CONNECTION ASSESSMENT & APPROVAL PROCESS

Preliminary Assessment Report – Final Version

Date: October 7, 20033

Norfolk Energy Inc.

Build New 115-27.6kV 'Bloomsburg' MTS

CAA ID No. 2003 – 093

Long Term Forecasts & Assessments Department

Consistent Information Set Department

Disclaimer

IMO

This report has been prepared solely for the purpose of assessing whether the connection applicant's proposed connection with the IMO-controlled grid would have an adverse impact on the reliability of the integrated power system and whether the IMO should issue a notice of approval or disapproval of the proposed connection under Chapter 4, section 6 of the Market Rules.

Approval of the proposed connection is based on information provided to the IMO by the connection applicant and the transmitter(s) at the time the assessment was carried out. The IMO assumes no responsibility for the accuracy or completeness of such information, including the results of studies carried out by the transmitter(s) at the request of the IMO. Furthermore, the connection approval is subject to further consideration due to changes to this information, or to additional information that may become available after the approval has been granted. Approval of the proposed connection means that there are no significant reliability issues or concerns that would prevent connection of the proposed facility to the IMO-controlled grid. However, connection approval does not ensure that a project will meet all connection requirements. In addition, further issues or concerns may be identified by the transmitter(s) during the detailed design phase that may require changes to equipment characteristics and/or configuration to ensure compliance with physical or equipment limitations, or with the Transmission System Code, before connection can be made.

This report has not been prepared for any other purpose and should not be used or relied upon by any person for another purpose. This report has been prepared solely for use by the connection applicant and the IMO in accordance with Chapter 4, section 6 of the Market Rules. The IMO assumes no responsibility to any third party for any use, which it makes of this report. Any liability which the IMO may have to the connection applicant in respect of this report is governed by Chapter 1, section 13 of the Market Rules. In the event that the IMO provides a draft of this report to the connection applicant, you must be aware that the IMO may revise drafts of this report at any time in its sole discretion without notice to you. Although the IMO will use its best efforts to advise you of any such changes, it is the responsibility of the connection applicant to ensure that it is using the most recent version of this report.

Executive Summary

This Preliminary Assessment has investigated the impact of the proposed new 115-27.6kV 'Bloomsburg' MTS on the IMO-controlled grid. It has been concluded that the proposal would not have any significant adverse system impact on the IMO-controlled grid and that a System Impact Assessment would not be necessary.

The Proposal

Norfolk Power Distribution Inc. (Norfolk Power) customers are presently supplied from Norfolk TS. Norfolk Energy Inc., an affiliate company to Norfolk Power, is proposing to build a new transformer station, designated as 'Bloomsburg' MTS. The new station will be located near Highway 24 north of the City of Simcoe.

The new 'Bloomsburg' MTS is designed for an ultimate 115-27.6kV DESN configuration with two 3-phase 25/33.3/41.7MVA transformers and six 27.6kV feeder positions. However, Norfolk Energy Inc., the *Connection Applicant*, is presently only seeking approval for connection of the initial stage that includes only a single transformer and three feeder positions. The new station will be connected to the 115kV transmission circuit A1N, which supplies the Hydro One Networks Inc. Norfolk TS. The connection point to the IMO-controlled grid is about 2km from Norfolk TS.

The initial summer peak loads supplied from the new station will be up to 33MVA.

The scheduled in-service date for the new station is June 2004.

Compliance with Market Rules

The proposed plan is in compliance with the Market Rules, if the proponent fulfills the connection requirements outlined in Section 4.0 of this report.

Impact of 'Bloomsburg' MTS on the IMO-controlled Grid

The proposed plan is intended to provide supply for future load growth in the area. This assessment has concluded that the proposed project will not materially affect the load meeting capability and reliability of the IMO-controlled grid.

IMO's Requirements for Connection

The *Connection Applicant* shall fulfill the following connection requirements:

- Provide evidence to support that the transformer at 'Bloomsburg' MTS has an overexcitation specification of at least 115% and that the transformer is capable of continuous operation at a maximum system voltage of 127kV.
- Ensure that the power factor of the load supplied from the new 'Bloomsburg' MTS is maintained within the range of 0.9 lagging to 0.9 leading as measured at the defined metering point, which is the 115kV supply point.
- Maintain the availability of resources and facilities that provide the capability of reducing the secondary voltage at the new 'Bloomsburg' MTS by 3% and 5% within 5 minutes of receiving direction from the IMO to do so.
- Install independent phase controlled compensators on the 27.6kV bus similar to those at Norfolk TS to limit the magnitude of any negative sequence voltage within acceptable level.
- Provide the necessary on-line monitoring facilities as specified by the IMO.
- Complete the IMO Facility Registration Process, including metering registration, before placing the proposed new facilities in service.

