



CONNECTION ASSESSMENT & APPROVAL PROCESS ASSESSMENT SUMMARY

Applicant: Enbridge Pipelines Inc.

**Project: Cardinal Substation – Modification of
115kV Substation**

CAA ID: 2002 – EX071

**Long Term Forecasts & Assessments Department\
Consistent Information Set Department**

Date: December 19, 2002

1.0 Description of Proposal

The Enbridge Cardinal substation, located in Cardinal Township in eastern Ontario, is supplied from the 115kV St. Lawrence TS to Brockville TS transmission circuit L1MB, owned by Hydro One Networks Inc. The peak load demand at the substation is less than 3MW.

The 115kV substation presently consists of:

- ❖ One 3-phase 7.5MVA 115-4.16kV transformer; winding connection: delta primary, resistance grounded wye secondary
- ❖ A 138kV 600A disconnect switch in series with a 138kV fused disconnect with a 65E fuse
- ❖ 4.16kV facilities, including switchgear, two motors (1 x 2500HP and 1 x 1500HP), and two capacitors (300kvar and 175kvar) one for each motor
- ❖ Auxiliary facilities including station services, and protection and control systems

Enbridge Pipelines Inc. is proposing to modify the 115kV connection to the IMO-controlled grid and to replace the transformer protection system at the substation. The proposed plan includes:

- ❖ Replacement of the existing 65E fuse of the fused disconnect with a 100E fuse unit
- ❖ Installation of a new 115kV 1200A SF₆ circuit switcher
- ❖ Installation of a new transformer protection scheme including associated current transformers and battery bank; and
- ❖ Replacement of the existing 4.16kV switchgear with a pad mounted 5kV vacuum circuit breaker

After the implementation of the proposed modification, the Cardinal substation will be connected to the IMO-controlled grid via a new 115kV circuit switcher, the existing fused disconnect with a 100E fuse, and the existing 138kV disconnect switch. Figure 1 shows the existing 115kV connection to the IMO-controlled grid and the proposed modification to the connection facilities at the Enbridge Cardinal substation.

The modified connection facilities are rated as follows:

115kV Disconnect Switch

Manufacturer:	Kearney
Voltage Rating (kV)	138
Continuous Current Rating (A):	600
Short Circuit Rating (kA):	61

115kV Fused Disconnect

Manufacturer:	S&C Electric
Voltage Rating (kV)	138
Fuse Cutout Rating:	100E
Short Time Interrupting Current Rating (kA):	10.5

115kV Circuit Switcher

Manufacturer:	S&C Electric
Voltage Rating (kV)	115
Continuous Current Rating (A):	1200
Short Circuit Rating (kA):	25

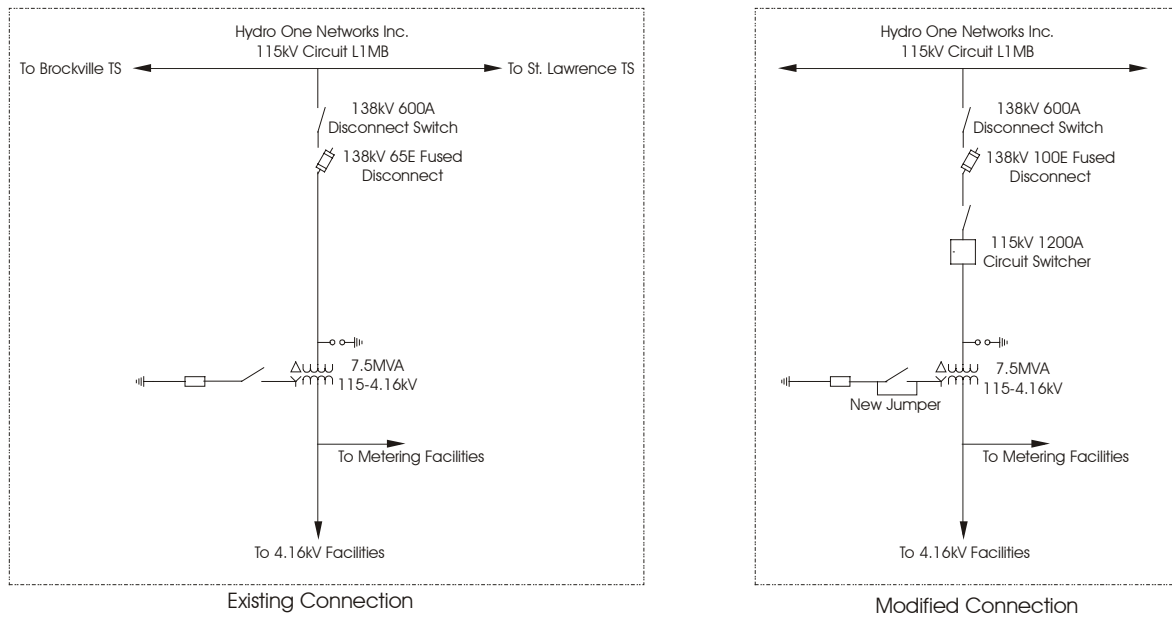


Figure 1: Enbridge Cardinal Station 115kV Connection Facilities

The scheduled in-service date for the proposed work is February 15, 2003.

