Ottawa River Power Corporation
Substation
Condition Assessment Report

Project: 17153

costello
Utility Consultants

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0	A.Rist September 25/17			Issued for internal comment
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2				

1 EXECUTIVE SUMMARY

Costello Utility Consultants has been retained by Ottawa River Power Corporation to perform a substation condition assessment on eleven municipal substations. These substations include eight in Pembroke and three in Almonte. The typical useful life of major substation equipment is about forty-five (45) years, and nine of eleven stations are over forty (40) years old. Our assessment indicates that there are safety and reliability issues associated with both the age and the condition of the station equipment.

Major issues identified require immediate attention for public safety. Many of the station fences were missing barbed wire at the top, or have gaps along the bottom. The security of the fence is crucial to keeping the public away from dangerous equipment. Some fences have grounding and bonding issues, and if left uncorrected, could lead to a shock if someone were to touch the fence during a fault. Another public safety concern is the overcurrent protection and automatic reclosing settings on the stations. Some stations lack ground fault protection, and therefore expose the public and electrical apparatus to fault conditions beyond recommended practice. ORPC also provides up to four automatic circuit recloses to attempt to clear transient faults. Typical urban LDC's allow only one attempt for reclosing, as there is a higher probability of the public being involved (for example motor vehicle accidents).

A concern to public and worker safety is the unconventional station neutrals in Pembroke. Seven of the substations have direct buried copper neutrals, which look like regular ground connections on the poles. Copper thieves usually choose the ground wire to cut, but if they were to cut the station neutral they could be exposed to high voltage. This hazard could exist to the general public should this neutral connection be cut, tampered with, or be accidentally damaged. It is also dangerous for workers who need to attach equipment to the ground grid for the same reason. The only station (MS8) using a different neutral method had the wire which was assumed to be the system neutral cut. Station neutrals should be checked, and then replaced with a neutral system that is installed as per technical standards.

Worker safety is also high priority for utilities. Many of the stations have low clearances for the incoming 44kV equipment, and some stations cannot be entered without being within safe limits of approach. This can be a major worker safety issue, especially in bad weather and outage conditions. Some stations are equipped with indoor mini oil circuit breakers, which contain flammable oil as the electrical insulator. If a failure was to happen in these breakers, an explosion fueled by the oil will exasperate the already dangerous arc flash situation.

The Almonte area is experiencing high load growth as the residential housing booming due to close proximity to Ottawa. Two of the three existing stations require some or total replacement, and one new station is required for growth.

The ORPC stations are in serious need of capital replacement. It is our opinion that ORPC should develop a plan for the, repair, replacement and/or elimination of most of its substations.

2 INTRODUCTION

As part of Ottawa River Power Corporation's (ORPC) Asset Management Program, Costello Associates Inc. has been engaged to provide a preliminary assessment of eight (8) municipal distribution substations in Pembroke and three (3) in Almonte. This assessment is based on visual inspections and limited maintenance records that were available at the time of the inspections.

This initial assessment is intended to provide the foundation for an ongoing program that includes capital planning, periodic maintenance, inspections, and testing.

2.1 Goals of Asset Condition Report

Asset management plans are necessary to provide a long term, systematic approach to system planning, as well as managing business and operational risk. Utilities utilize strategies for replacing aging assets, taking into consideration factors such as health and safety, environment, asset condition, life expectancy, and risk exposure.

As part of the overall asset condition process, the assessment of the condition of ORPC's municipal substations can be used to prioritize stations rehabilitation and replacement projects, based on electrical condition, health and safety issues, and age.

2.2 Criteria for Substations Assessment

All stations were field inspected and assessed based on two evaluation models. The first model was developed by Thunder Bay Hydro, with minor changes based on our own experiences.

In determining the overall condition of a station, the evaluation model considers three main areas of concern:

- Public Safety
- Worker Safety
- Risk of Major Equipment Failure

Classification ratings of the above categories are as follows:

- Blue – excellent condition. No mitigation is required for twenty or more years.
- Purple –good condition. No mitigation is required for eleven to twenty years.
- Yellow – average condition. Mitigation is required between four and 11 years.
- Orange – fair condition. Mitigation is required between two to three years.
- Red – poor condition. Mitigation is required immediately, within one year.

The second evaluation model is a points-based system, which considers equipment operating condition, usually based on detailed knowledge gained from maintenance and testing.

2.3 Summary of Stations Deficiencies

Deficiencies in the stations area can be classified in three main areas: age, environmental, and public/worker safety.

2.3.1 Age

Major substation equipment such as power transformers and switchgear have a typical useful life (TUL) of forty-five (45) years[1]. Other equipment, such as insulated feeder cables, protection systems, batteries, and building structures may have shorter life expectancy. Life expectancy can often be extended with regular maintenance.

The ORPC utility average age of the major substation equipment assessed is approximately 48 years in Pembroke, and 35 years in Almonte. Nine of the eleven stations are older than forty years. **Clearly the age of the stations is a concern, and will require a strategy for replacement.**

2.3.2 Environment

The most typical utility source of environmental concerns in substations is PCB contamination. To the best of our knowledge ORPC has no contaminated substation transformers or circuit breakers in its substations. We have no knowledge if older transformers were once PCB contaminated and cleaned. If so, it is possible that the soil in some of the substations has been contaminated with PCB's as a result of minor transformer leaks. No soil analysis was performed as part of this assessment. It is expected that in the event that any substation be decommissioned, a detailed soil study would be completed and any problems be dealt with in accordance with applicable regulations.

A significant environmental concern with several stations is the close proximity to storm drains, ditches, municipal water supplies, and open water (Ottawa River and Mississippi River). Should there be a catastrophic failure of a power transformer, some of the ORPC stations have oil containment features and some do not. It is therefore possible that a large quantity of transformer oil may be released. The utility would be held accountable to clean up such a spill and the costs for cleaning a spill into a river or lake would be substantial. This poses a significant environmental risk, and therefore stations in proximity to water, ditches, or storm drains were assigned low ratings in the environmental category.

The use of oil containment systems in small distribution substations historically was not considered necessary. However, we strongly believe that the benefits of oil containment outweigh the present-day risks and liabilities associated with a major oil leak. We recommend that ORPC install oil containment as part of any stations rehabilitation work and on any new stations constructed in the future.

2.3.3 Public and Worker Safety

Public and worker safety is often considered the highest priority for any electric utility. Any station with a public safety issue automatically resulted in the lowest "Code Red" classification. Serious worker safety issues also attracted this classification. It should be noted that in some cases the work required to remedy safety issues is minor, and could be completed very quickly. These stations could then be reclassified to a more favorable rating.

Common safety issues observed include non-standard station neutral connections, very low clearances to high voltage components within stations[2], low clearances to station fences (public safety), and entry control by perimeter fences (public safety).

[1] Kinectrics Inc. Report No: K-418033-RA-001-R000 prepared for the OEB July 2010.
[2] The OSHA and IHSA minimum limit of approach to energized primary is 3.0m (10 feet).

The Ontario Electric Safety Code (OESC) has very specific rules regarding station fencing, and most utilities use fencing standards that go beyond the OESC requirements to ensure public safety. For example, the fence fabric needs to be within two inches of the ground, at least six feet high, and topped with three strands of barbed wire. Most LDCs ensure the fabric is buried at least 150mm in the crushed stone, and is least 7.5 feet high, and topped with three strands of barbed wire. There were multiple stations which had gaps below the fence, or the bottom of the chain-link was not tensioned to prevent a larger gap. For most stations, especially with decorative fences, the barbed wire was either missing or broken. The metal portions of fence constructs must also be bound to the ground grid, which was not the case in some of the stations.

The station neutrals are a large concern for public and worker safety. The bare 3/0, direct buried station neutrals look as if they were simply ground wires. They could easily be mistaken and then cut, either for grounding access or by copper thieves. This would leave a dangerous voltage accessible to whoever cut the wire, as well as the public in general. Even touching the bare wire could cause a shock if a fault were to occur at the same time. We suspect that all stations may have problems with their transformer neutral to distribution system neutral connections. This is a critical safety concern to both the public and to utility workers. It is recommended that this be further investigated by engineering and maintenance personnel during planned maintenance.

Another common issue noted in many substations is the overcurrent protection and reclosing methodology. Many stations have four reclose attempts before lockout, which is not common practice in an urban environment. Urban faults have a high probability of human interference, such as a motor vehicle accident, and it is common utility practice to have one fast and one slow reclose attempt to lockout. The first auto-reclose attempt on a few of the stations is instantaneous. The Hydro One Standard suggests 600ms as the minimum time to reclose, which helps prevent fault restrike. There is also no ground protection on many feeders, which is also a public safety concern, as low current ground faults will not be seen by the protection equipment.

2.4 Enabling Stations for Future Smart Grid Initiatives

SCADA is seen by electric utilities as an invaluable tool for monitoring and measuring their system's performance. SCADA systems are installed at most Ontario LDC's. All of the Pembroke stations have SCADA equipment installed, although the MS-1 station RTU failed about two years ago. None of the Almonte stations have SCADA.

Two of the three Almonte stations have some SCADA capabilities, and could be connected to the Pembroke SCADA system with minimal expense

The current SCADA system uses ORPC-owned copper communication circuits. These circuits require overvoltage protection in order to protect workers and equipment. None of the ORPC stations have this voltage protection, and this is a serious safety concern for workers.

3 SUBSTATION CONDITION ASSESSMENT SUMMARY

3.1 Pembroke MS-1 Substation

The Pembroke MS-1 substation in its present form is well over 60 years old. We understand that this station was originally constructed in 1917.The three single phase transformers were installed in 1955, the switchgear in 1962, and other components have been replaced since then.

The station is located in downtown Pembroke next to the ORPC office. The proximity to the office, fence, and office windows makes the location of the station a concern. This building is in close proximity to the high voltage structure, and does not meet the minimum clearance requirements under the Ontario Building Code. We are concerned with this close proximity in terms of low

clearances, site security (windows that open into the substation yard), and station grounding. In addition, the decorative fence does not meet the security requirements of the Ontario Electric Safety Code.

The high voltage components of MS1 are quite low to the ground and have very low limits of approach. This can be very dangerous for workers, whether they are working in the station or have a slip and fall incident. Workers breach limits of approach by entering the station. There are also office windows which are located too close to high voltage porcelain equipment, which has been known to explode under certain circumstances.

The three power transformers were manufactured in 1955, making their age 62 years. They are past their expected end of life.

The low voltage switchgear for this station is in an office environment, inside the main ORPC office. Desks, printers, and files in a switchgear room in conflict with OESC, and could cause unqualified personnel to enter the high voltage area. These obstructions should be removed from the room immediately.

The station neutral is a direct buried bare 3/0 wire. This is not standard practice and is a hazard to public and workers. The bare copper wire makes the neutral look like most pole grounds which can cause a dangerous situation if someone were to cut into it for any reason.

Given the age of this station, the concerns regarding its close proximity to the adjacent buildings, and its sensitive location in the downtown area, we recommend that this station be a candidate for complete replacement. If possible, the station should be relocated to a more suitable area. Relocating the station would also aid in continuity of service to the generator which feeds Pembroke through MS1, as the existing MS1 could function until the new station is ready for service.

3.2 Pembroke MS-2 Substation

The Pembroke MS-2 substation was installed in 1968, and has been partially reconstructed. The condition assessment was rated poorly due to problems with the perimeter fencing and the installed solar panels. It is our understanding that since the inspection took place, the solar panel issue has been remediated.

The power transformer was manufactured in 1968, making its age 49 years.

This station is equipped with indoor mini-oil circuit breakers that are past end of life. These breakers are filled with combustible insulating oil, and therefore have an increased risk of fire and arc flash should there be a catastrophic switchgear failure. Most utilities have removed indoor oil-filled circuit breakers from service.

The station neutral is a direct buried bare 3/0 wire. This is not standard practice and is a hazard to public and workers. The bare copper wire makes the neutral look like most pole grounds which can cause a dangerous situation if someone were to cut into it for any reason.

This station could be easily upgraded with new three phase electronic reclosers that would offer improved protection and coordination, and compatibility with SCADA and Smart Grid (SG) applications. A complete design for the station upgrade was provided by Costello in 2014 and this station could be completely upgraded with minimal effort

3.3 Pembroke MS-3 and MS-7 Substations

The Pembroke MS-3 and MS-7 substations share one yard. The MS-3 substation is a 4.16kV secondary and the MS-7 is a 13.8kV secondary. Both stations are quite old, 50 and 43 years, with their original transformers.

The station received an “Orange” rating on its evaluation, mainly due to concerns with public and worker safety. The grounding and bonding inside of the stations is not up to code, and there are security issues with the fence.

Both station transformers have exceeded their expected end of life. The metal clad switchgear buildings are not properly grounded and bonded, as well as having some structural issues.

The MS3 station is equipped with indoor mini-oil circuit breakers that are past end of life. These breakers are filled with combustible insulating oil, and therefore have an increased risk of fire and arc flash should there be a catastrophic switchgear failure. Most utilities have removed indoor oil-filled circuit breakers from service.