Customer Impact Assessment

Based on the assumption that there are no large motors or large generators connected to the Norfolk Power Inc. system, there is no change in impact on other customers is expected due to connection of the proposed single transformer Bloomsburg MTS.

Notification of Approval

It is recommended that Notification of Approval be granted for connection of the new 'Bloomsburg' MTS to the IMO-controlled grid, subject to the *Connection Applicant* meeting the connection requirements outlined in Section 4.0 of this report.

1.0 Description of Proposal

Norfolk Power Distribution Inc. (Norfolk Power) customers are presently supplied from Norfolk TS. Norfolk Energy Inc., an affiliate company to Norfolk Power, is proposing to build a new transformer station, designated as 'Bloomsburg' MTS,. to supply its new loads. The new station will be located near Highway 24 north of the City of Simcoe in the Regional Municipality of Haldimand – Norfolk.

The new 'Bloomsburg' MTS is designed for an ultimate 115-27.6kV DESN configuration with two 3-phase 25/33.3/41.7MVA 115-27.6kV transformers and six 27.6kV feeder positions. Norfolk Energy Inc., the *Connection Applicant,* is in the process of negotiating with transformer vendors and has therefore provided the IMO with only preliminary transformer data. The transformer at 'Bloomsburg' MTS will be a 3-phase 25/33.3/41.7MVA 110-28.4kV transformer with under load tap changer on the secondary winding. The transformer will be delta connected primary and wye connected secondary.

However, the *Connection Applicant,* is presently only seeking approval for connection of the initial stage that includes only a single transformer and three feeder positions. The new station will be connected to the 115kV transmission circuit A1N, which supplies the Hydro One Networks Inc. Norfolk TS, via a 138kV 1200A circuit switcher. The connection point to the IMO-controlled grid is about 2km from Norfolk TS. Figure 1 shows the connection to the IMO-controlled grid and the initial stage of the new transformer station.

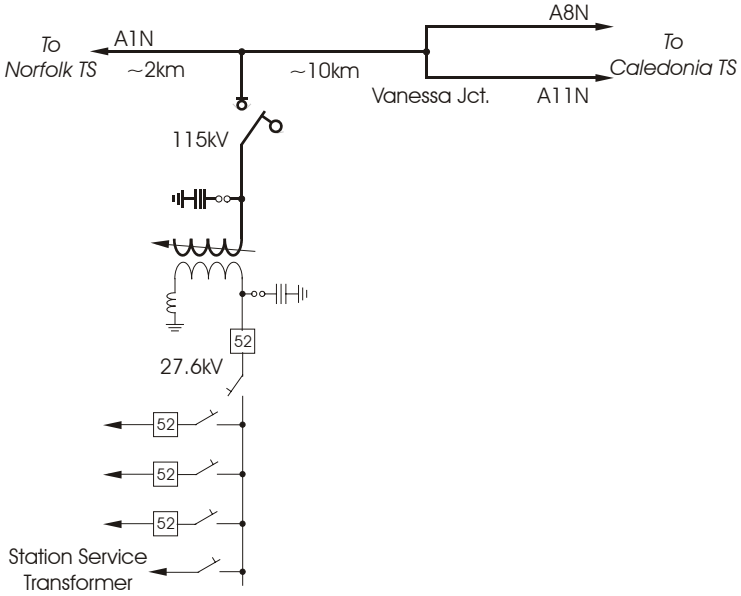

Figure 1 – 'Bloomsburg' MTS

The initial station summer peak demand will be about 23MVA to 33MVA. This comprises new load plus a part of the Norfolk Power's existing load that is currently supplied from Norfolk TS. The station load demand is forecast to grow at an annual rate of 1%.

The scheduled in-service date for the new station is June 2004.

