A REPORT TO  
THE BOARD OF COMMISSIONERS OF PUBLIC UTILITIES

<table>
<thead>
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<th>Electrical</th>
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Upgrade Terminal Station  
at Wiltondale  

July 2012
SUMMARY

The upgrade of the Wiltondale Terminal Station is required to maintain the safety and reliability of this facility. These improvements involve replacing the wood box structures with steel box structures, replacing the electrical equipment and upgrading the grounding system in the terminal station.

The wood pole structures used in this terminal station have reached their end of service life and are showing signs of deterioration and structural stress. The existing electrical equipment in this terminal station includes disconnect switches, a recloser, a circuit breaker, bus conductors and insulators which are all nearing the end of their service life and are in deteriorated condition as well. Finally, the grounding system is inadequate for the proper operation of the station’s protective devices.

Continued operation of this terminal station in its current condition increases the safety risk to Hydro personnel and reduces the reliability performance to the system.
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1 INTRODUCTION

The Island Interconnected System is made up of generating stations, terminal stations, transmission and distribution lines that deliver electrical energy to residential, commercial and industrial customers. The purpose of a terminal station is to interconnect transmission and distribution lines. Terminal stations containing transformers will also convert the system voltages to suitable levels for the purpose of transmissions and distribution. All the 230 kV and 138 kV terminal stations were constructed using steel structures to support the electrical equipment in the station. Many of the 66 kV terminal stations were constructed in the 1960s and 1970s and used wood pole structures to support the electrical equipment in the station. The wood pole structures in these stations are showing signs of deterioration as a result of their operating environment and age.

The Wiltondale Terminal Station is a 66 kV station with wood poles structures. Figure 1 below shows a picture of the Wiltondale Terminal Station.
2 PROJECT DESCRIPTION

This project proposal is for the restoration and modernization of the support structures and electrical equipment within the Wiltondale Terminal Station. The scope of this project proposal includes:

- Replacement of wood pole box structures with steel box structures (including concrete foundations);
- Replacement of the 66 kV oil filled circuit breaker;
- Replacement of the 12.5 kV recloser;
- Replacement of four 66 kV disconnect switches;
- Replacement of one 12.5 kV disconnect switch;
- Replacement of bus work, hardware and insulators;
- Restoration of concrete pads for transformer, recloser and circuit breaker;
- Replacement of the station protection and control equipment and its relocation to a prefabricated control building;
- Replacement of station grounding system; and
- Installation and removal of a mobile substation.

The mobile substation will allow the station to be bypassed during construction. This will minimize the outage duration to the customers of Wiltondale and the south side of Bonne Bay while the terminal station is refurbished.
3 JUSTIFICATION

The Wiltondale terminal station was constructed in 1975 using wood pole structures and wood crossarms. The equipment contained in this terminal station is the original equipment installed. Continued operation of this terminal station using the existing support structure and equipment increases the safety risk to personnel and compromises the systems reliability.

The 37 year old wood pole structure in the Wiltondale Terminal Station is in deteriorated condition. The crossarm assemblies are showing signs of structural stress and are cracked in several locations. Additionally, the wood pole structure design is congested and restricts access to station equipment. Figure 2 below shows the deteriorated condition of the structure.

![Figure 2: Deteriorated Wood Structure](image-url)
The electrical equipment within the terminal station is 37 years old, with the exception of the power transformer, which is 48 years old. This equipment includes the disconnect switches, circuit breaker, recloser, bus conductors, insulators, grounding system and power transformer.

The disconnect switches have reliability issues related to the misalignment of the switch blades and mechanical linkages used for opening and closing the disconnects. Circuit breaker B1L29 is an oil filled breaker and contains Polychlorinated Byphenyls (PCBs). Hydro is currently replacing equipment containing PCBs in compliance with Environment Canada PCB Regulation SOR/2008-273. The recloser is original to the terminal station. The unavailability of spare parts and servicing for the recloser increases the risk to the reliability of providing service to customers. Figures 3a, 3b and 3c show pictures of the disconnect, circuit breaker and recloser located in the Wiltondale terminal station.

Figure 3a: Disconnect Switches
The insulators used in the Wiltondale Terminal Station are older style insulators subject to cement growth problems. As the cement in the insulators ages, cracks occur and water is able to penetrate the cracks. Through freezing and thawing cycles, pressure is placed upon the porcelain material in the insulator. Over time, the pressure caused by cement growth will crack the porcelain and result in failure of the insulator.