The station neutrals are direct buried bare 3/0 wire. This is not standard practice and is a hazard to public and workers. The bare copper wire makes the neutral look like most pole grounds which can cause a dangerous situation if someone were to cut into it for any reason.

Given the age, condition, and safety issues with this station, it is a candidate for complete replacement. ORPC should consider the replacement of the switchgear with new arc resistant switchgear or outdoor three phase reclosers.

3.4 Pembroke MS-4 Substation

The Pembroke MS-4 substation was installed in 1958, with a transformer which was constructed in 1963. This means that the transformer is 54 years old, and has exceeded its typical life expectancy.

This station received a “Red” condition rating due to public and worker safety concerns.

The station fence is circumvented by part of a 44kV structure which is outside of the station fence. The structure could be climbed and a person standing next to the support is within limits of approach. Although the 44kV structure is in an ORPC equipment yard, the yard fence is not locked during the day and does not meet OESC requirements for a substation. The station is in a residential area with homes around. There is the possibility that a child could enter the yard and climb the structure, easily coming within limits of approach for the 44kV circuit breaker.

Structures inside of the station fence are low and require secondary fencing for worker safety. With the low clearance for the 44kV structures and equipment, there could easily be a slip and fall accident where the worker accidentally comes in contact with high voltage. Even working on other parts of the station allow the worker to carry equipment within limits of approach. The low structures should be fenced off to keep workers away from the equipment except under maintenance situations.

This station has issues with grounding. The fence is not properly bonded, and requires some upgrades and maintenance to meet OESC. The current ground grid does not encompass the gate swing, if a fault were to happen, a person could be in contact with the fence or gate and not be protected by the ground grid leading to a touch or step-potential shock.

The station neutrals are direct buried bare 3/0 wire. This is not standard practice and is a hazard to public and workers. The bare copper wire makes the neutral look like most pole grounds which can cause a dangerous situation if someone were to cut into it for any reason.

Given the age, condition, and safety issues with this station, it is a candidate for complete replacement. At a minimum, the station fence must be fixed to remediate the public safety concerns.

3.5 Pembroke MS-5 Substation

The Pembroke MS-5 substation was constructed in 1968. This station is built as a residential bungalow in order to esthetically fit into the surrounding residential neighborhood.

This type of construction in residential neighborhoods was quite common in the 1960's and 70's. This station however, was constructed with a "home-made" 44 kV structure mounted directly on the roof of the house. This is not typical, and provides an opportunity for someone to use a ladder to access the roof and come into contact with the 44 kV supply. These stations typically have underground incoming and outgoing connections, which would guard against someone coming in contact.

We understand that the residential loads currently supplied by this station have mostly been converted to 13.8 kV. We recommend that this station NOT be re-energized, and that ORPC investigate alternatives to safely supply the load to this area from other stations.

3.6 Pembroke MS-6 Substation

The Pembroke MS-6 station was constructed in 1976, with some work done in recent years. The station appears to be in reasonable condition, although there are minor maintenance issues. The station received a "Red" condition rating due to the fence grounding and station neutrals, but with some repairs to the station fence and replacing the station neutral, the condition rating will become "Blue" and its equipment should provide many more years of reliable service.

The station neutrals are direct buried bare 3/0 wire. This is not standard practice and is a hazard to public and workers. The bare copper wire makes the neutral look like most pole grounds which can cause a dangerous situation if someone were to cut into it for any reason.

3.7 Pembroke MS-8 Substation

The Pembroke MS-8 substation was constructed in 1985. The transformer is the youngest in Pembroke at 26 years, and should still have several years of service left.

This station received a "Red" condition assessment due to multiple public and worker safety issues.

The fence around the station does not meet the requirements for security as specified in the OESC. The security of the fence is greatly compromised by the fire escape on the restaurant next door. The fence has large brick and cement posts, which provide a large landing pad for anyone wishing to jump the fence from the fire escape.

The 44 kV connections to the power transformer are very low to the ground, as is a hazard for utility workers. The design of this station does not meet clearance standards per CSA or the OESC. ORPC has placed numerous signs warning of this condition, but in our opinion, this would not relieve ORPC from responsibility should there be an accident. One view could be that ORPC was aware of the issue, and chose not to fix it. We recommend that at a minimum, additional

fencing be installed per an approved design, until this structure could be effectively raised or replaced.

This station also has ABB DPU protection relays, with an instantaneous reclosing configuration. As per typical Hydro specifications, we recommend one automatic reclose attempt in urban areas, with a minimum reclose delay of 600ms.

3.8 Almonte MS-1 Substation

The Almonte MS-1 substation was reconstructed in 2009. The station is built along the Mississippi River, but has secondary oil containment to prevent oil leaks into the river.

This station received a “Red” condition assessment due to worker safety issues.

The indoor electrical switchgear is a padmount design G&W Viper reclosers and S&C Electric Vista switchgear. The connections to this equipment are via 600A bolt-on elbows. This equipment is not installed inside a separate metal enclosure. IHSA rules require that these elbows be treated as live equipment, and therefore this indoor location is by definition a high voltage vault. IHSA specifies that the lock-to-lock rubber glove rule should apply for entry to this station.

In addition, there is a desk with a computer inside this vault, and unqualified personnel were observed entering this building. It is our opinion that only qualified staff should enter this building, and only when they are working on the electrical gear using approved safety methods. This is not an area for a desk, for staff eating lunch, or doing administrative work.

Further, the fence inside of the building that is intended to separate the high voltage gear from workers is not bonded or grounded according to the OESC. This fence should either be removed following a revised access policy, or be grounded in accordance with the OESC.

Once these issues have been corrected, the station should provide many more years of reliable service.

3.9 Almonte MS-2 Substation

The Almonte MS-2 substation was constructed in 1975. The station was undergoing some maintenance during our inspection.

This station received a “Red” condition assessment due to public and worker safety issues.

The fence around the substation is sheet metal. The fence is not bonded properly and poses a public safety risk. The fence also appears to be leaning inward, and is braced in a few places. The fence should be repaired or replaced. The neighbor also has stacked materials against the wall, making it easier to climb the wall and gain station entry. There is no barbed wire on this wall, as required by the OESC.

The station yard was undergoing work. The neutral station bus was exposed and without any labeling. Some of the maintenance changes in the station should have engineering plans drawn up and followed. There are also porcelain lightning arrestors which can explode and are a safety concern.

3.10 Almonte MS-3 Substation

The Almonte MS-3 substation was constructed in 1965. It and the transformer are 52 years old. There are several age-related issues with this station.

This station received a “Red” condition assessment due to public and worker safety issues.

The station yard requires some work. There should be 150mm of crushed stone in the yard and 1m beyond the station fence to act as an insulator to keep people safe in the event of a fault. There is quite a bit of vegetation growing inside of the station yard, which should be removed. After removal a landscape fabric should be laid down, and then the crushed rock to further prevent vegetation growth. The current stone is for landscaping, it has settled into the dirt due to its mechanical properties, and different stone should be used in the future.

There is also a concern with the other station equipment. The switchgear used is obsolete and will be difficult to find parts, making servicing difficult. There are porcelain lightning arrestors and insulators which have been known to explode. With the proximity to public residences this is a serious cause for public safety concern.

Given the station’s age and condition, it is a good candidate for complete replacement.

4 RECOMMENDATIONS

4.1 Maintenance Program

A regular maintenance program is critical to ensuring the safety and reliability of station assets. Regular maintenance, coupled with periodic (i.e. monthly) site inspections are commonplace in Ontario LDC’s. Municipal substations are typically withdrawn from service for maintenance every three to five years, depending on the condition of the equipment and the resources available to the utility.

ORPC has in the past contracted a nearby LDC to perform maintenance. ORPC also performs periodic transformer oil testing and monthly substation inspections. ORPC also performs annual infrared thermography inspections of the stations and the distribution system.

We suggest that ORPC completely document the maintenance program. We suggest that all stations should be immediately scheduled for end to end maintenance in order to assist in the prioritization of station capital projects. In addition, transformer oil analysis should be performed at least once per year.

4.2 Aging Plant

As mentioned above, the average age of the ORPC substations is approaching the average life expectancy for this type of equipment. Half of the stations are now older than 40 years. A strategy is required to plan for the replacement of these assets. The replacement cost of substation equipment is significant, and costs have been rising steadily over the past few years due to the increase in cost of metals.

The replacement of station assets should be forecasted, based on the safety, reliability, and age of the stations, in concert with consideration for distribution projects. Ongoing periodic condition assessments should be performed to determine the priority of replacement projects.

4.3 Feeder Protection & Coordination

We recommend that ORPC perform a detailed review of the 44kV, 13.8kV, and 4.16 kV feeder protection and coordination. There is some evidence to suggest that some of the distribution system may not have adequate overcurrent protection. This is a public safety issue, and poses a risk to ORPC equipment.

Many of the stations do not follow current utility protection practices. Several stations have four reclose attempts; while this is common in rural conditions it is uncommon in urban areas due to the high probability of public involvement during a fault. The first reclose attempt was quite often without intentional delay, which has a high probability of fault restrike. The Hydro One standard has a 600ms delay in order to allow the ionized air to dissipate before attempting to reenergize the system. Another public safety concern is the lack of ground fault protection. The protection settings will not be able to detect a low-current ground fault, which could endanger public safety.

4.4 Budgeting for Station Replacement

A long term forecast should be developed to plan for the budgeting and execution of station replacement projects. In conjunction with other distribution projects, the costs and timing of station projects should be coordinated and prioritized to provide a long term plan for all aspects of the distribution system.

Care should be taken to purchase similar transformer windings on new assets. Two transformer stations can only back up each other because they are DY1 windings, while the others are DY11. ORPC needs to determine which winding it will be using and order similar windings for all new transformers.

4.4.1 Voltage Conversion

Replacing and upgrading substations is a significant expense, but it can be a great opportunity. Many utilities do not undertake voltage conversion because of the significant expense of replacing substation transformers and other equipment before end of life. ORPC should consider the benefits and costs of voltage conversion from 4kV to 13kV while planning for substation replacements.

Upgrading stations to be a higher voltage level can help a distribution system greatly. Losses are dependent on current levels, and higher voltages require less current for the same amount of power consumed. Changing from a 4.16kV system to 13.8kV can reduce losses by a factor of 11. In addition, crews would not need to consider if stations, MS2 and MS7 for example, have the same voltage to restore power in maintenance or outage situations. Having one voltage level simplifies work practices as well, since crews will know what voltage to expect and have been trained on that voltage level's safe work practices.

It was noted that ORPC has been building to 15kV standards for years. Some sections of 4.16kV could be converted by changing just the distribution transformers, while older sections may require more work. Fewer substations are required at 13.8kV because the higher voltage enables a larger distribution area to be covered, with more load and fewer feeders. It is possible that one new 13.8kV substation could be installed instead of replacing two 4.16kV substations. The distribution system should be analyzed to determine if the cost of finishing or accelerating the conversion to 13.8kV could result in fewer substations and overall less cost to ORPC.