2.0 Assessment

This Preliminary Assessment has investigated the impact of the proposed new 115-27.6kV transformer station on the IMO-controlled grid and is based on information included in the connection assessment application. Results presented in this report are only valid for the data provided by the connection applicant. If subsequent equipment testing indicates that the specifications for new facilities are significantly different from the values provided, then additional studies might be required to re-assess the impact on the IMO-controlled grid.

Although 'Bloomsburg' MTS is designed for a DESN configuration, the *Connection Applicant* is seeking approval for the connection of a single transformer at the new station. This Preliminary Assessment has therefore only investigated the impact of the single transformer arrangement on the IMO-controlled grid. The *Connection Applicant* must submit a separate connection application for approval for the installation of the second transformer.

'Bloomsburg' MTS will be connected to the 115kV transmission line tap A1N, which presently supplies Norfolk TS, a Hydro One Network Inc. facility. The line tap A1N is connected at Vanessa Junction to the two radial transmission circuits A8N and A11N, which presently are terminated at the Hydro One Networks Inc. Allanburg TS in the Regional Municipality of Niagara. Hydro One Networks Inc. has received approval under CAA 2002 – 056 for the installation of two 230/115kV auto-transformers at its existing Caledonia TS in the Town of Haldimand and for the re-termination of A8N and A11N onto its new 115kV facilities at the station in the spring of 2004. This Preliminary Assessment has therefore been based on the assumption that circuits A8N and A11N will be terminated at Caledonia TS.

2.1 Compliance with Market Rules

References:
Market Rules: Chapters 4 and 5
Appendix 4.1: IMO-Controlled Grid Performance Standards
Appendix 4.3: Requirements of Connected Wholesale Customers and Distributors Connected to the IMO-Controlled Grid
Appendix 4.17: IMO Monitoring Requirements – Connected Wholesale Customers and Distributors
Appendix 4.22: IMO Monitoring Requirements – Distributors and Connected Wholesale Customers Performance Standards

2.1.1 Connection Equipment Ratings (Market Rules Chapter 4 Section 3.0, Appendices 4.1 and 4.3)

This assessment focuses only on the high voltage facilities that connect to the IMO-controlled grid. Low voltage facilities are not expected to have adverse impact on the IMO-controlled grid and will not be assessed.

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

The *Connection Applicant* is presently negotiating with transformer vendors and thus could only provide preliminary information on the transformer that will be installed at 'Bloomsburg' MTS. The proposed new station will initially include one 3-phase 25/33.3/41.7MVA 110-28.4kV transformer. There will be no off load tap at the primary winding and the secondary winding will be equipped with an under load tap changer. Details of the under load tap changer were not provided. The summer and winter 10-day limited time ratings of the transformer are 54.2MVA and 62.4MVA respectively.

Applicable Canadian standard for power transformer (CAN/CSA-C88-M90) requires that power transformers shall be capable of continuous operation at 105% rated voltage at full load and 110% rated voltage at no load. If the proposed 110-28.4kV transformer at 'Bloomsburg' MTS meets the minimum requirements of the Canadian standard, it would only be capable of continuous operation to a maximum voltage of 115.5kV at full load and 121kV at no load.

The *Connection Applicant* shall therefore provide evidence to support that the transformer at 'Bloomsburg' MTS has an overexcitation specification of at least 115% and that the transformer is capable of continuous operation at a maximum system voltage of 127kV.

The transformer will likely be connected to the IMO-controlled grid via a 138kV 1,200A (about 239MVA at 115kV) 25kA S&C Electric Model 2010 circuit switcher. The connection applicant will confirm in the near future whether the transformer is to be connected to A1N circuit via a circuit switcher or air break disconnect switch with appropriate remote trip facilities. Short circuit studies carried out by Hydro One Network Inc. in support of its connection application for the new facilities at Caledonia TS show that after the re-termination of A8N and A11N at Caledonia TS, the maximum 115kV and 27.6kV fault levels at Norfolk TS would be about 8.5kA and 4.5kA respectively. The new 'Bloomsburg' MTS will be supplied radially from Caledonia TS and there is no known plan to connect any embedded generation, large synchronous, or induction motors to the new station. The new station would, therefore, not expect to have any significant impact on the existing fault level in the area. As 'Bloomsburg' MTS will only be 2km from Norfolk TS, the maximum fault levels at 'Bloomsburg' TS is expected to be in the same order of magnitude as those at Norfolk TS. The proposed 138kV circuit switcher would therefore be adequate for the proposed 25/33.3/41.7 MVA transformer and the expected 115kV fault level at the station.

