REPORT

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System Impact Assessment Report

CONNECTION ASSESSMENT & APPROVAL PROCESS

Issue 1.0

CAA ID No. 2005 - 207

Applicant: ***Five Nations Energy Inc.***

Project: ***Energize Second Transformers at Fort Albany TS and Attawapiskat TS***

Transmission Assessments & Performance Department

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System Impact Assessment Report

Energize Second Transformers at Fort Albany TS and Attawapiskat TS

IESO

This report has been prepared solely for the purpose of assessing whether the connection applicant's proposed connection with the IESO-controlled grid would have an adverse impact on the reliability of the integrated power system and whether the IESO 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 IESO by the connection applicant and the transmitter(s) at the time the assessment was carried out. The IESO 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 IESO. 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 IESO-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 IESO in accordance with Chapter 4, section 6 of the Market Rules. The IESO assumes no responsibility to any third party for any use, which it makes of this report. Any liability which the IESO 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 IESO provides a draft of this report to the connection applicant, you must be aware that the IESO may revise drafts of this report at any time in its sole discretion without notice to you. Although the IESO 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.

HYDRO ONE

Special Notes and Limitations of Study Results

The results reported in this System Impact Assessment are based on the information available to Hydro One, at the time of the study, suitable for a preliminary assessment of a new generation or load connection proposal.

The short circuit and thermal loading levels have been computed based on the information available at the time of the study. These levels may be higher or lower if the connection

information changes as a result of, but not limited to, subsequent design modifications or when more accurate test measurement data is available.

This study does not assess the short circuit or thermal loading impact of the proposed connection on facilities owned by other load and generation (including OPGI) customers.

In this System Impact Assessment, short circuit adequacy is assessed only for Hydro One breakers and does not include other Hydro One facilities. The short circuit results are only for the purpose of assessing the capabilities of existing Hydro One breakers and identifying upgrades required to incorporate the proposed connection. These results should not be used in the design and engineering of new facilities for the proposed connection. The necessary data will be provided by Hydro One and discussed with the connection proponent upon request.

The ampacity ratings of Hydro One facilities are established based on assumptions used in Hydro One for power system planning studies. The actual ampacity ratings during operations may be determined in real-time and are based on actual system conditions, including ambient temperature, wind speed and facility loading, and may be higher or lower than those stated in this study.

The additional facilities or upgrades which are required to incorporate the proposed connection have been identified to the extent permitted by a preliminary assessment under the current IESO Connection Assessment and Approval process. Additional facility studies may be necessary to confirm constructability and the time required for construction. Further studies at more advanced stages of the project development may identify additional facilities that need to be provided or that require upgrading.

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SIA Findings

Conclusions

This System Impact Assessment has been conducted to examine the effect of energizing the second transformers at Fort Albany and Attawapiscat substations on the reliability of the IESO-controlled grid. It is concluded that the proposed project will not have adverse impact on the IESO-controlled grid.

Notification of Approval for Connection Proposal

Since the proposed work at Fort Albany and Attawapiscat substations will not have adverse impact on the IESO-controlled grid, it is therefore recommended that Notification of Conditional Approval for connection be issued to Five Nations Energy Inc. (FNEI), subject to IESO's Requirements for Connection listed below, and any further requirements that may be identified by FNEI in the Customer Impact Assessment.

IESO's Requirements for Connection

The requirements for connection for the proposed project are listed as follows:

1. The Connection Applicant is required to apply for the extension of the existing exemption (Application No. 01-1155). If the extension is not granted, FNEI should install UFLS and/or voltage reduction facilities at the stations to meet the Market Rules requirements.

2. It is required that FNEI install all the equipment needed to monitor the information required by the IESO on a continuous basis.

3. With respect to the protection and telecommunication requirements, the connection applicant will have to follow the Transmission System Code technical requirements.

1. Project Description

1.1 Introduction

Five Nations Energy Inc. (FNEI) is proposing to expand their existing Fort Albany and Attawapiskat Substations by installing second step-down transformers at each station.

Fort Albany Substation is presently equipped with one 6/8/10 MVA 132/8.32 kV step-down transformer supplied by 115 kV circuit M3K and Attawapiskat Substation is equipped with one 6/8/10 MVA 132/4.16 kV step-down transformer supplied by 115 kV circuit K5. The peak demands on the stations during the winter 2005 were about 2.2 MVA at Fort Albany and 2.0 MVA at Attawapiskat.