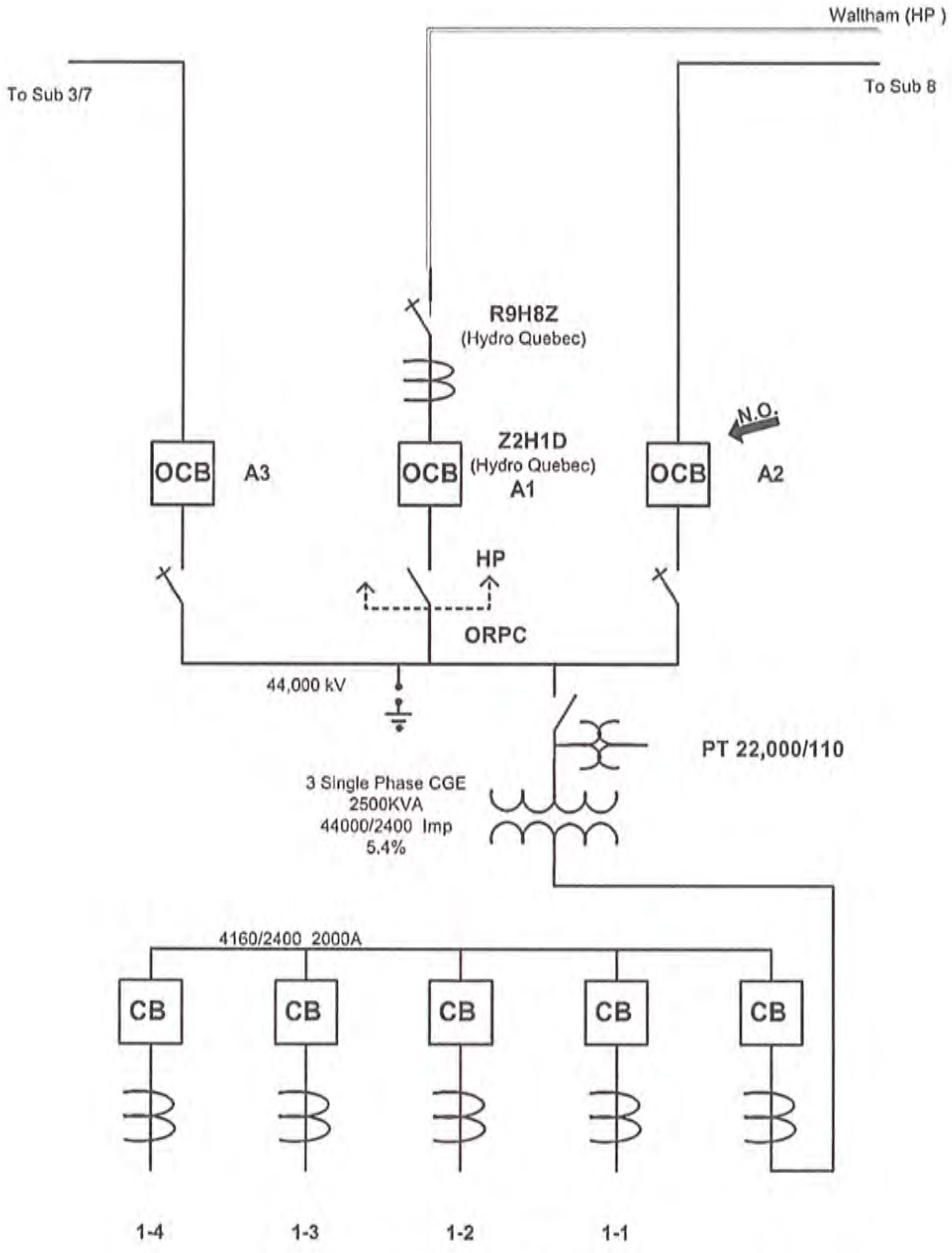
5 CONCLUSIONS

The age and condition of several of the ORPC substation assets are a significant concern. A long term substation replacement/rehabilitation program is required immediately. A short term plan for work required should be created as part of the next capital budget process, with the creation of a longer-term plan to be developed soon afterwards.

The replacement or rehabilitation of the ORPC substations should consider the objectives of the smart grid initiatives, as well as the present day requirements for safety, reliability, and environmental responsibility.

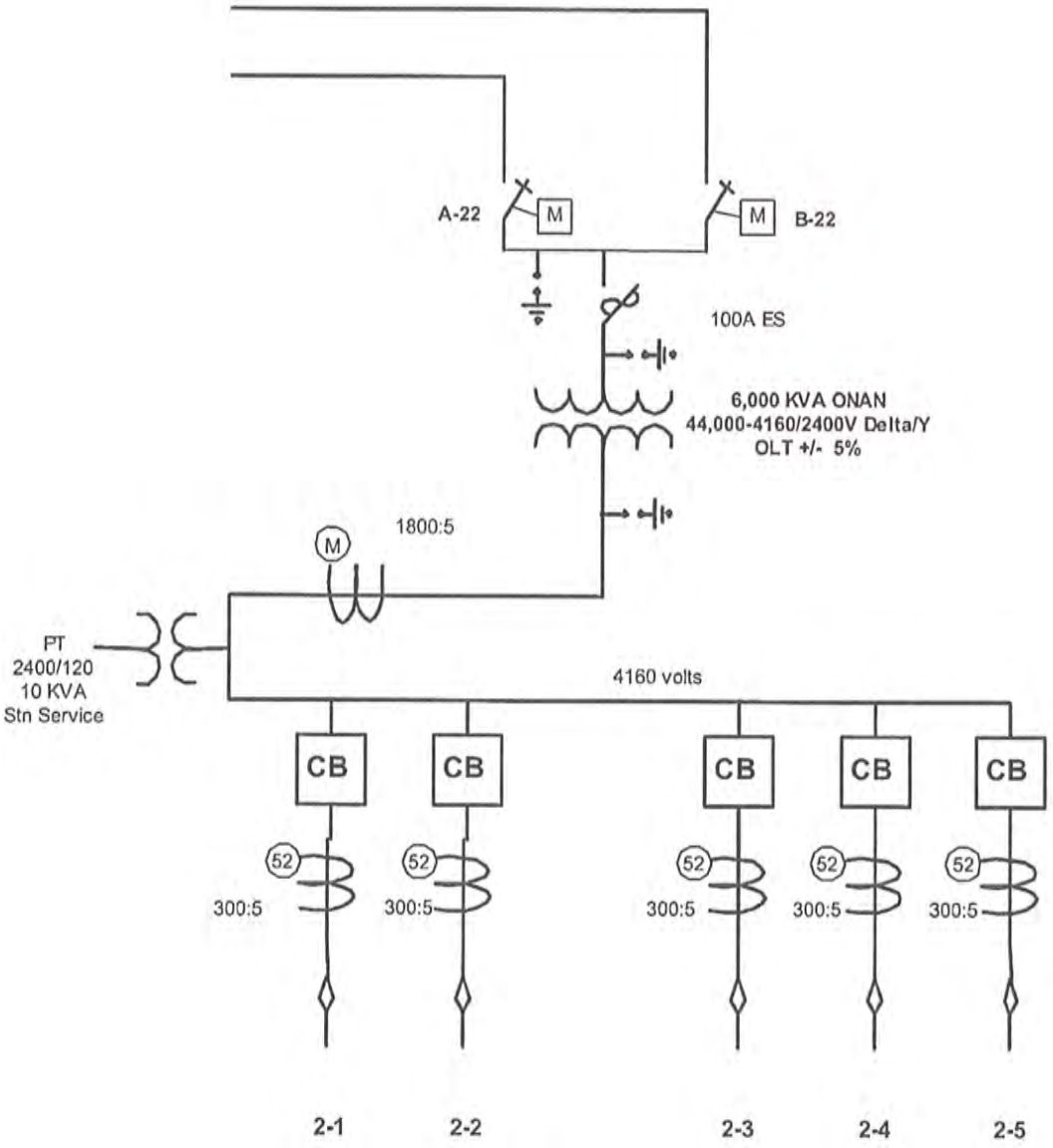
APPENDIX A: Station Single Line Diagrams

Station I Line Schematics



Pembroke Sub 1

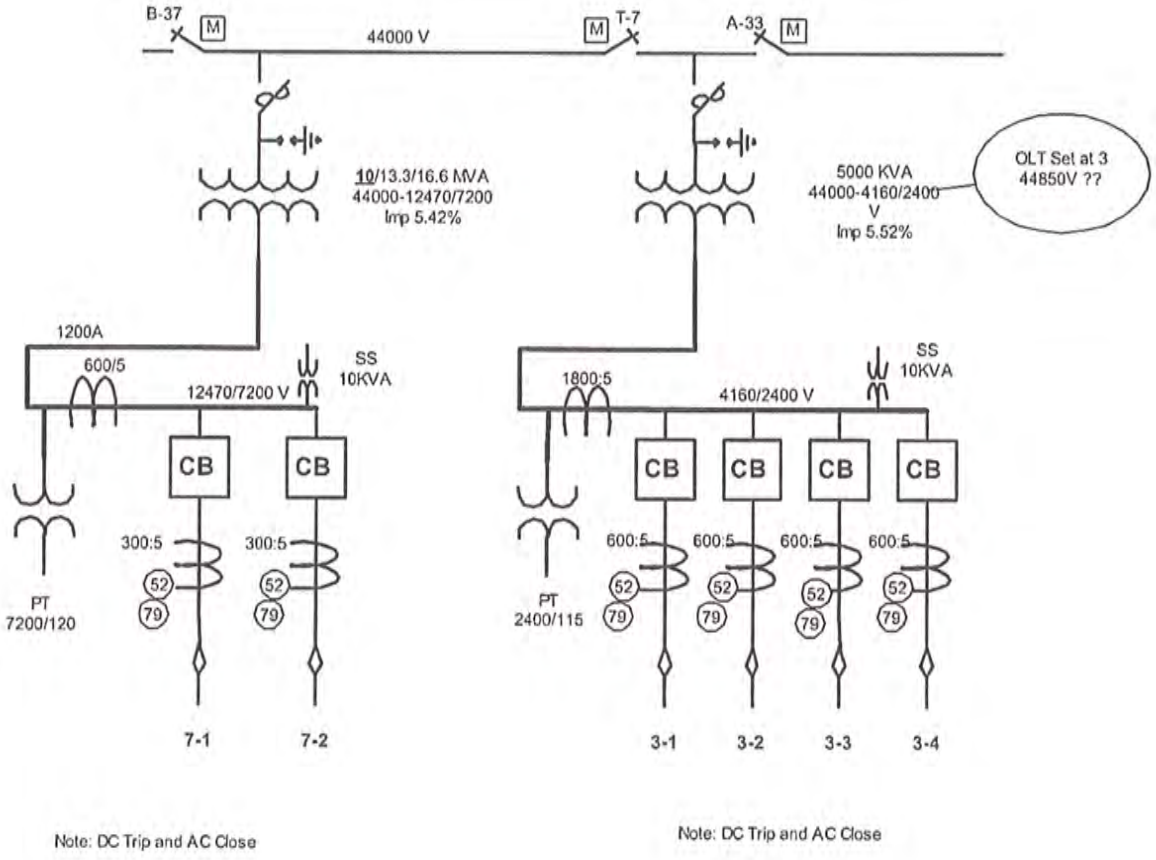
283 Pembroke St. West.