However, it should be noted that although the proposed 138kV 1,200A 25kA circuit switcher would be adequate for the fault level at 'Bloomsburg' MTS, the Transmission System Code requires that all new 115kV equipment be capable of interrupting a maximum fault level of 50kA. Should any future development in the area by a third party increase the maximum fault level at the 'Bloomsburg' MTS beyond the 25kA rating of the circuit switcher. The proponent would be responsible for the subsequent replacement of the circuit switcher at the 'Bloomsburg' MTS.

2.1.2 Power Factor (Market Rules Chapter 4 Section 3.0 and Appendix 4.3)

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 composition of the loads supplied from 'Bloomsburg' MTS will be about 50% residential, 30% industrial, and 20% commercial. The *Connection Applicant* has indicated that the loads supplied from the new 'Bloomsburg' MTS will be operating at a power factor within the range stipulated in the Market Rules lagging and would be in compliance with the Market Rules.

The connection assessment application shows that there is no plan to install low voltage shunt capacitor banks for power factor correction at the new station. If, in the future, the power factor at the 'Bloomsburg' MTS should deteriorate and were to be consistently outside the specified range, the connection applicant shall undertake to install power factor correction facilities at the station.

2.1.3 Under-Frequency Load Shedding (Market Rules Chapter 5 Section 10.4, Market Rules Chapter 4 Section 3.0, and Appendix 4.3)

As part of the demand control actions that are required to ensure system security under emergency operating conditions, the Market Rules stipulate that distributors, in conjunction with the relevant transmitter, shall

make arrangements to enable automatic under-frequency load shedding of at least 30% of its total peak customer demand.

Information included in the connection assessment application shows that automatic under-frequency load shedding facilities will be provided. The automatic under-frequency load shedding relay would be set to operate feeder breakers at discrete frequency levels to meet the Market Rules requirements.

2.1.4 Voltage Reduction Requirements (Market Rules Chapter 5 Section 10.3, Market Rules Chapter 4 Section 3.0, and Appendix 4.3)

As part of the demand control actions, the Market Rules further stipulate that distributors connected to the IMO-controlled grid with directly connected load facilities of aggregated rating above 20MVA and with the capability to regulate distribution voltages under load, shall provide the capability to reduce distribution voltages by 3% and 5% within 5 minutes of receiving direction from the IMO.

– Transformer at the 'Bloomsburg' MTS is equipped with under load tap changer, which under normal operating conditions will operate automatically to maintain the 27.6kV bus voltage. Remote manual control of the under load tap changers is also available via SCADA.

The 'Bloomsburg' MTS thus has the capability to reduce the secondary voltage at the new 'Bloomsburg' MTS by 3% and 5% within 5 minutes of receiving direction from the IMO to do so.

2.1.5 On-line Monitoring Requirements (Market Rules Chapter 4 Section 7.5, Appendices 4.17 and 4.22)

In order to facilitate the operations of the IMO-controlled grid, certain information including active and reactive power demands, status of circuit switcher, etc shall be provided to the IMO on a continual basis.

General monitoring requirements and minimum performance standards are outlined in the Market Rules Appendices 4.17 and 4.22.

The connection applicant shall obtain the exact monitoring requirements for the new 'Bloomsburg' MTS via the IMO Facility Registration process.

2.2 Impact of 'Bloomsburg' MTS on the IMO-controlled Grid

The station will be supplied via the line tap A1N that is connected to the circuits A8N and A11N. The radial transmission circuits A8N and A11N will be re-terminated to the 230/115kV Caledonia TS, which will be connected to the Nanticoke GS to Middleport TS 230kV transmission circuits N2M and N6M. The following assessment has therefore investigated the impact of 'Bloomsburg' MTS on the local 115kV transmission that will be supplying the new station and the 230kV transmission system between Nanicoke GS and Middleport TS.

2.2.1 Short Circuit Assessment

The new station is to be used solely for load supply and there is no known plan to connect any embedded generation, large synchronous, or induction motors to the new station. The new station would, therefore, not expect to have any significant impact on the existing fault level in the area.