The grounding system in the Wiltondale Terminal Station was installed when the station was constructed. This grounding system is substandard compared to Hydro’s Terminal
Engineering Standards TS07-004-R2 and the Institute of Electrical and Electronic Engineers (IEEE) Standard 80-2000. The current grounding system poses a safety concern with the step/touch potential hazard to staff when working in the station. Step/touch potentials occur during system fault or as a result of equipment failure and introduce different voltage levels between equipment that is within step or touch distance. When different voltage levels are present in close proximity to one another, there is a risk of electrical shock or electrocution should an individual touch a grounded piece of equipment or step from one location to another.

System grounding is a key element to the operation of the system protection and control equipment. Proper terminal station grounding provides a solid ground reference to the operating voltages. This ground reference is critical for the proper operation of protection and control devices.

The power transformer in the Wiltondale terminal station was manufactured in 1964. The operating conditions and favourable test results do not justify replacement at this time. The only work involved with the power transformer will be its relocation to a new concrete pad. This is necessary as the existing location of the transformer pad does not accommodate the spacing requirements of the new support structures.

Restoring the terminal station structures and equipment under a combined project will avoid duplication of costs otherwise incurred if this work were completed at different times. The duplication of costs would include the labour cost for separate system outages of approximately $20,000, setup cost of the mobile substation of approximately $40,000 and mobilization costs for labour resources and hoisting equipment of approximately $25,000. Upon completion of this project, Hydro will have a fully restored terminal station with a new service life of 40 years. The only exception will be the transformer, which will be replaced based on the results of engineering assessments and testing.

1 The stated cost is not an actual, but is a minimum estimate for this activity.
3.1 Existing System

The Wiltondale Terminal Station provides electrical energy to customers of the Wiltondale area and the south side of Bonne Bay through the Glenburnie terminal station, as seen in the system operating diagram in Appendix A.

The Wiltondale Terminal Station is energized by a 2.4 kilometre 66kV electrical tap from transmission line TL226. This transmission line is routed between Deer Lake Terminal Station and the Rocky Harbour Terminal Station. Electrical power from the Wiltondale Terminal Station consists of two wood box structures complete with crossarms which support the overhead buswork, insulators and five disconnect switches. The transformer, circuit breaker and recloser are all mounted on concrete pads. The circuit breaker, B1L29, is a protection and isolation device for transmission line TL229. The transformer and recloser are used for the Wiltondale Distribution System. The transformer will step down or reduce the 66kV transmission voltage to a 12.5kV distribution voltage level while the recloser is used for protection of the 12.5kV distribution system during system disturbances.

Figure 4 shows the location of the Wiltondale Terminal Station within the Island Interconnected System.
Upgrade Terminal Station at Wiltondale

3.1.1 Operating Regime
The Wiltondale Terminal Station operates on a continuous basis. Electrical components such as the disconnects, circuit breaker and recloser, operate on an as needed basis to isolate and protect equipment. During normal operation this equipment is in a closed or energized state.

3.1.2 Age of Equipment or System
The Wiltondale Terminal Station was constructed in 1975. All of the equipment in the Terminal Station is 37 years old, with the exception of the power transformer, which is 46 years old.

3.1.3 Major Work and/or Upgrades
Two projects have be completed at the Wiltondale terminal station in recent years. The first, completed in 2008, was a transformer replacement as a result of a transformer failure. The old transformer was replaced with a used unit purchased from Newfoundland Power.
The second, completed in 2009, involved upgrading the safety and security of the terminal station. This involved replacing the fence and extending the terminal station to accommodate the installation of the mobile substation.

### 3.2 Operating Experience

The Wiltondale Terminal Station has two primary purposes; it provides 66 kV transmission level electricity to the Glenburnie Terminal Station using TL229 and it provides 12.5 kV distribution level electricity to the Wiltondale customers. As such, for the purposes of load forecasting both terminal stations need to be considered.

The customer demographics in both Wiltondale and Glenburnie include residential and commercial customers. Using the latest Hydro data\(^2\), the numbers show both Wiltondale and Glenburnie Distribution Centers are steady for the forecasted period of 2011 through 2016.

### 3.2.1 Outage Statistics

Outage statistics for terminal stations include outages as a result of both the transmission line and terminal station failures, but the performance of the terminal station is not directly measured. Following Canadian utility practice of tracking system performance, Hydro measures the forced outage performance of terminal stations.

Table 1 lists the five-year average outage frequency (T-SAIFI) and outage duration (T-SAIDI) data of the Wiltondale Terminal Station and Northern Region, and compares Hydro’s system averages to Canadian Electricity Association (CEA) system averages.

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Table 1: Forced Outage Performance Statistics

<table>
<thead>
<tr>
<th>Delivery Point Affected</th>
<th>T-SAIFI</th>
<th>T-SAIDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wiltondale</td>
<td>7.80</td>
<td>179.80</td>
</tr>
<tr>
<td>Hydro, Northern Region</td>
<td>5.20</td>
<td>215.97</td>
</tr>
<tr>
<td>Hydro</td>
<td>1.60</td>
<td>88.43</td>
</tr>
<tr>
<td>CEA (2006-2010)</td>
<td>0.72</td>
<td>66.12</td>
</tr>
</tbody>
</table>

T-SAIFI is a measure of the frequency of transmission interruptions that a delivery point experiences during a given period.