Note: DC trip and AC close

Pembroke - Fraser St Sub 2

Corner of Fraser & Dickson St. Pembroke



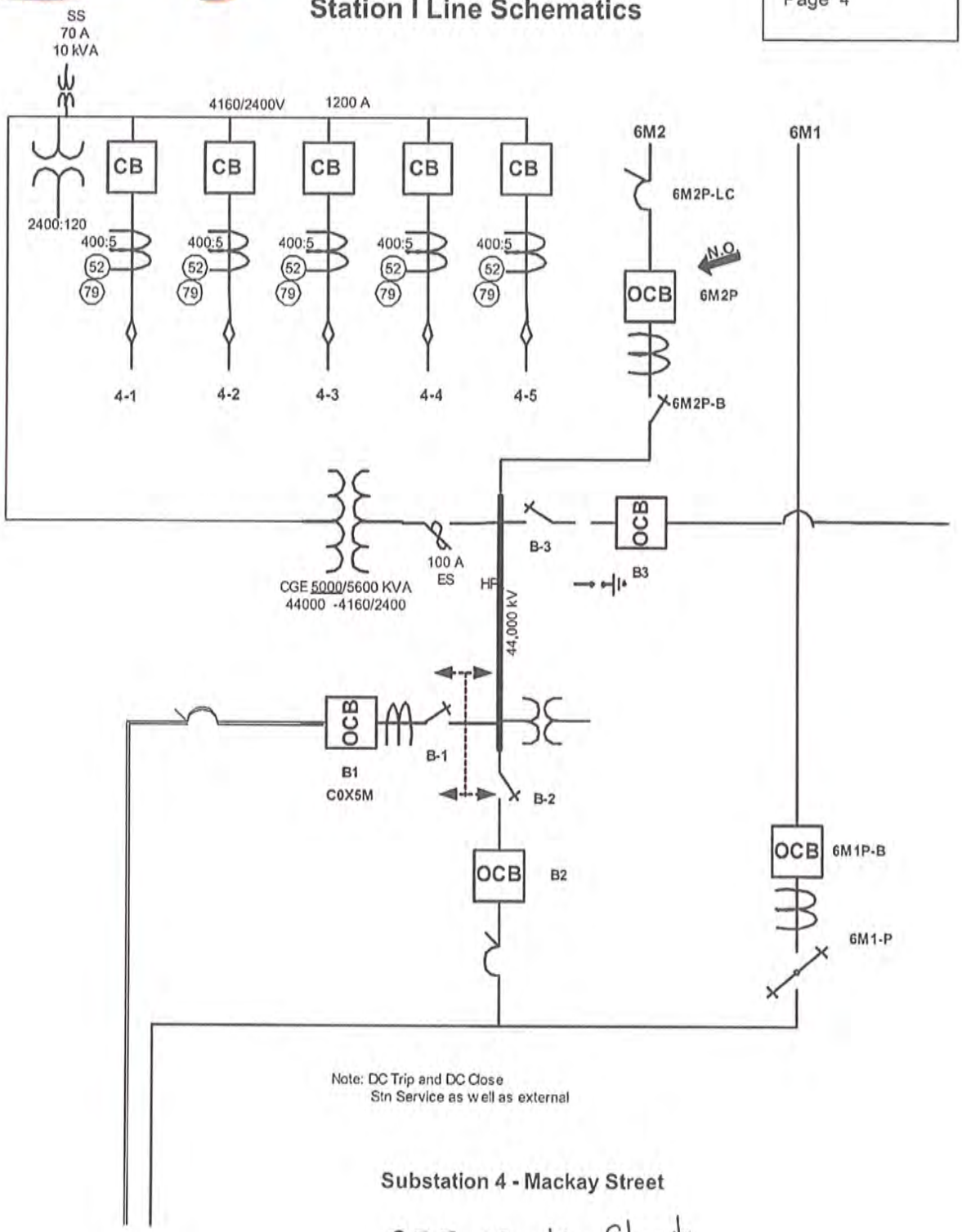
Note: DC Trip and AC Close

Note: DC Trip and AC Close

Third Ave Sub 3 and 7

736 Third Avenue Pembroke

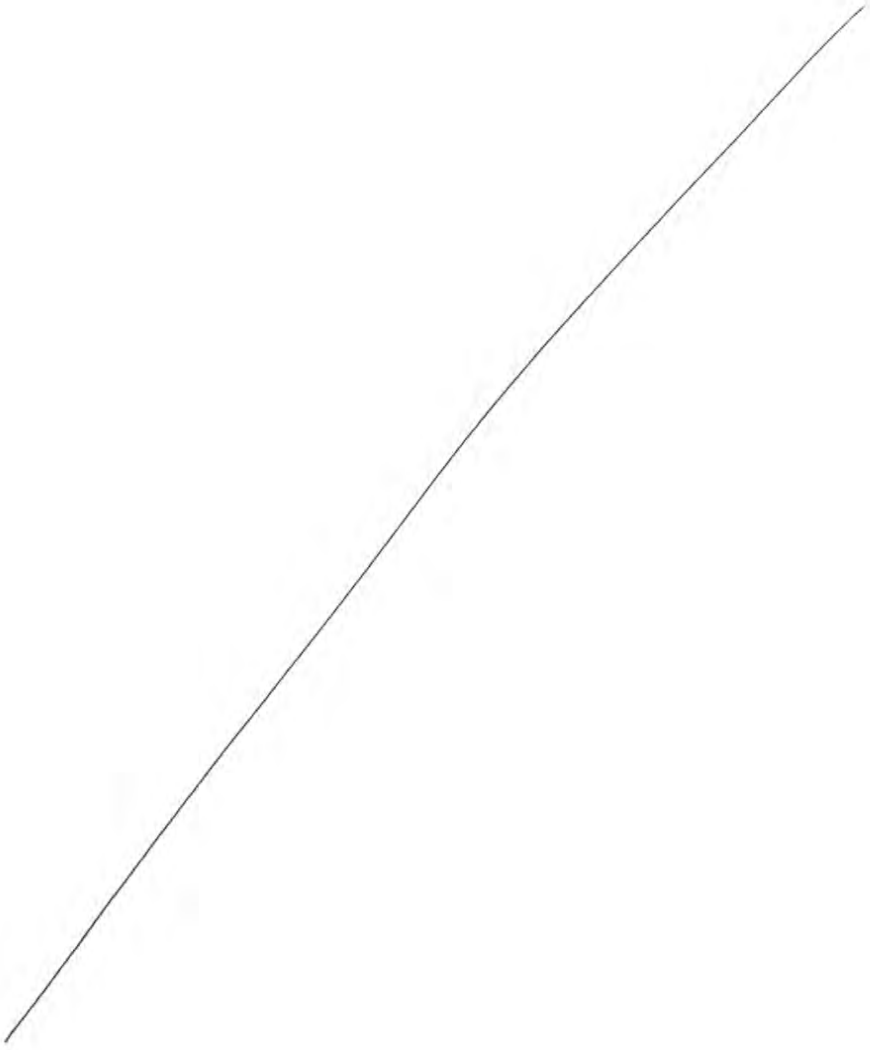
Station I Line Schematics



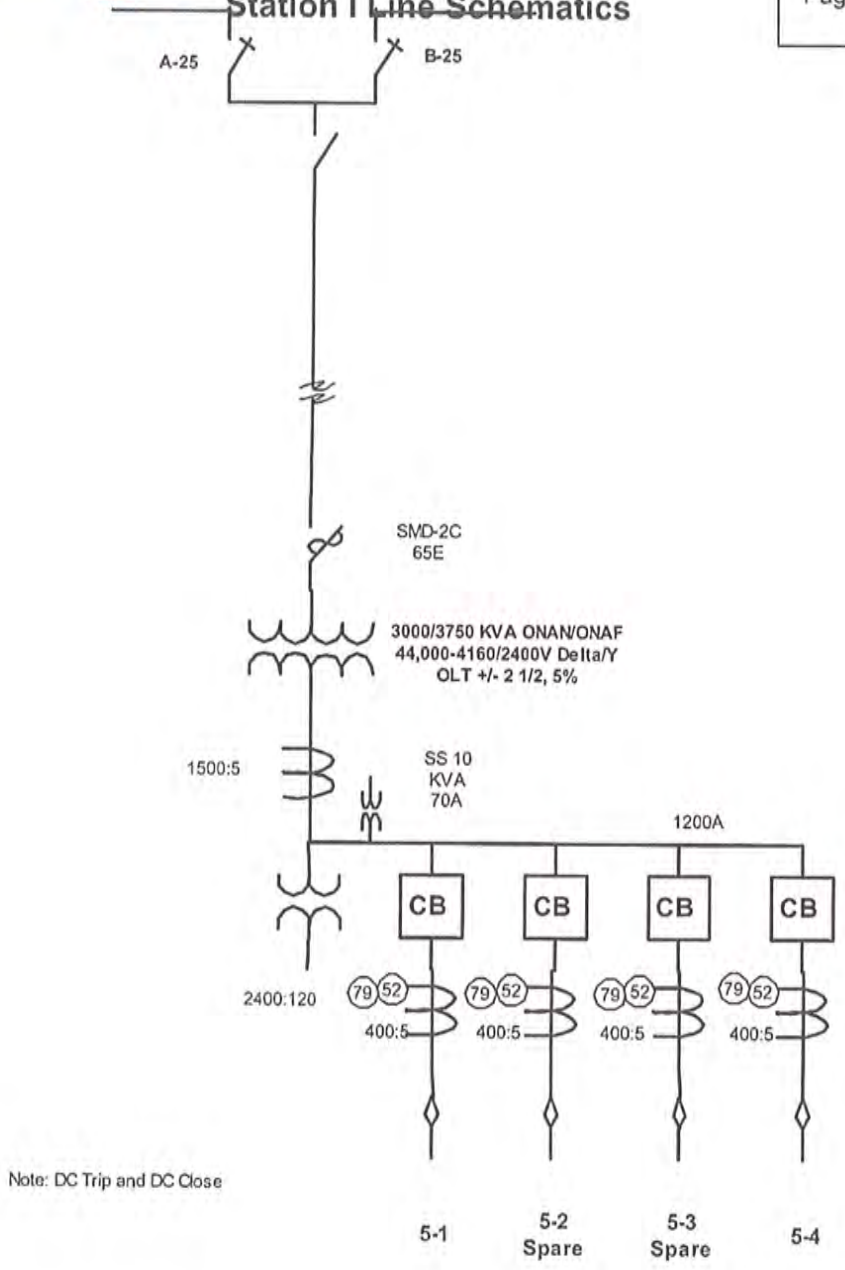
Note: DC Trip and DC Close
Stn Service as well as external