2.2.2 Thermal Loading Considerations

'Bloomsburg' MTS will be radially supplied from Caledonia TS, which will be connected to the 230kV circuits N2M and N6M. The 230kV circuits N2M and N6M from Nanticoke GS to Middleport TS are two of the four circuits (N1M, N2M, N5M, and N6M) that incorporate the Nanticoke 230kV generation facilities into the system. The addition of new loads at Caledonia TS would result in the reduction of power flow on the circuits from Caledonia TS to Middleport TS. 'Bloomsburg' MTS would therefore have no negative impact on the thermal loading of these two 230kV circuits.

The summer ratings of the 115kV transmission circuits that will be supplying 'Bloomsburg' MTS are listed in Table 1. The limiting circuit will be A1N.

Circuit	Section		Conductor Size	Max. Op. Temp. (°C)	Continuous Rating[1] (A/MVA[4])	Emergency Rating[2] (A/MVA[4])	15-Min. LTR[3] (A/MVA[4])
	From	To					
A1N	Vanessa Jct.	Norfolk TS	411.4 ACSR 15/7	80	480/97	480/97	480/97
A8N	Caledonia TS	Hartford Jct.	605 ACSR 54/7	71	530/105	530/105	530/105
	Hartford Jct.	Vanessa Jct.	795 ACSR 26/7	127	850/169	1090/217	1210/241
A11N	Caledonia TS	Hartford Jct.	605 ACSR 54/7	71	530/105	530/105	530/105
	Hartford Jct.	Vanessa Jct.	795 ACSR 26/7	127	850/169	1090/217	1210/241

Notes
1. Based on 93°C or maximum operating temperature whichever is less, with 30°C ambient temperature and 4km/h wind
2. Based on maximum operating temperature, with 30°C ambient temperature and 4km/h wind
3. Based on maximum operating temperature, 30°C ambient temperature, 4km/h wind and a pre-load current equal to the continuous rating
4. Based on 115kV

Table 1 - Transmission Circuit Summer Ratings- TBC

The 2002 summer peak demand at Norfolk TS was about 85 MVA. Initially, the new 'Bloomsburg' MTS will be supplying existing loads that will be transferred from Norfolk TS. The overall summer peak demand in 2004 on circuit A1N would be slightly higher than 85 MVA. Circuit A1N with a summer continuous rating of about 97MVA would be adequate to supply both Norfolk TS and the new 'Bloomsburg' MTS. However, circuit A1N could be overloaded in the summer of 2008 if the area loads supplied from these two stations grew at a modest rate of 1% per year.

Furthermore, Hydro One Networks Inc. is in the process of replacing the two existing transformers at Norfolk TS with 50/66.6/83.3MVA units. The station capacity of Norfolk TS will be increased to about 105MVA when the transformer replacement project is complete in late 2003. With the addition of the new 'Bloomsburg' MTS, the total load supply capability of these two stations will be 146.7MVA.

The capacity of the 115kV circuits supplying Norfolk TS and 'Bloomsburg' MTS will require upgrading in the future to match the total load to be supplied from these two stations. Hydro One Networks Inc. has received approval under CAA 2002 – EX070 for the installation of a future second 115kV circuit from Vanessa Junction to Norfolk TS for a double circuit supply arrangement and the upgrading of the existing circuit A1N. However, currently there is no firm plan to install the second circuit and upgrading of the existing A1N circuit.

2.2.3 Voltage Profile Assessment

Power flow studies have been carried out to investigate the impact of the new 'Bloomsburg' MTS on the voltage profile in the area, including the loss of 'Bloomsburg' MTS. Both peak and off-peak load conditions were simulated in these studies.

Peak Load Conditions
- Nanticoke voltage at 240kV
- 'Bloomsburg' MTS load 30MW @ 0.9 lagging power factor
- Norfolk TS load 54MW @ 0.9 lagging power factor

Off Peak Load Conditions (55% of Peak)
- Nanticoke voltage at 250kV
- 'Bloomsburg' MTS load 16.5MW @ 0.9 lagging power factor
- Norfolk TS load 30MW @ 0.9 lagging power factor

The voltage study concentrated on identifying the effect of a contingency associated with the new 'Bloomsburg' transformer on the voltages at Norfolk TS and Caledonia TS.