T-SAIDI is a measure of average total interruption duration, in hours, that a delivery point experiences during a given period.

It can be seen from the performance statistics in Table 1 that both the frequency and duration statistics for Wiltondale are considerably higher than CEA and Hydro averages.

3.2.2 Legislative or Regulatory Requirements

The use of PCBs in oil circuit breaker bushings has presented an environmental issue which has led to the development of a plan for its removal and safe disposal. Prior to 1980, many bushing manufacturers used PCBs in their insulating oil. The concentration levels of PCBs vary by manufacturer and also vary within manufacturer by year. The latest revision of Environment Canada’s *PCB Regulation, 2008* has strict applications and end-of-use dates for various equipment containing varying concentrations of PCBs.

The current regulation required all bushings with PCB levels 500 mg/kg or greater be taken out of service by December 31, 2009. Additionally, all electrical transformers with PCB levels between 50 to 499 mg/kg must be taken out of service by December 31, 2025. At that time Hydro filed an application for extension under subsection 17 (2) of *PCB Regulation SOR/2008-273*. In 2010, Environment Canada granted Hydro the extension for replacement.
of PCB contaminated CTs, PTs and bushings with unknown PCB concentrations, authorizing a deadline for replacement by December 31, 2014.

CEA, on behalf of member utilities including Hydro, has been lobbying Environment Canada for an amendment of the *PCB Regulations, 2008*, to allow bushings and instrument transformers an end-of-use date of December 31, 2025. This request is based on the fact that it is not possible for utilities to replace all of the equipment with unknown PCB levels by December 31, 2014, due to the lack of availability of engineered-to-order equipment and the numerous power outages required.

On May 25, 2012, CEA informed its member utilities that Environment Canada has agreed in principle to the December 31, 2025 end-of-use date. The compliance mechanism will be in the form of an amendment. Environment Canada is planning to complete the draft amendment in the spring of 2013 and the final regulation publication in the spring of 2014. CEA is now urging the Minister of the Environment to move ahead the final regulation.

### 3.2.3 Safety Performance

Support structures are designed to consider wind and ice loads typical for Newfoundland and Labrador’s geographical regions. The integrity of the support structure is affected by weather and operating conditions over time. The wood pole structure in the Wiltondale terminal station is aged and showing signs of structural stress seen by cracks in the wood crossarm assemblies. Additionally, the wood pole structure arrangement is congested and restricts access to station equipment.

Aged insulators and bus supports introduce a safety hazard by the increased risk of falling parts. Cement growth problems in older style insulators weaken their structural strength and can result in falling parts. The disconnect switches are mounted on the wood pole structure. The mechanical force required to open and close the disconnect switches introduces a safety hazard as this operation relies on the structural integrity of the wood
pole structure. In its current condition, the wood support structure integrity is weakened.

All of these conditions increase the safety risk for Hydro personnel and decrease system reliability for the customers in areas of Wiltondale and the south side of Bonne Bay.

### 3.2.4 Maintenance History

The five-year maintenance history for the Wiltondale Terminal Station including all assets is shown in Table 2:

<table>
<thead>
<tr>
<th>Year</th>
<th>Preventive Maintenance ($000)</th>
<th>Corrective Maintenance ($000)</th>
<th>Total Maintenance ($ 000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>3.2</td>
<td>0.2</td>
<td>3.4</td>
</tr>
<tr>
<td>2010</td>
<td>1.8</td>
<td>3.2</td>
<td>5.0</td>
</tr>
<tr>
<td>2009</td>
<td>0.6</td>
<td>0.0</td>
<td>0.6</td>
</tr>
<tr>
<td>2008</td>
<td>1.4</td>
<td>80.4</td>
<td>81.8</td>
</tr>
<tr>
<td>2007</td>
<td>0.0</td>
<td>0.4</td>
<td>0.4</td>
</tr>
</tbody>
</table>

### 3.2.5 Historical Information

The Rocky Harbour Terminal Station upgrade is a recent project similar to the Wiltondale Terminal Station upgrade. The scope of work of the two projects is similar in that they involve replacement of the wood box structures with steel box structures and replacement of electrical equipment. The scope of work differs based on the quantity of electrical equipment being replaced.