Substation 4 - Mackay Street

935 MacKay Street



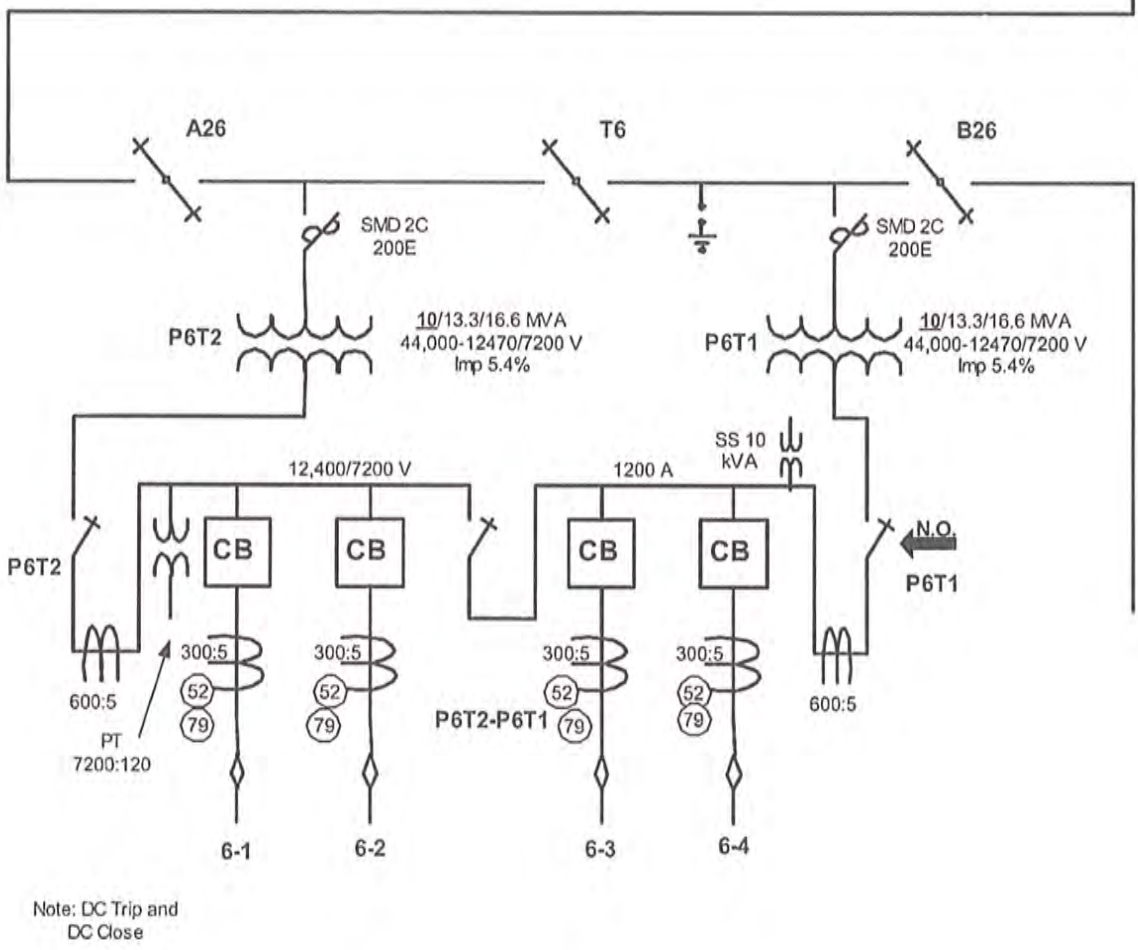
Station Line Schematics



Note: DC Trip and DC Close

Pembroke - O'Brien Sub 5

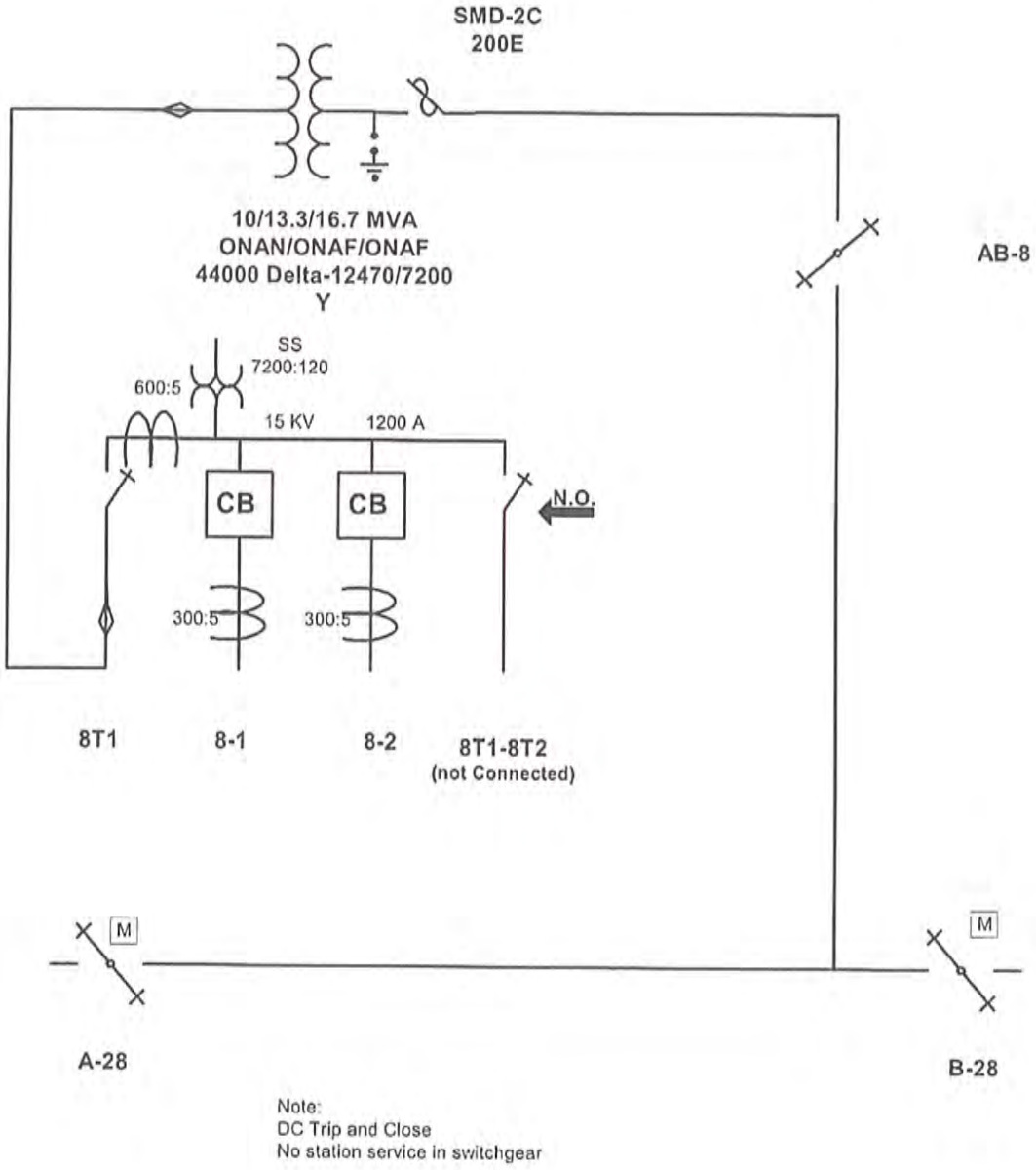
506 O'Brien St. Pembroke



Note: DC Trip and
DC Close

Quarry Rd Sub 6

289 Quarry Road Pembroke

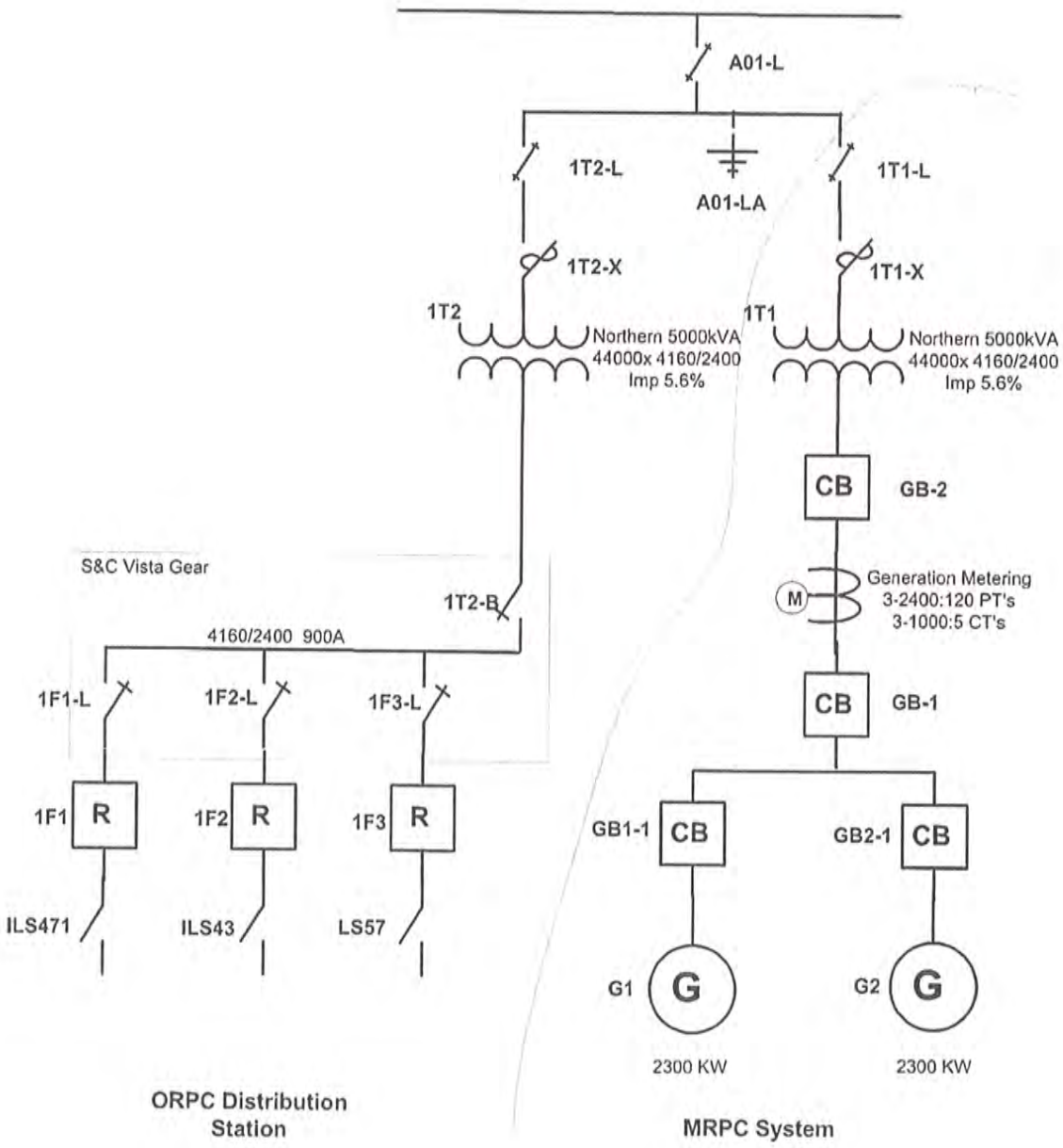


Note:
DC Trip and Close
No station service in switchgear

Taylor Sub #8

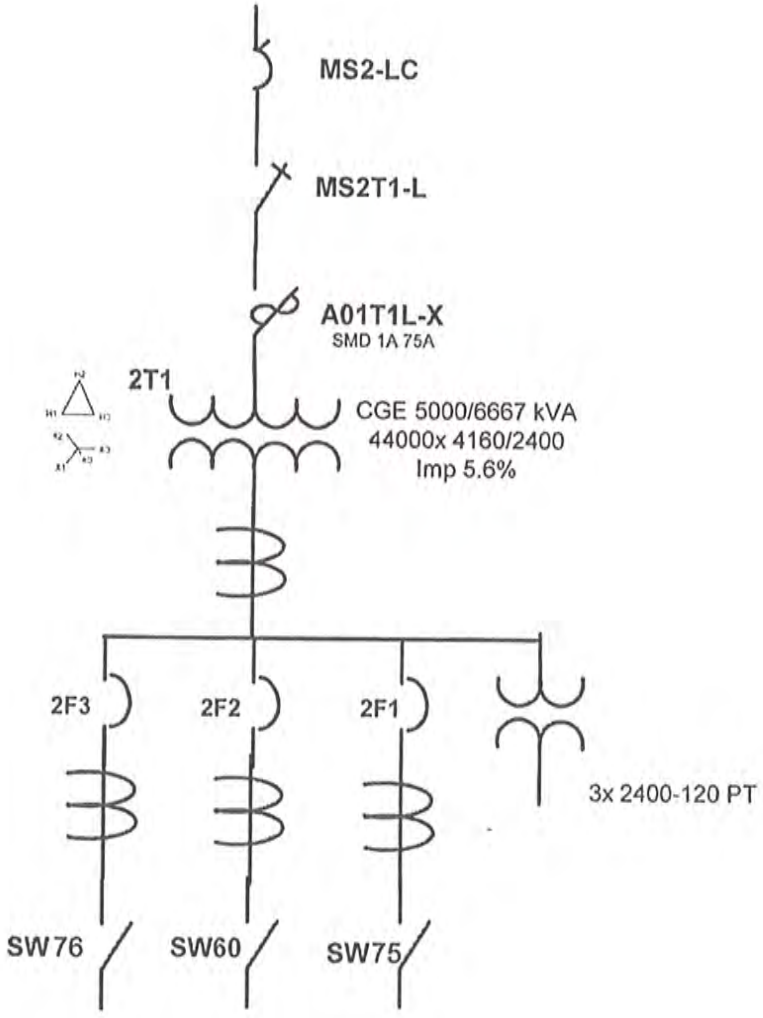
256 Nelson St. Pembroke

ORPC Almonte MS1 & MRPC Sub
Ottawa Street, Almonte



Main St. Almonte, On

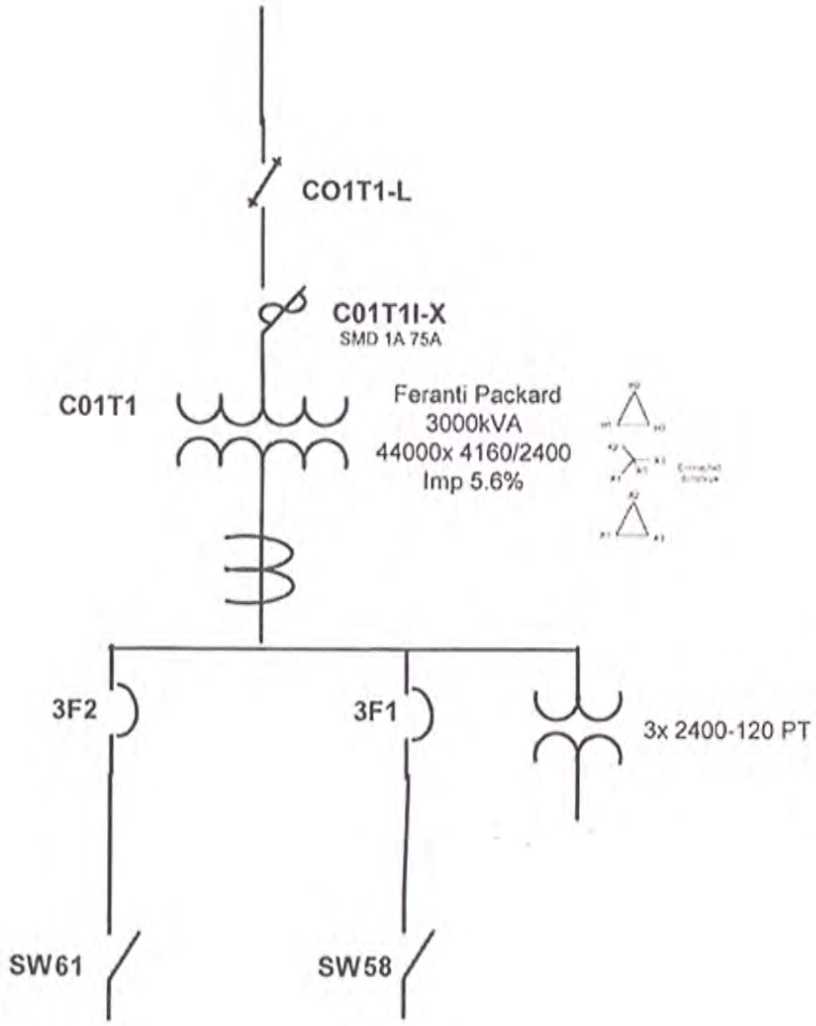
Almonte MS2
Victoria Street



311 Victoria St.
ALMONTE

Station I Line Schematics

Almonte MS 3
King Street



442 KING ST. ALMONTE

APPENDIX B: Station Photographs

Pembroke MS1

WOOD FENCE NOT TO CODE.
NO BARB WIRE AND GAPS GREATER THAN
50mm AT THE BOTTOM

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Client Contact

Ottawa River Power

Ottawa River Power Corporation

Contact Name
283 Pembroke Street West
Pembroke, Ontario K8A 6Y6
Ph: 613-732-3687
Email:

OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-1
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2082

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2082

GROUNDING AND BONDING.
PARKING METER AND STREETLIGHT.

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SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-1
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2083

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2083

CRUSHED STONE IS TO EXTEND 1.00m
OUTSIDE OF THE FENCE.

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SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-1
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2086

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2086

NO FENCE GROUNDING AS PER CODE

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SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-1
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2088

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2088

NO GROUNDING AND BONDING OF STRUCTURES

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SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-1
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2090

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2090

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SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-1
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2092

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2092

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SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-1
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2094

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2094

IMPROPER INSTALLATION OF
CONTROL CABLES – NOT TO CODE

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OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-1
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2103

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2103

ANCHOR FOR TOWER STRUCTURE IS IN THE BASEMENT. NO WAY TO MEASURE THE STRENGTH OF THIS. STRANDS ARE FRAYING.