Results of the studies are summarized in Table 2.

Case	Caledonia TS Voltage 115kV	Norfolk Voltage		Bloomsberg Voltage	
		115 kV	27.6 kV	115 kV	27.6 kV
Peak Load					
Pre-fault	121	114.43	26.7	114.43	30.7
Post-fault	122	117.9	27	-	-
Delta V	.8%	3%	1.1%		
Off-Peak Load					
Pre-fault	125.2	122.2	29.2	122.2	31
Post-fault	125.5	123.5	29.4	-	-
Delta V	0.2%	1.2%	0.7%		

Table 2. Voltage Study Results

The results of this study show that the loss of the new station will create a voltage raise of up to 3% on the HV side of Norfolk TS, which is within the Market Rules requirements for sudden voltage change. Thus, it can be concluded that the new 'Bloomsburg' MTS will not have a negative impact on the local area voltage profile.

It should be noted that for peak load conditions the voltages at Norfolk TS and the new 'Bloomsburg' MTS are approaching levels that are close to the minimum acceptable system voltages by the Market Rules. During these conditions the voltage at Caledonia TS must be maintained at or above 121 kV to ensure that the voltages at Norfolk TS and the new 'Bloomsburg' MTS meet the Market Rules requirements.

Low voltage facilities and low voltage system performance do not in general have any adverse impact on the IMO-controlled grid and therefore are not assessed. However, there is a unique low voltage phenomenon in the area that might impact on the customers supplied from the new 'Bloomsburg' MTS.

'Bloomsburg', MTS will be supplied from circuits A8N and A11N. These two circuits, from Hartford Junction to Vanessa Junction, share the same towers with the 500kV Nanticoke GS to Longwood TS

transmission line N582L. High power flow on the 500kV circuit could induce excessive voltage imbalance on the 115kV circuits A8N and A11N resulting in harmful levels of negative sequence voltage at the 'Bloomsburg' MTS 27.6kV bus. Independent phase controlled compensators similar to those at Norfolk TS would be required at Bloomsburg MTS to limit the magnitude of any negative sequence voltage within acceptable level. The *Connection Applicant* is advised to consult Hydro One Networks Inc. regarding this low voltage phenomenon at 'Bloomsburg' MTS.

Norfolk Energy Inc. is responsible for designing its facilities in compliance with TSC, Market Rules, and IMO's requirements.

3.0 Conclusions

Based of this Preliminary Assessment, it has been concluded that:

- The proposed 'Bloomsburg' MTS would have no adverse impact on the capability or the reliability of the IMO-controlled grid.
- If the *Connection Applicant* fulfill the connection requirements outlined in Section 4.0 of this report, the proposed 'Bloomsburg' MTS would be in compliance with the Market Rules.

4.0 IMO's Requirements for Connection

Norfolk Energy Inc. shall:

- Provide evidence to support that the transformer at 'Bloomsburg' MTS has an overexcitation specification of at least 115% and that the transformer is capable of continuous operation at a maximum system voltage of 127kV.
- Ensure that the load supplied from the new 'Bloomsburg' MTS shall operate at a power factor within the range of 0.9 lagging to 0.9 leading as measured at the defined metering point, which is the 115kV connection point to the IMO-controlled grid.
- Maintain the availability of resources and facilities that provide the capability of reducing the secondary voltage at the 'Bloomsburg' MTS by 3% and 5% within 5 minutes of receiving direction from the IMO to do so.
- Install independent phase controlled compensators on the 27.6 kV bus similar to those at Norfolk TS to limit the magnitude of any negative sequence voltage within acceptable level.
- Provide the necessary on-line monitoring facilities as specified by the IMO via the Facility Registration Process.
- Complete the IMO Facility Registration Process including metering registration before placing the new 'Bloomsburg' MTS in service.

5.0 Customer Impact Assessment

Based on the assumption that there are no large motors or large generators connected to the Norfolk Power Inc. system, and Customer meets the requirements identified by the IMO, there is no change in impact on other customers is expected due to connection of the proposed single transformer Bloomsburg MTS.

6.0 Notification of Approval

Based on the above assessment, it is recommended that a System Impact Assessment would not be necessary and subject to the *Connection Applicant* meeting the connection requirements outlined in Section 4.0 a Notification of Approval for this proposal be issued to the *connection applicant*.