-5104**

Dear Eric,

K.P.C. Power Electrical Ltd. (KPC) completed the Substation Maintenance program at the Chalk Substation located at 44 Chalk Street, Seaforth on April 11, 2019. Please find enclosed the oil analysis results from the site visit.

Please feel at liberty to contact our office, should you have any questions or concerns. Thank you for the opportunity to have been of service.

Yours Truly,

Vern George
Field Supervisor
K.P.C. Power Electrical Ltd. (KPC)

WEIDMANN

WEIDMANN ELECTRICAL TECHNOLOGY
919 FRASER DR. UNIT 13 + BURLINGTON, ON + L7L 4X8
905-632-8697 + 905-632-8698
WWW.WEIDMANN-ELECTRICAL.COM

TEST REPORT
01-7235098-592778-00

KPC Power Electrical Ltd	**Serial#:**	P14801	**Mfr:**	CARTE	**Control#:**	7235098
1111 BURNS ST. E	**Location:**	44 CHALK ST	**kV:**	27.6	**Order#:**	592778
UNIT 1	**Equipment:**	TRANSFORMER	**kVA:**	5000	**Account:**	6541
WHITBY, ON L1N 6A6 CA	**Compartment:**	MAIN(BOTTOM)	**Year Mf'd:**	1987	**Received:**	05/02/2019
ATTN: PAUL BECKMAN	**Breathing:**	SEAL	**Syringe ID:**		**Reported:**	05/16/2019
PO#: 19IM-5104	**Bank:**	**Phase:** 3	**Bottle ID:**			
Project ID: FESTIVAL HYDRO	**Fluid:**	MIN **Liters:** 3168	**Sampled By:**	JV		
Customer ID: T1						

		Lab Control Number:	7235098	7231747
		Date Sampled:	04/22/2019	04/11/2019
		Order Number:	592778	591870
		Oil Temp:	15	
Dissolved Gas Analysis (DGA)		**Hydrogen (H2) (µL/L):**		<2
ASTM		**Methane (CH4) (µL/L):**		10
D-3612		**Ethane (C2H6) (µL/L):**		2
		Ethylene (C2H4) (µL/L):		4
		Acetylene (C2H2) (µL/L):		<1
		Carbon Monoxide (CO) (µL/L):		888
		Carbon Dioxide (CO2) (µL/L):		4016
		Nitrogen (N2) (µL/L):		69206
		Oxygen (O2) (µL/L):		16194
		Total Dissolved Gas (TDG) (µL/L):		90320
		Total Dissolved Combustible Gas (TDCG) (µL/L):		904
		Equivalent TCG (%):		0.821
DGA		**DGA Keys Gas / Interpretive Method:**		
Diagnostics		**PER IEEE C57.104-2008** (most recent sample)		
		DGA TDCG Rate Interpretive Method:		
		PER IEEE C57.104-2008 (two most recent sample)		
		DGA Cellulose (Paper) Insulation:		
Comment:				
General Oil Quality (GOQ)				
ASTM D-1533	**Moisture in Oil**	**(mg/kg):**		5
ASTM D-971	**Interfacial Tension**	**(mN/m):**		32.57
ASTM D-974	**Acid Number**	**(mg KOH/g):**		0.011
ASTM D-1500	**Color Number**	**(ASTM):**		L1.5
ASTM D-1524	**Visual Exam.**	**(Relative):**		PASS
				CLR&BRIGHT
ASTM D-1524	**Sediment Exam.**	**(Relative):**		ND
ASTM D-1816	**Dielectric Breakdown 2 mm**	**(kV °C):**		60 (23°C)
ASTM D-924	**Power Factor @ 25°C (Routine)**	**(%):**		0.251
ASTM D-4052	**Density @15°C**	**(g/mL):**		0.8788
ASTM D-2668	**Oxidation Inhibitor**	**(wt. %)**		0.077
Comment:				
Furanic Compound		**2-Furaldehyde (µg/L):**		< 10
ASTM D-5837		**5-Hydroxy-methyl-furaldehyde (µg/L):**		< 10
		2-Acetylfuran (µg/L):		< 10
		5-Methyl-2-furaldehyde (µg/L):		< 10
		2-Furyl alcohol (µg/L):		< 10
Furanic Compound Diagnostics (most recent sample):				