2.0 Assessment

The proposed work involves the 115kV connection facilities to the IMO-controlled grid, the 4.16kV facilities, and the transformer protection scheme.

The Transmission System Code, issued by the Ontario Energy Board and the Connection Agreement between the applicant and the Transmitter, Hydro One Networks Inc., cover protection system requirements for the substation. This assessment therefore does not cover the proposed modification to the transformer protection scheme and assumes that it will comply with the Transmission System Code.

The low voltage facilities at the Cardinal substation would have no adverse impact on the IMO-controlled grid. This assessment will therefore concentrate on assessing the 115kV facilities at the substation.

2.1 Compliance with Market Rules

*References: Market Rules: Chapters 4 and 5
Appendix 4.1: IMO-Controlled Grid Performance Standards and
Appendix 4.3: Requirements of Connected Wholesale Customers and Distributors Connected to the IMO-Controlled Grid*

Connection Equipment Ratings

All 115kV equipment connected to the IMO-controlled grid must be capable of operating within the normal operating voltage range of 113kV and 127kV.

Both the disconnect switch and the fused disconnect are rated at 138kV. Although the new circuit switcher has a nominal voltage rating of 115kV, the manufacturer S&C Electric has indicated that the device is capable of operating at a maximum voltage of 145kV.

The primary protective device at the substation is the new 115kV circuit switcher. The fused disconnect provides back-up protection if the circuit switcher fails to operate in response to a contingency. The circuit switcher has a short circuit rating of 25kA and the rating of the fuse cutout is determined by protective relay setting co-ordination.

Based on information from Hydro One Networks Inc., the maximum 115kV fault level at the Cardinal substation is less than 10kA. The new 115kV circuit switcher is adequate with enough margin for fault level increases due to future development in the area. However, the Transmission System Code specifies that all new 115kV equipment and system elements connected to the transmission system shall, as a minimum, be capable of interrupting a maximum fault level of 50kA. It should be noted that should any future development in the area by a third party increase the fault level at the Cardinal substation beyond the 25kA rating of the circuit switcher. The subsequent replacement of the circuit switcher at Cardinal substation might well be the responsibility of Enbridge Pipelines inc.

Power Factor

Connected wholesale customers connected to the IMO-controlled grid shall operate at a power factor within the range of 0.9 lagging to 0.9 leading as measured at the defined metering point.

The peak demand at the Cardinal substation is less than 3MW. There are two capacitor banks with ratings of 300kvar and 175kvar at the substation for power factor correction. Historic data indicate that the station has been operating within the specified range.

This proposal does not involve any change to the station load demand. It is therefore expected that the substation will continue to operate within the acceptable power factor range.

Under-Frequency Load Shedding, Voltage Reduction, and On-line Monitoring Requirements

There are no under-frequency load shedding and on-line monitoring facilities at the substation. The existing 3-phase 7.5MVA 115-4.16kV transformer has off-load taps but no on-load tap changer. The current peak demand at the station is less than 3MW and the applicant is not proposing to increase the station load demand.

The Cardinal substation is supplying non-dispatchable load and the current maximum station capacity is only 7.5MVA. The station would be exempt from the requirements for on-line monitoring and voltage reduction requirements.

Similarly, with a peak demand of less than 3MW, it would not be required, at this time, to install under-frequency load shedding facilities.

The IMO is conducting its annual system wide review of under-frequency load shedding requirements. If the review identifies that under-frequency load shedding facilities would be required at the Cardinal substation, the IMO will issue a directive to Enbridge Pipelines Inc. for installation of such facilities.

2.2 Impact on System Reliability

The Cardinal substation is an existing facility. As the applicant is not increasing the station load demand, the proposal would not have any adverse impact on the IMO-controlled grid in respect to thermal loading on the supply circuit L1MB, voltage profile, or short circuit levels in the operating area.

With the existing arrangement, any fault involving the 7.5MVA transformer will result in the tripping of the 115kV circuit L1MB. Other customers connected to L1MB would be affected. After the implementation of the proposed plan, the new circuit switcher would clear any fault involving the transformer while the circuit L1MB would remain in service resulting in better system reliability.

The provision of differential protective relay and circuit switcher for transformer protection at the substation is a definite improvement over the existing arrangement that relies on the fused disconnect and remote coverage from the terminal station St. Lawrence TS.

3.0 Notification of Approval

Based on the above assessment, it is recommended that a Notification of Approval for the proposed modification to the Cardinal substation be issued to the applicant.