The new step-down transformers are to be connected to the same 115 kV M3K (Fort Albany Substation) and K5 (Attawapsikat Substation) lines as the first transformers. At each station, a new low voltage bus (8.32 kV at Fort Albany and 4.16 kV at Attawapsikat) is to supply a total of two feeders. Switching facilities have been included in the design to allow the new bus to be connected to both transformers at each substation. Whenever one of the step-down transformers is out-of-service, the remaining transformer will be adequate to supply all the loads at the substation.

The scheduled in-service date for the new facilities is November 2006 for Attawapiskat Substation and November 2007 for Fort Albany Substation.

This study reviews the proposed connection arrangement for the second transformers at Fort Albany TS and Attawapiskat TS substations, and examines their impact on reliability of the IESO-controlled grid.

1.2 Description of the Existing FNEI System

Five Nations Energy Inc. system consists of a 270 km 115 kV transmission line connected to the existing 115 kV circuit C6R at Moosonee DS. The transmission line is supplying local area loads at New Moosonee TS, Fort Albany TS, Kashechewan TS and Attawapiskat TS.

The Five Nations 115 kV transmission line comprises of three sections, with lengths of 159 km (to Fort Albany), 11 km (to Kashechewan) and 100 km (to Attawapiskat) respectively. The final section is switched via a 115 kV circuit breaker at Kashechewan.

The radial 115 kV circuit C6R is terminated on to the Hydro One system at Abitibi Canyon GS, which in turn is radially connected to the main 115 kV system at Hunta SS. Circuit C6R consists of a 35.4 km section from Abitibi Canyon GS to Otter Rapids GS and a further 144 km section from Otter Rapids GS to Moosonee DS. Circuit C6R is operated normally open at the Otter Rapids bus.

In FNEI 115 kV system, voltage control is provided from the generators connected to the 115 kV bus at Abitibi Canyon GS and shunt reactors at Hydro One Moosonee and FNEI substations. There are a total of four 115 kV shunt reactors located at Moosonee (one 6.5 MVAr reactor), Fort Albany (two 3.4 MVAr reactors) and at Attawapiskat (one 2.5 MVAr reactor). Each reactor is switched by a dedicated circuit-switcher.

The existing FNEI 115 kV system is shown in Figure 1.

1.3 Description of Supply to Victor Mine Project

In 2002 De Beers Canada Exploration Inc. was proposing to develop the Victor Mine Project in north-eastern Ontario, located approximately 100 km inland from Attawapiskat on James Bay. This project involved major expansions and modifications in FNEI system.

Three proposals for supplying the new mine load were presented to the IESO and the IESO proposed an alternative supply arrangements. All the four supply arrangements were studied for a system impact assessment. The IESO concluded that each of the four options would have no adverse impact on the IESO-controlled grid and a Notification of Approval to Connect was granted to the project applicant. (CAA ID No. 2002-086, Preliminary Assessment dated 16th July 2003 and Addendum dated 12th December 2004).

It was concluded in the assessment that the reinforcement of the existing transmission system through the incorporation of the following facilities, would enhance its load meeting capability so that a load of 20 MW can be supplied at the Victor Mine, in addition to meeting the forecast peak loads at Moosonee and at the Five Nations communities through to 2020:

- a new 115 kV line between either Pinard TS or Otter Rapids GS & Moosonee DS (approximately 179 km or 144 km)
- a new 115 kV line between Moosonee DS & Kashechewan S/S (approximately 170 km)
- a second 6.5 MVAr shunt reactor (rated at 138kV) at New Moosonee S/S, connected to the new 115 kV line between Pinard TS (or Otter Rapids GS) and New Moosonee S/S.
- a 5.5 MVAr shunt reactor (rated at 138 kV) at Kashechewan S/S, connected to the new 115 kV line between New Moosonee S/S and Kashechewan S/S.
- a 6.0 MVAr shunt reactor (rated at 138 kV) at the Victor Mine Substation, connected to the new 115 kV line between Attawapiskat S/S and the Victor Mine Substation.
- and two +12/-15 MVAr SVCs connected to the 13.8 kV bus at the Victor Mine Substation, on either side of the bus-section breaker, and set to control the 115 kV bus at the Substation.
- a new 115 kV line between Attawapiskat S/S & the Victor Mine (approximately 100 km)

The above proposed facilities for the Victor Mine project are shown in Figure 2.

FNEI indicates that a 115 kV transmission line from Otter Rapids to Moosonee SS will be built. The Attawapiskat to Victor HV line is presently under construction and scheduled for in by Sept 30 2006. The new circuit will only supply up to 6 MW for the first 10 months until the mine reaches full production. The new SVC at Victor is expected in service on September 30 2006 and new reactors at Kashechewan and Moosonee will be in service on June 30 2007. In addition, Hydro One has confirmed that the in service date for the new reactor at Moosonee will be June 30 2007.