Notations: 1. Analysis is ISO/IEC 17025:2017 accredited, ANAB Accredited Certificate Number L2303 2. This test is conducted by a subcontracted laboratory. 3. Subcontracted laboratory has received ISO Standard 17025 accreditation for this test. 5. This test is conducted by Weidmann Laboratory other than Primary Lab. 6. Weidmann Laboratory has received ISO Standard 17025 accreditation for this test. 7. Imported Sample: WEIDMANN Electrical Technology accepts no responsibility for these results; accreditation status does not apply to these results. 8. Imported Equipment 10. mg/kg , µg/g, µg/mL, µL/L = ppm, µg/L = ppb, mN/m = dynes/cm, mm²/s = cSt

KPC Power Electrical Ltd	**Serial#:**	P14801	**Mfr:**	CARTE	**Control#:** 7235098
1111 BURNS ST. E	**Location:**	44 CHALK ST	**kV:**	27.6	**Order#:** 592778
UNIT 1	**Equipment:**	TRANSFORMER	**kVA:**	5000	**Account:** 6541
WHITBY, ON L1N 6A6 CA	**Compartment:**	MAIN(BOTTOM)	**Year Mf'd:**	1987	**Received:** 05/02/2019
ATTN: PAUL BECKMAN	**Breathing:**	SEAL	**Syringe ID:**		**Reported:** 05/16/2019
PO#: 19IM-5104	**Bank:**	**Phase:** 3	**Bottle ID:**		
Project ID: FESTIVAL HYDRO	**Fluid:** MIN	**Liters:** 3168	**Sampled By:**	JV	

Customer ID: T1

	Lab Control Number:	7235098	7231747
	Date Sampled:	04/22/2019	04/11/2019
	Order Number:	592778	591870
	Oil Temp:	15	

New insulation with a high degree of mechanical strength will typically have a Degree of Polymerization (DP) of 1000-1300. "Middle Aged" paper is approximately 500 and paper with less than 250 is in its "Old Age." Severely degraded insulation with a DP of 150 or less will have very little mechanical strength and may result in a transformer failure. The above estimations are based on a study by Chendong of GSU transformers filled with mineral oil.

Estimated Average Degree of Polymerization (DP):

Estimated Operating Age of the Equipment:

Notations:

Comment:

Particle Count	**>= 4 µm(c)/mL:**	1069
ASTM D-6786[5]	**>= 6 µm(c)/mL:**	393
	>= 10 µm(c)/mL:	137
	>= 14 µm(c)/mL:	76
	>= 21 µm(c)/mL:	42
	>= 38 µm(c)/mL:	11
	>= 70 µm(c)/mL:	1
	ISO CODE:	17/16/13
	Diagnostics:	Particle Count High. Filtration or replacement is strongly recommend.

Comment:

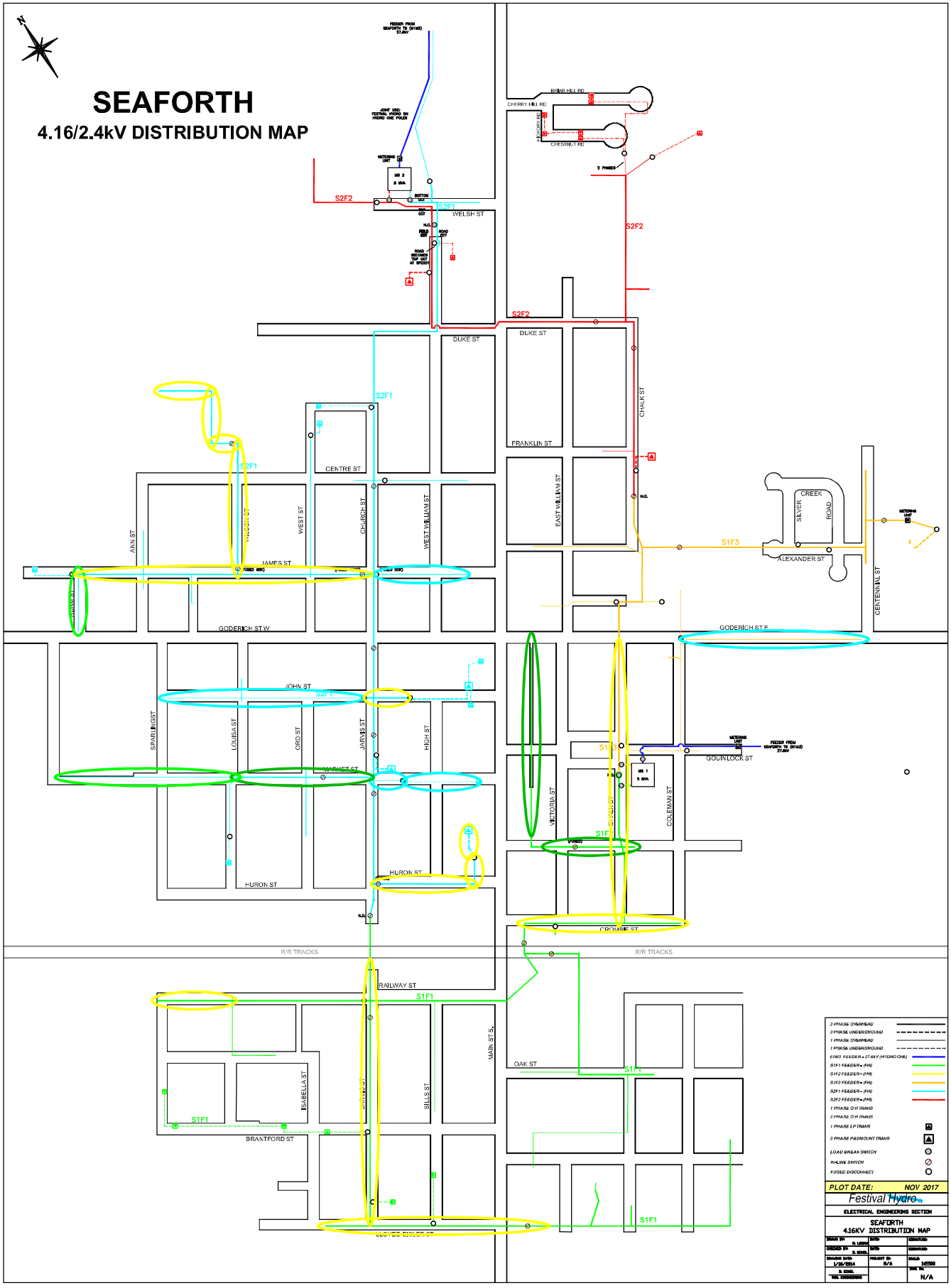
End of Test Report

Authorized By:

JANET KAROLAT
SUPV CHEMIST

Notations: 1. Analysis is ISO/IEC 17025:2017 accredited, ANAB Accredited Certificate Number L2303 2. This test is conducted by a subcontracted laboratory. 3. Subcontracted laboratory has received ISO Standard 17025 accreditation for this test. 5. This test is conducted by Weidmann Laboratory other than Primary Lab. 6. Weidmann Laboratory has received ISO Standard 17025 accreditation for this test. 7. Imported Sample: WEIDMANN Electrical Technology accepts no responsibility for these results; accreditation status does not apply to these results. 8. Imported Equipment 10. mg/kg , µg/g, µg/mL, µL/L = ppm, µg/L = ppb, mN/m = dynes/cm, mm²/s = cSt

Appendix D – Feeder Framing Assessment


SEAFORTH
4.16/2.4kV DISTRIBUTION MAP
S2F2
S2F1
WELSH ST
DUKE ST
CHERRY HILL RD
CHESTNUT RD
CHALK ST
FRANKLIN ST
EAST WILLIAM ST
WEST WILLIAM ST
CHURCH ST
CENTRE ST
WEST ST
ANN ST
JAMES ST
GODERICH ST W
GODERICH ST E
S1F3
CREEK
SILVER
ROAD
ALEXANDER ST
CENTENNIAL ST
JOHN ST
SPARLING ST
LOUISA ST
ORD ST
JARVIS ST
HIGH ST
MARKET ST
HURON ST
S1F2
VICTORIA ST
COLEMAN ST
GODERICH ST
GOULDLOCK ST
R/R TRACKS
RAILWAY ST
S1F1
MAIN ST S
OAK ST
ISABELLA ST
SILLS ST
BRANTFORD ST
3 PHASE OVERHEAD
3 PHASE UNDERGROUND
1 PHASE OVERHEAD
1 PHASE UNDERGROUND
61M3 FEEDER - 27.6kV (HYDRO ONE)
S1F1 FEEDER - (FH)
S1F2 FEEDER - (FH)
S1F3 FEEDER - (FH)
S2F1 FEEDER - (FH)
S2F2 FEEDER - (FH)
1 PHASE O/H TRANS
3 PHASE O/H TRANS
1 PHASE LP TRANS
3 PHASE PADMOUNT TRANS
LOAD BREAK SWITCH
IN-LINE SWITCH
FUSED DISCONNECT
PLOT DATE: NOV 2017
Festival Hydro
ELECTRICAL ENGINEERING SECTION
SEAFORTH
4.16KV DISTRIBUTION MAP
N/A

Appendix N

AMI 2.0 Evaluation Summary