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SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-1
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2108

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2108

PAINT CONDITION ON BUS DUCT

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SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-1
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2111

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2111

PORCELAIN INSTRUMENT TRANSFORMERS – VERY LOW CLEARANCES FOR WORKERS

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SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-1
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2114

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2114

FENCE GAPS ARE LARGER THAN 50mm AND LACK OF CRUSHED STONE

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SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-1
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2115

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2115

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SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-1
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2116

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2116

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SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-1
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2119

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2119

EXPOSED WIRING – CODE VIOLATION

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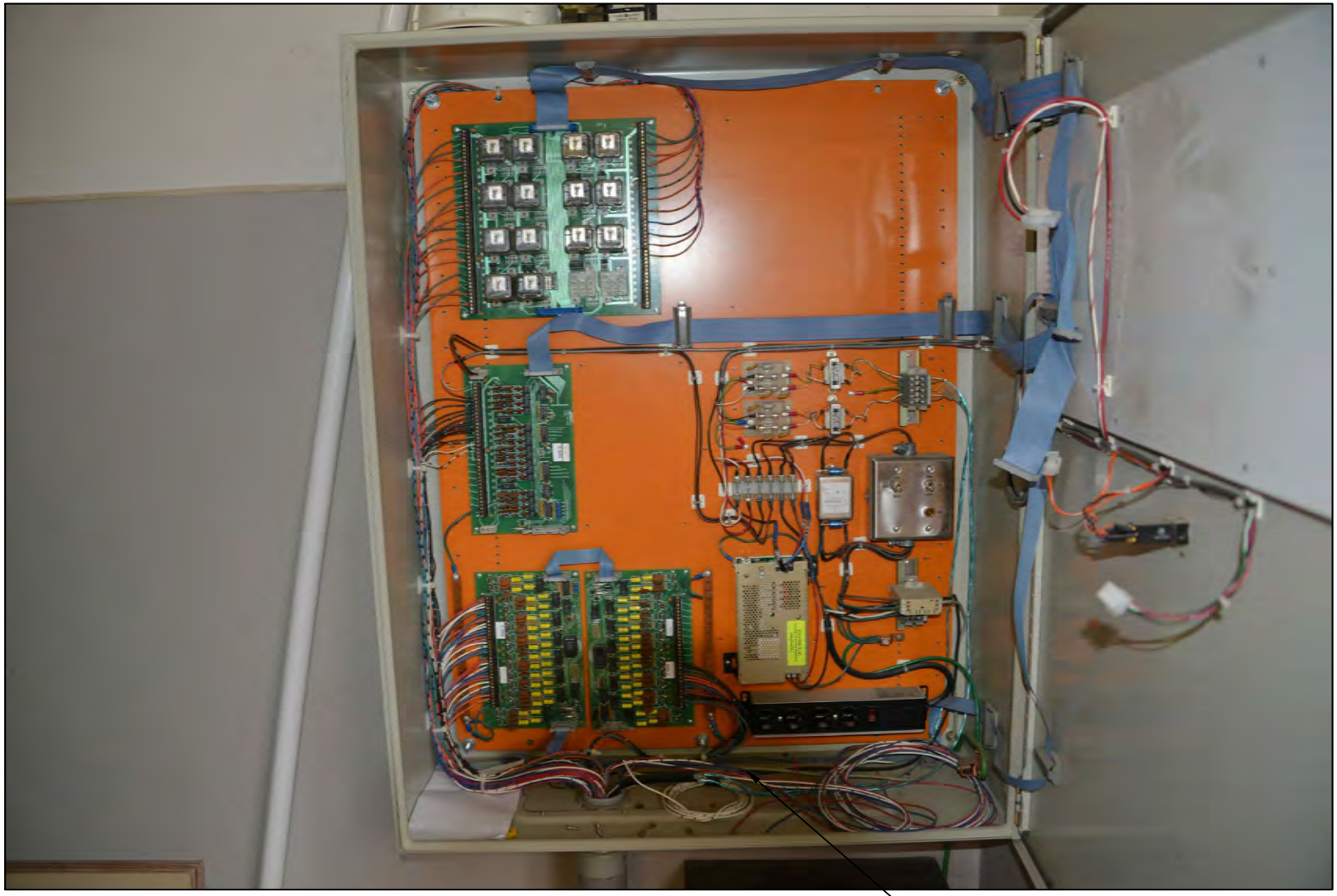
OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-1
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2122

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2122



FAILED SCADA RTU

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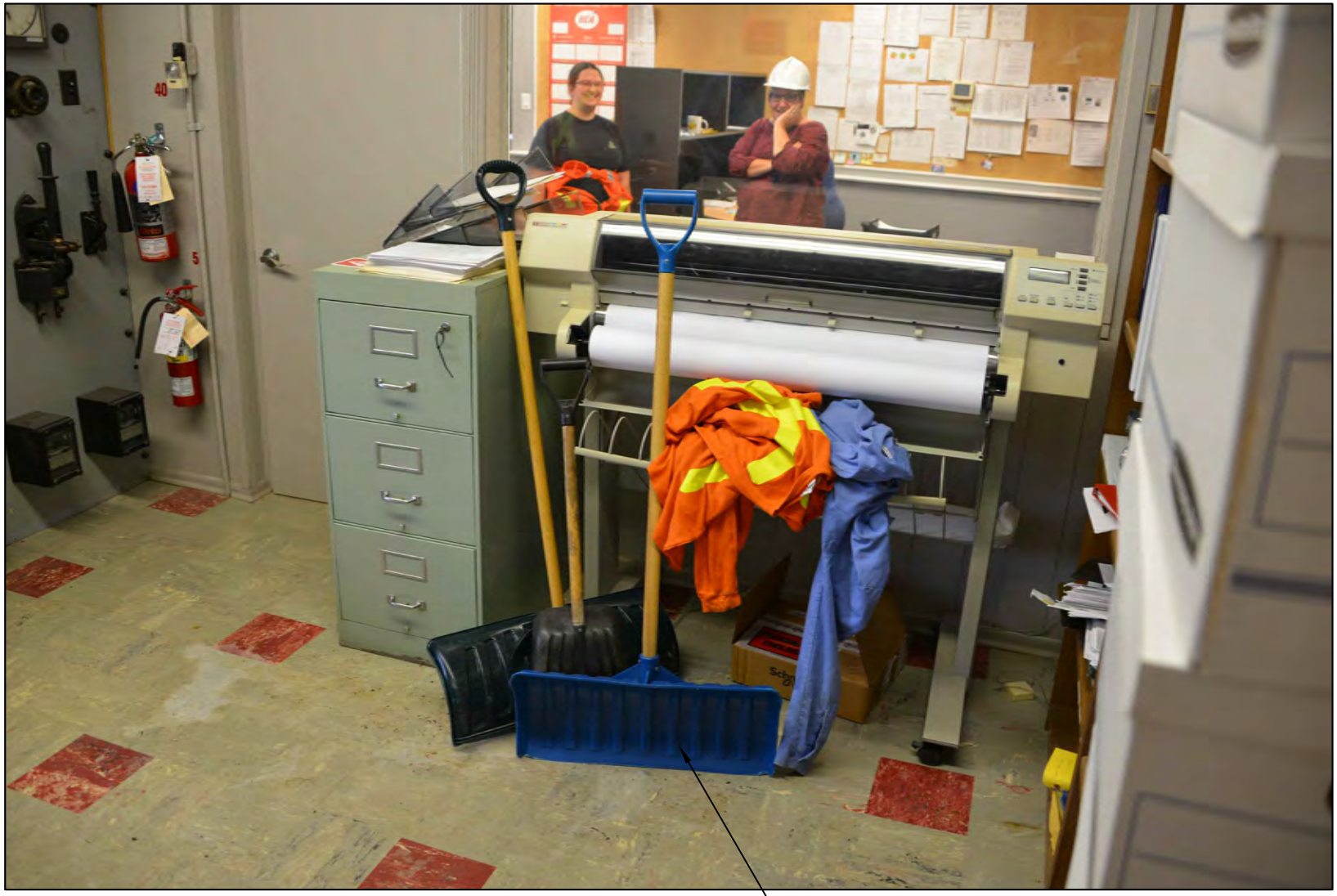
OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-1
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2124

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2124



OFFICE EQUIPMENT AND STORAGE IN THE SUBSTATION ROOM – CODE VIOLATION. OFFICE ATTACHED TO SUBSTATION (GLASS).

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OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-1
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2135

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2135

MINI OCB'S COMBUSTIBLE IN OFFICE ENVIRONMENT

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SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-1
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2136

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2136

Pembroke MS2

STATION L.V NEUTRAL
CONNECTION IS BARE 3/0 WIRE

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SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-2
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2332

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: Z.KOOMANS	Date: 30/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2332

LOW CLEARANCE BETWEEN SOLAR PANELS AND STATION FENCE.

GROUNDING SAFETY ISSUE.

SECURITY ISSUE.

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Email:

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SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-2
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2335

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: Z.KOOMANS	Date: 30/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2335

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Pembroke, Ontario K8A 6Y6
Ph: 613-732-3687
Email:

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SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-2
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2336

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: Z.KOOMANS	Date: 30/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2336

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Pembroke, Ontario K8A 6Y6
Ph: 613-732-3687
Email:

OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-2
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2342

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: Z.KOOMANS	Date: 30/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2342

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Ph: 613-732-3687
Email:

OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-2
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2344

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: Z.KOOMANS	Date: 30/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2344

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Email:

OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-2
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2356

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: Z.KOOMANS	Date: 30/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2356

NEED TO CONFIRM STATION NEUTRAL CONNECTIONS DURING OUTAGE

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SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-2
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2361

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: Z.KOOMANS	Date: 30/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2361

Pembroke MS3 and Pembroke MS7

BARE STRANDED NEUTRAL CONNECTIONS RUN UP RISER POLE. THIS IS DANGEROUS.

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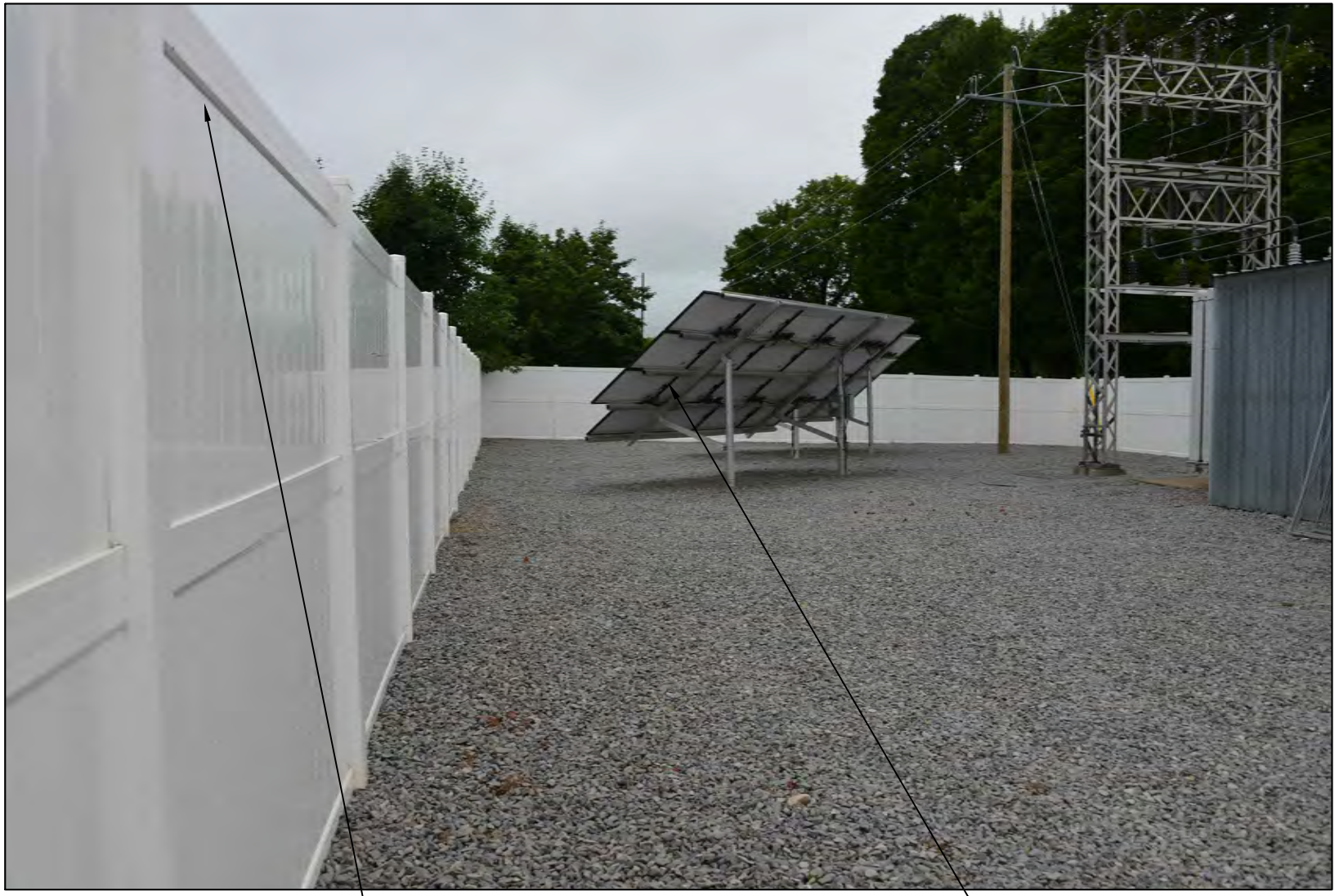
SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-3 AND MS-7
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2144