– End of Section –

2. Review of Connection Proposals

Fort Albany Substation is presently equipped with one 6/8/10 MVA 132/8.32 kV step-down transformer supplied by 115 kV circuit M3K and Attawapiskat Substation is equipped with one 6/8/10 MVA 132/4.16 kV step-down transformer supplied by 115 kV circuit K5. The new step-down transformers are to be connected to the same 115 kV M3K (Fort Albany) and K5 (Attawapsikat) as the first transformers.

2.1 Proposed Connection Arrangement

2.1.1 New facilities at Fort Albany

The proposed new transformer at Fort Albany will be identical to the first transformer with a capability of 6/8/10 MVA and connect to M3K through a HV circuit switcher. A new low voltage 8.32 kV dual bus is to supply a total of two feeders (F4 and F5). Switching facilities have been included in the design to allow the new bus to be connected to both transformers at each substation. Whenever one of the step-down transformers is out-of-service, the remaining transformer will be adequate to supply all the loads at the substation.

The single line diagram of Fort Albany Substation is shown in Figure 3.

Technical specifications of the second transformer are as follows:

Transformation	132/8.32 kV
Continuous rating	6/8/10 MVA
Impedance	7.67% based on 6 MVA
Configuration	3 phase, High side: delta, Low voltage side: wye (neutral grounded)
Tapping	off-load tap changer with 4 steps 1/-3×2.5%

Technical specifications of the HV circuit switcher are as follows:

Voltage rating	138 kV
Continuous current rating	1200 A
Interrupting capability	20 kA

Technical specifications of the LV breakers are as follows:

Voltage rating	138 kV
Continuous current rating	1200 A
Interrupting capability	18 kA

2.1.2 New Facilities at Attawapiscat

The proposed new transformer at Attawapiscat will be identical to the first transformer with a capability of 6/8/10 MVA and connect to K5 through a HV switcher. A new low voltage 4.16 kV dual bus is to supply a total of two feeders (F3 and F4). Switching facilities have been included in the design to allow the new bus to be connected to both transformers at each substation. Whenever one of the step-down transformers is out-of-service, the remaining transformer will be adequate to supply all the loads at the substation.

The single line diagram of Attawapiscat Substation is shown in Figure 3.

Technical specifications of the second transformer are as follows:

Transformation	132/4.16 kV
Continuous rating	6/8/10 MVA
Impedance	7.67% based on 6 MVA
Configuration	3 phase, High side: delta, Low voltage side: wye (neutral grounded)
Tapping	off-load tap changer with 4 steps 1/-3×2.5%

Technical specifications of the HV circuit switcher are as follows:

Voltage rating	138 kV
Continuous current rating	1200 A
Interrupting capability	20 kA

Technical specifications of the LV breakers are as follows:

Voltage rating	138 kV
Continuous current rating	1200 A
Interrupting capability	18 kA

2.2 Power Factor

The Market Rules require that wholesale customers and distributors connected to the IESO-controlled grid shall operate at a power factor within the range 90% lagging to 90% leading as measured at the defined meter point.

The information received from the connection applicant indicates that the power factor is over 0.95 for the existing load and 0.975 for the projected load. Considering the transformer losses the power factor at the defined meter points at Fort Albany and Attawapiscat substations should meet the Market Rule's requirements.

2.3 Underfrequency Load Shedding Requirements

The Market Rules (Chapter 5 section 10.4) require that each distributor and connected wholesale customer, in conjunction with the relevant transmitter, make arrangements to enable the automatic disconnection of up to 35% of its peak demand for conditions of system under-frequency. To meet this requirement an underfrequency load shedding (UFLS) scheme must be installed at the station. The single line diagram provided by the applicant does not show the presence of the UFLS scheme.

The under frequency automatic load shedding should be provided by tripping LV feeder breakers to achieve:

- Automatic load shedding of 12% of station load at a nominal set point of 59.3 Hz and
- Automatic load shedding of an additional 23% of station load at a nominal set point of 58.8 Hz, for a total load reduction of 35% of the total station load.

The exemption related to UFLS and voltage reduction was granted with conditions to FNEI on June 19, 2001 (Application No. 01-1155). It was stated in the exemption that the exemption shall be reconsidered when the addition of any new transformer facilities is to be added to Five Nations existing or new connections. FNEI is seeking to extend the existing exemption 01 -1155 to the modification to both stations as proposed in this project.

The Connection Applicant is required to apply for the extension of the existing exemption. If the extension is not granted, FNEI should install UFLS at the stations to meet the Market Rules requirements.