The Wiltondale Terminal Station upgrade includes replacement of additional electrical equipment, specifically a circuit breaker and five disconnects. The original budget for the Rocky Harbour Terminal Station upgrade project was $794,900 and was planned as a two year project. The budget was revised to reflect the additional costs for the mobile substation installation and the replacement of a transmission line structure. This additional work was addressed during the execution phase of the project and resulted in a capital budget change order of $359,500. The total budget for the Rocky Harbour Terminal Station
Upgrade is now $1,154,400 and is scheduled for completion by the end of 2012.

The Wiltondale Terminal Station upgrade project is similar to the Rocky Harbour Terminal Station upgrade project. In comparison, the additional material required for the Wiltondale Terminal Station upgrade is approximately $200,000 more than the Rocky Harbour material costs. The work involved in installing the additional material corresponds to an additional cost of approximately $200,000 for labour, travel, equipment and contract work. Finally, the Wiltondale Terminal Station upgrade project applies a contingency of 20 percent, whereas the Rocky Harbour project applied a contingency of 10 percent. This difference results in an increase in cost of approximately $300,000.

3.2.6 Anticipated Useful Life
The anticipated useful life of the equipment within the Wiltondale Terminal Station is between 40 and 55 years.

3.3 Development of Alternatives
There are no viable alternatives to this project. The status quo is not an option as the risk to safety and reliability will increase with continued operation.
4 CONCLUSION

The Wiltondale Terminal Station upgrade will improve the safety and reliability performance of this facility benefiting the customers of Wiltondale and the south side of Bonne Bay. The existing wood box structure and station equipment have reached the end of their useful service life.

Hydro plans to replace the existing wood box structures with steel box structures. At the same time, Hydro will replace the electrical equipment in the terminal station, with the exception of the power transformer. This will optimize capital expenditures for this work, which would otherwise require a second mobilization and demobilization of the mobile substation in the near future.

4.1 Budget Estimate

The budget cost for this work is $1,871,000. The resource assignment for this project requires the use of a contractor for labour in completing the civil works, structure erection, steel inspection along with the installation of electrical equipment and station grounding grid. Hydro will use internal resources to complete the engineering, design, project management, procurement, electrical isolations and station equipment commissioning.

The budget estimate for this project is shown in Table 3.

<table>
<thead>
<tr>
<th>Project Cost: ($ X1,000)</th>
<th>2013</th>
<th>2014</th>
<th>Beyond</th>
<th>Total</th>
</tr>
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<tbody>
<tr>
<td>Material Supply</td>
<td>291.8</td>
<td>140.0</td>
<td>0.0</td>
<td>431.8</td>
</tr>
<tr>
<td>Labour</td>
<td>108.0</td>
<td>148.8</td>
<td>0.0</td>
<td>256.8</td>
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<tr>
<td>Consultant</td>
<td>36.2</td>
<td>10.0</td>
<td>0.0</td>
<td>46.2</td>
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<tr>
<td>Contract Work</td>
<td>156.7</td>
<td>390.0</td>
<td>0.0</td>
<td>546.7</td>
</tr>
<tr>
<td>Other Direct Costs</td>
<td>59.5</td>
<td>54.7</td>
<td>0.0</td>
<td>114.2</td>
</tr>
<tr>
<td>Interest and Escalation</td>
<td>45.5</td>
<td>150.7</td>
<td>0.0</td>
<td>196.2</td>
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<tr>
<td>Contingency</td>
<td>0.0</td>
<td>279.1</td>
<td>0.0</td>
<td>279.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>697.7</strong></td>
<td><strong>1,173.3</strong></td>
<td><strong>0.0</strong></td>
<td><strong>1,871.0</strong></td>
</tr>
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4.2 Project Schedule

Wiltondale is located at the entrance to Gros Morne National Park and experiences an increased volume of tourists during the summer season, starting in June. In order to maintain customer load demand and system reliability during this time, the project schedule is planned over a two-year period with design and procurement in 2013 and construction for April to June in 2014. The anticipated project schedule is shown in Table 4.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Start Date</th>
<th>End Date</th>
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<tr>
<td>Planning</td>
<td>January 2013</td>
<td>April 2013</td>
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<tr>
<td>Design</td>
<td>April 2013</td>
<td>September 2013</td>
</tr>
<tr>
<td>Procurement</td>
<td>September 2013</td>
<td>December 2013</td>
</tr>
<tr>
<td>Planning</td>
<td>January 2014</td>
<td>February 2014</td>
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<tr>
<td>Design</td>
<td>March 2014</td>
<td>April 2014</td>
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<tr>
<td>Procurement</td>
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<td>April 2014</td>
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<tr>
<td>Construction</td>
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<td>June 2014</td>
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<tr>
<td>Commissioning</td>
<td>June 2014</td>
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<tr>
<td>Closeout</td>
<td>July 2014</td>
<td>September 2014</td>
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APPENDIX A

System Operating Diagram – Wiltondale terminal station