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: A.RIST	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2144



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Ph: 613-732-3687
Email:

OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-3 AND MS-7
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2146

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: A.RIST	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2146

IMPROPER GROUNDING AND BONDING ON METAL CLAD SWITCHGEAR BUILDINGS

costello Utility Consultants

Costello Utility Consultants

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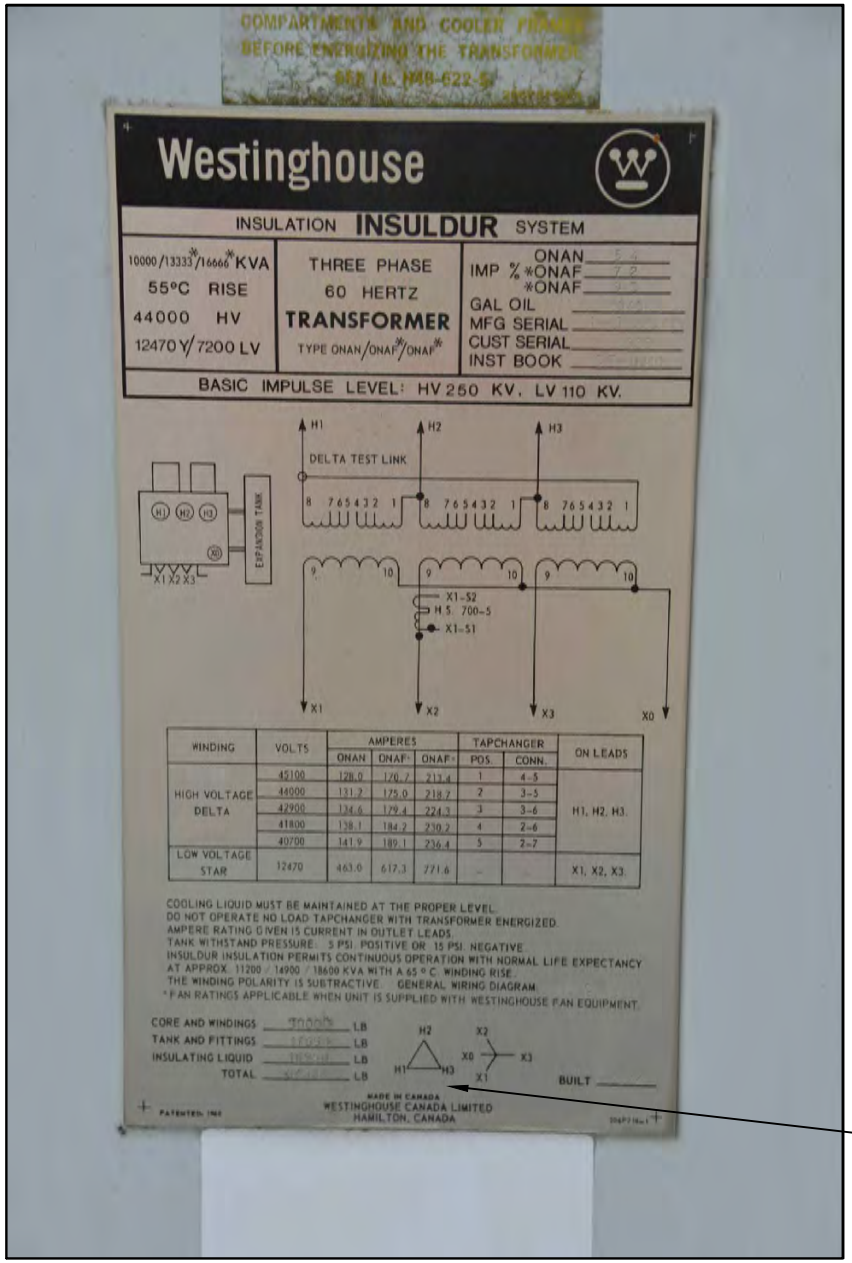
OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-3 AND MS-7
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2148

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: A.RIST	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2148



DYII VECTOR (NOT A PROBLEM, JUST FOR INFORMATION)

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OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-3 AND MS-7
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2156

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: A.RIST	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2156

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OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-3 AND MS-7
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2159

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: A.RIST	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2159

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OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-3 AND MS-7
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2165

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: A.RIST	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2165

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OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-3 AND MS-7
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2166

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: A.RIST	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2166

GRADIENT CONTROL MAT OR PORTABLE MAT
REQUIRED FOR SWITCHING

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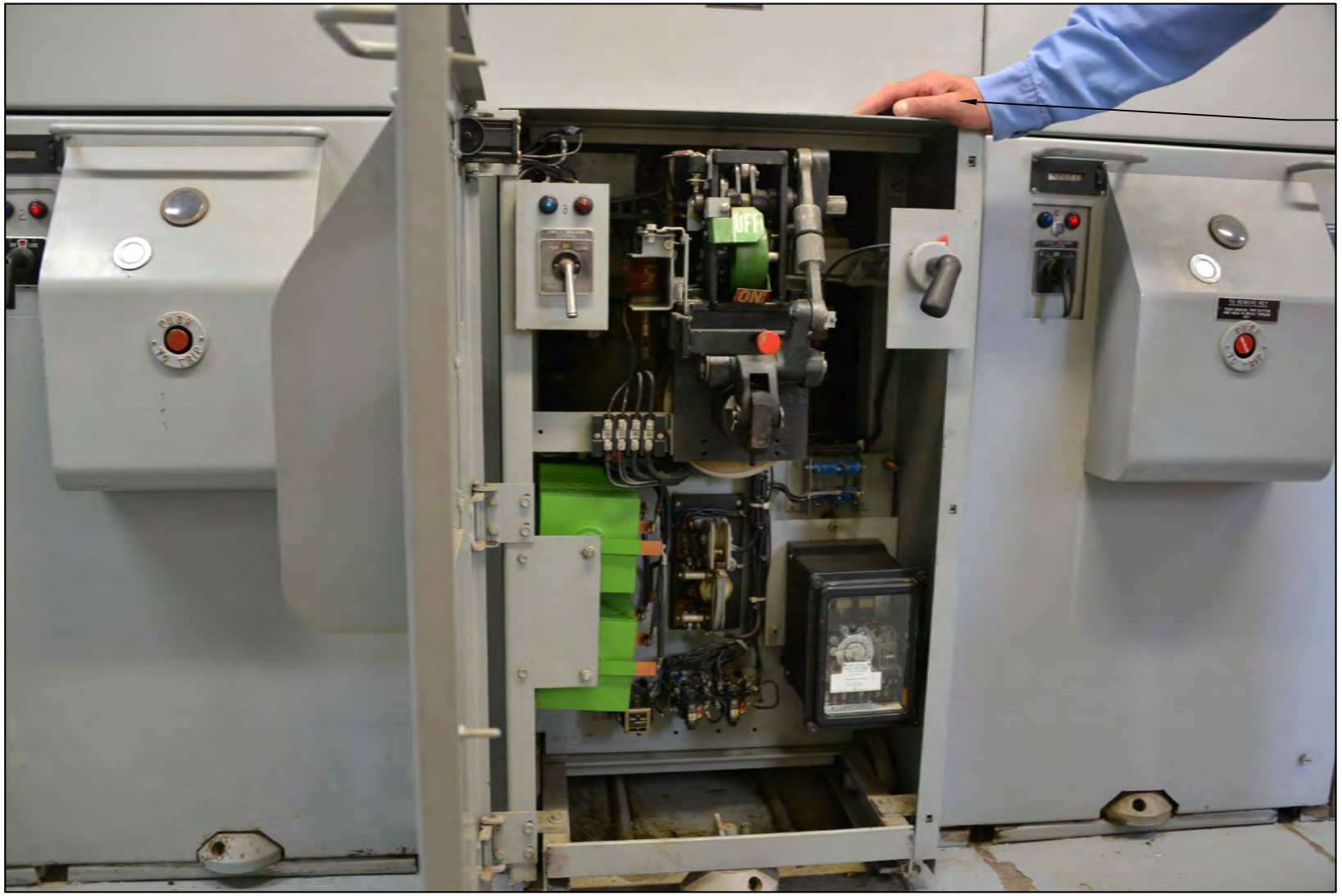
OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-3 AND MS-7
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2167

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: A.RIST	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2167



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OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-3 AND MS-7
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2168

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: A.RIST	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2168

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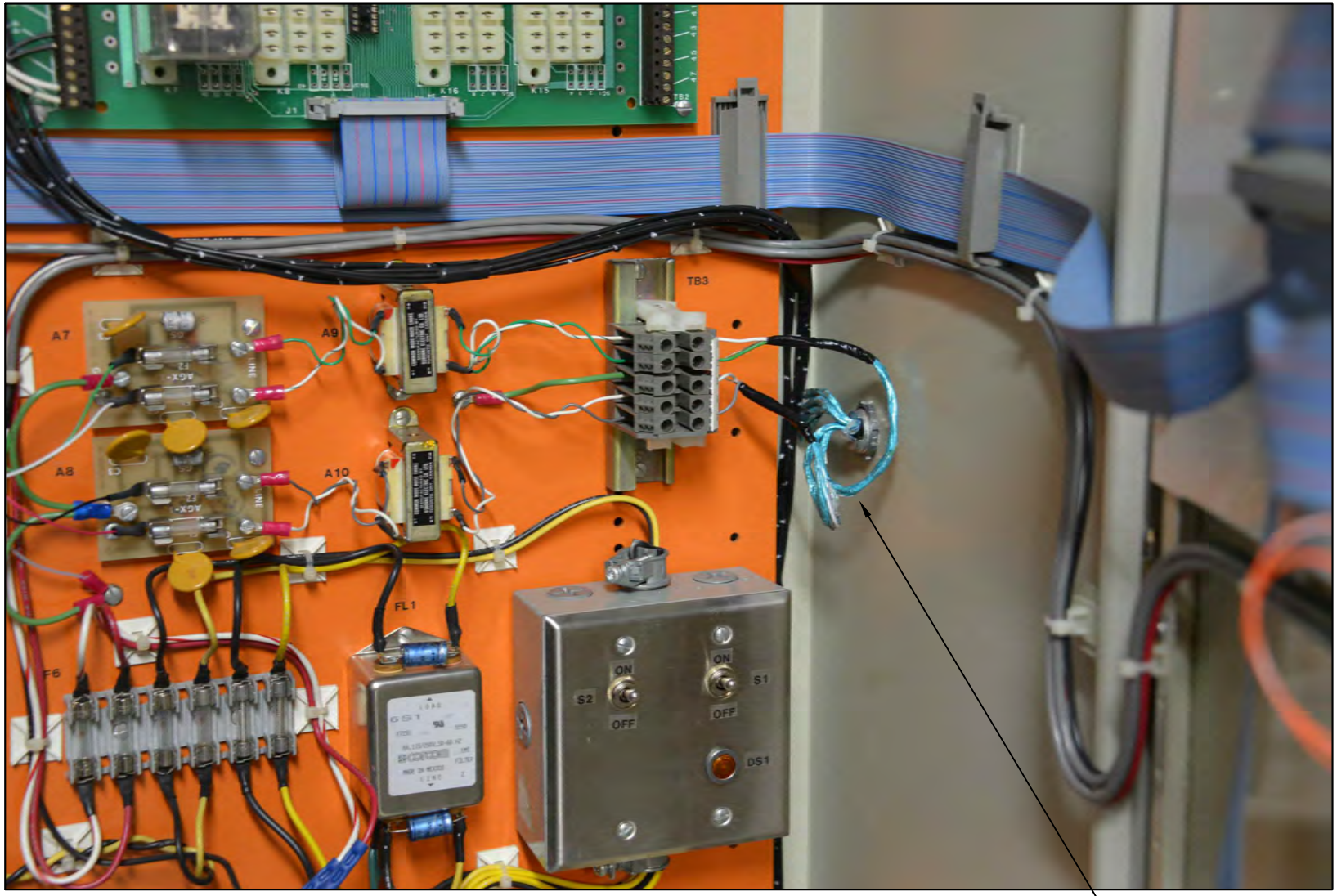
Email:

OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-3 AND MS-7
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2171

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: A.RIST	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2171



COPPER COMMUNICATION LINES
WITHOUT ELECTRICAL ISOLATION

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OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-3 AND MS-7
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2172

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: A.RIST	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2172

FOUR (4) AUTO RECLOSURES IN URBAN ENVIORNMENT

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OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-3 AND MS-7
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2175

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: A.RIST	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2175

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OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-3 AND MS-7
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2179

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: A.RIST	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2179

MS3 NO DELAY ON RECLOSING

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OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-3 AND MS-7
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2180

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: A.RIST	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2180

DOOR GROUNDING AND BONDING

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OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-3 AND MS-7
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2187

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: A.RIST	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2187

Pembroke MS4

UNGROUNDED VAULT COVER

BARBED WIRE FACING INWARD

1.00m CRUSHED STONE OUTSIDE OF THE FENCE IS REQUIRED

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OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-4
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2195

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2195

BARE SYSTEM NEUTRAL RUNS UP
THE POLE – THIS IS DANGEROUS

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OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-4
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2199

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2199

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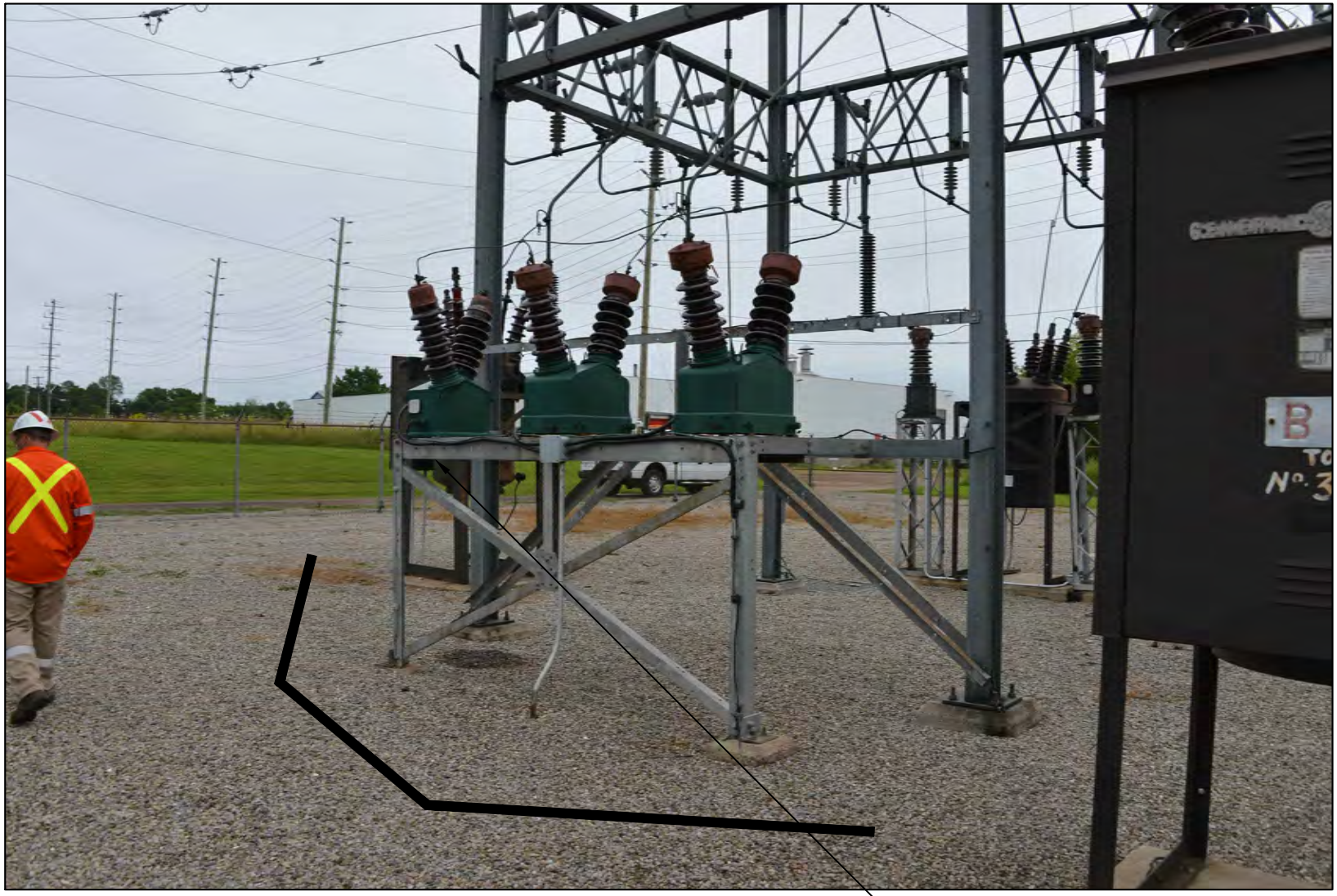
OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-4
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2214

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2214



LOW LEVELS OF APPROACH.
NEW FENCE SUGGESTED.

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OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-4
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2216

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2216

PUBLIC AREA (OUTSIDE STATION FENCE)
WITHIN LIMITS OF APPROACH.
STATION STRUCTURE IS OUTSIDE OF THE
STATION FENCE.

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OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-4
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2221

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2221

FENCE GATE SWINGS OUTSIDE OF THE STATION GROUND GRID

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OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-4
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2222

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2222

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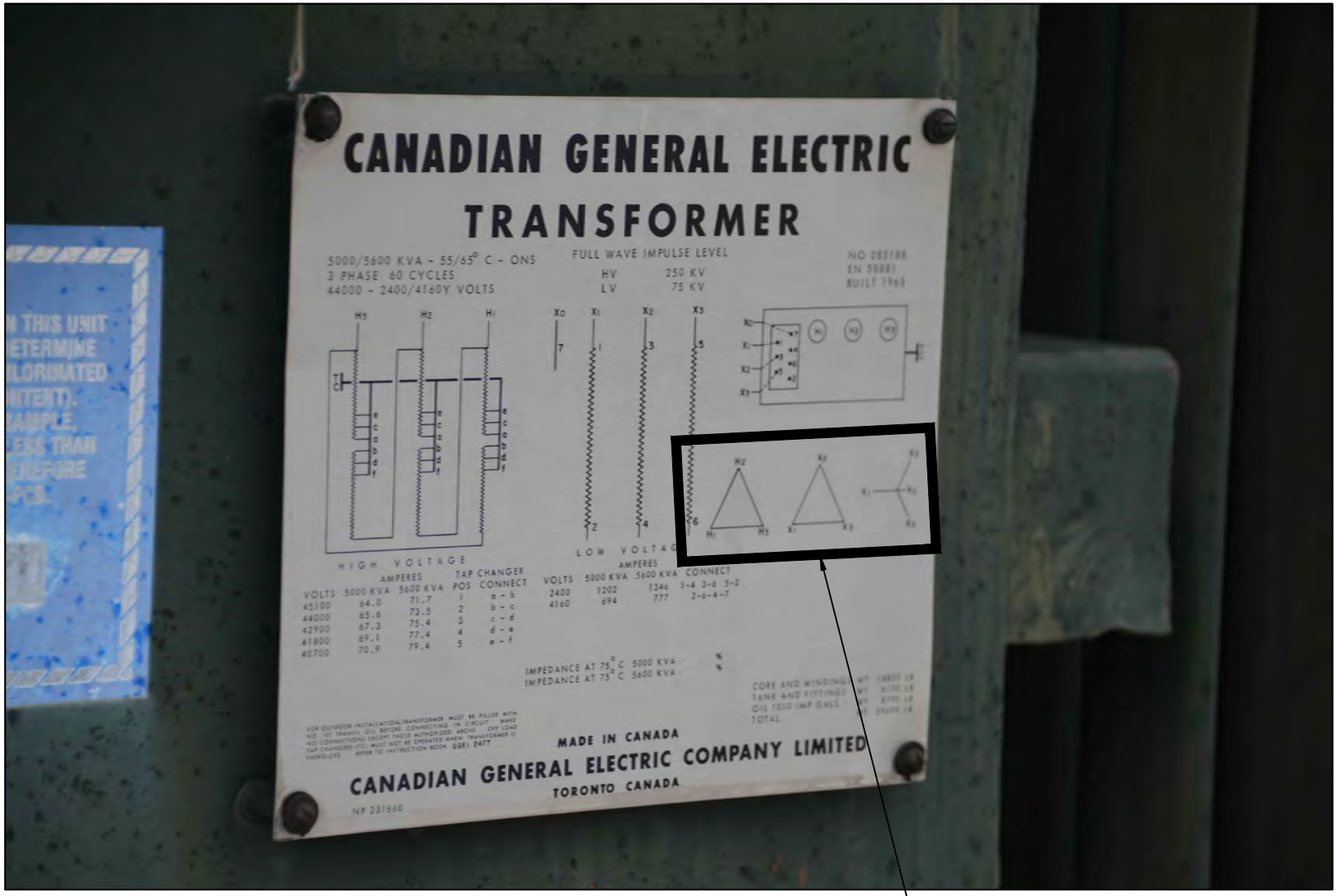
Email:

OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-4
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2225

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2225



CSA DYI VECTOR NOT A PROBLEM. FOR INFORMATION PURPOSES. THIS WILL NOT PARALLEL WITH DYII TRANSFORMER

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OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-4
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2229

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2229

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OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-4
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2230

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2230

GROUNDING AND BONDING OF VAULT LID

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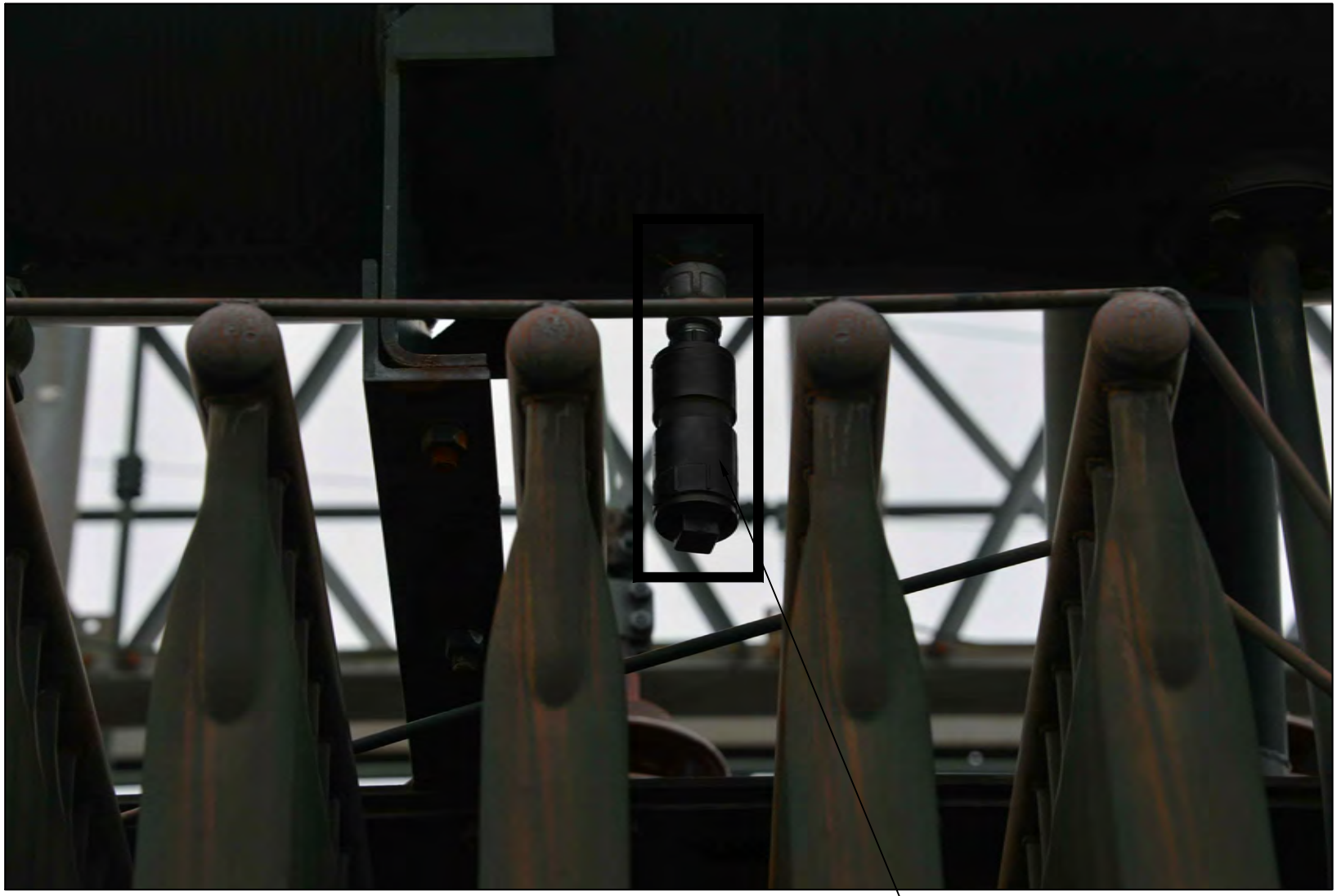
OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-4
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2232

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2232



SUGGEST BREATHER FOR ALL STATION TRANSFORMERS.

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OTTAWA RIVER POWER CORPORATION

SUBSTATION CONDITION ASSESSMENT
PEMBROKE MS-4
DATE TAKEN: THURSDAY AUGUST 3, 2017
PHOTO DSC_2234

Final Drawing Size: ANSI A (8.5x11)	Scale: N.T.S.
Drawn by: K.LAPIER	Date: 29/08/2017
Checked by: S.COSTELLO	Date: –
Approved by: R.LAPIER	Date: –
Project Number: 17153	Drawing Number: DSC_2234