2.4 Voltage Reduction Facilities Requirements

The Market Rules (Chapter 4 Appendix 4.3) require that distributors connected to the IESO controlled grid with directly connected load facilities of aggregated rating of 20 MVA or more and the capability to regulate distribution voltage under load, shall install and maintain facilities to provide voltage reduction capability to achieve load reduction during periods when supply resources are limited. Voltage reduction capability involves the capability to reduce demand by lowering the customer voltage by 3% and 5% and requires the controlling authority to be able to effect the voltage reduction within five minutes of receipt of the direction from the IESO.

As described in 2.3, the exemption related to voltage reduction was granted with conditions to FNEI on June 19, 2001 (Application No. 01-1155).

The Connection Applicant is required to apply for the extension of the existing exemption. If the extension is not granted, FNEI should install voltage reduction facilities at the stations to meet the Market Rules requirements.

2.5 On-line Monitoring

The Market Rules (Chapter 4 section 7.5) require that each connected distributor shall provide the IESO on a continual basis with on-line monitored quantities as specified in Appendix 4.17. The status of the existing switchers at Fort Albany and Attawapiscat substations is monitored by the IESO on a continual basis and the IESO requires that the status of the new switchers be monitored in the same way.

It is required that FNEI install all the equipment needed to monitor the information required by the IESO on a continuous basis.

2.6 Protection Systems

With respect to the protection and telecommunication requirements, the connection applicant will have to follow the Transmission System Code technical requirements.

– End of Section –

3. Data Verification

A full description of the connection arrangement of the proposed connections is included in section 2.1 of this report. It should be noted that 115 kV circuit switchers proposed for installation do not meet the interrupting capability recommended by the Transmission System Code.

The Fault Levels specified in Appendix 2, Transmission System Connection Point Performance Standards, indicate 50 kA for a nominal voltage of 115 kV. The interrupting capability of the new switchers is 20 kA which is below 50 kA as specified in Transmission System Code.

The results of the short circuit study performed in FNEI's Customer Impact Study for the Victor Mine supply project are summarized in Table 1 below.

Table 1 Short Circuit Level after Incorporation of Victor Mine Project

Bus Name	Fault Levels (kA)			
	Symmetrical		Asymmetrical	
	3-Phase	L-G	3-Phase	L-G
Moosonee 115 kV	1.086	0.685	1.087	0.685
Fort Albany 115 kV	0.709	0.416	0.713	0.418
Kashechewan 115 kV	0.690	0.404	0.694	0.405
Attawapiskat 115 kV	0.551	0.320	0.554	0.321

It can be seen that the fault levels at Fort Albany substation and Attawapiscat substation are far below the interrupting capability of 20 kA of the new switchers. In addition, there is no plan for system improvement or reconfiguration in FNEI's system in the future. Therefore, the new switchers with the interrupting capability of 20 kA are adequate.

– End of Section –

4. Fault Level Assessment

The Connection Applicant has advised that the existing diesel generators are not to be connected to the FNEI transmission line and will not be operated in parallel with the IESO-controlled grid. So there is no generation or large synchronous motors connected to the new expansion system.

In general, radial loads do not have a large impact on the system fault levels, but a small contribution in short circuit currents can be observed due to the grounding of the transformers. It is suggested that FNEI check if line-to-ground faults occurring on the distribution side have significant impact on the short circuit levels.

– End of Section –

5. Impact on System Reliability

The following estimates for the future load at Moosonee DS and at the Five Nations communities in Table 2 were used in the SIA analysis for Victor Mine project. Power factor is 0.975 for all the loads. FNEI has confirmed that the following load forecast in Table 2 is still practical and valid.

Table 2 Forecast Loads (MW)

Location	2006	2010	2015	2020
Moosonee	14.4	15.0	15.8	16.6
Fort Albany	1.9	2.3	2.8	3.5
Kashechewan	2.2	2.8	3.5	4.4
Attawapiskat	2.6	3.2	4.1	5.2
Victor Mine	6	29	29	29
Total	27.1	52.3	55.2	58.7

The SIA assessment for supply to Victor Mine project concluded that with the reinforcements described in section 2.0, the transmission system will be adequate to supply the forecast peak loads at Moosonee and at the Five Nations communities through to 2020.

The current project involving the installation of second transformers at Fort Albany and Attawapiskat substations will result in an increase the reliability of load supply. All study results obtained from previous SIA reports are applicable to this project. Therefore, it can be concluded that the proposed project will not have negative impact on the reliability of the IESO-Controlled grid.

– End of Section –

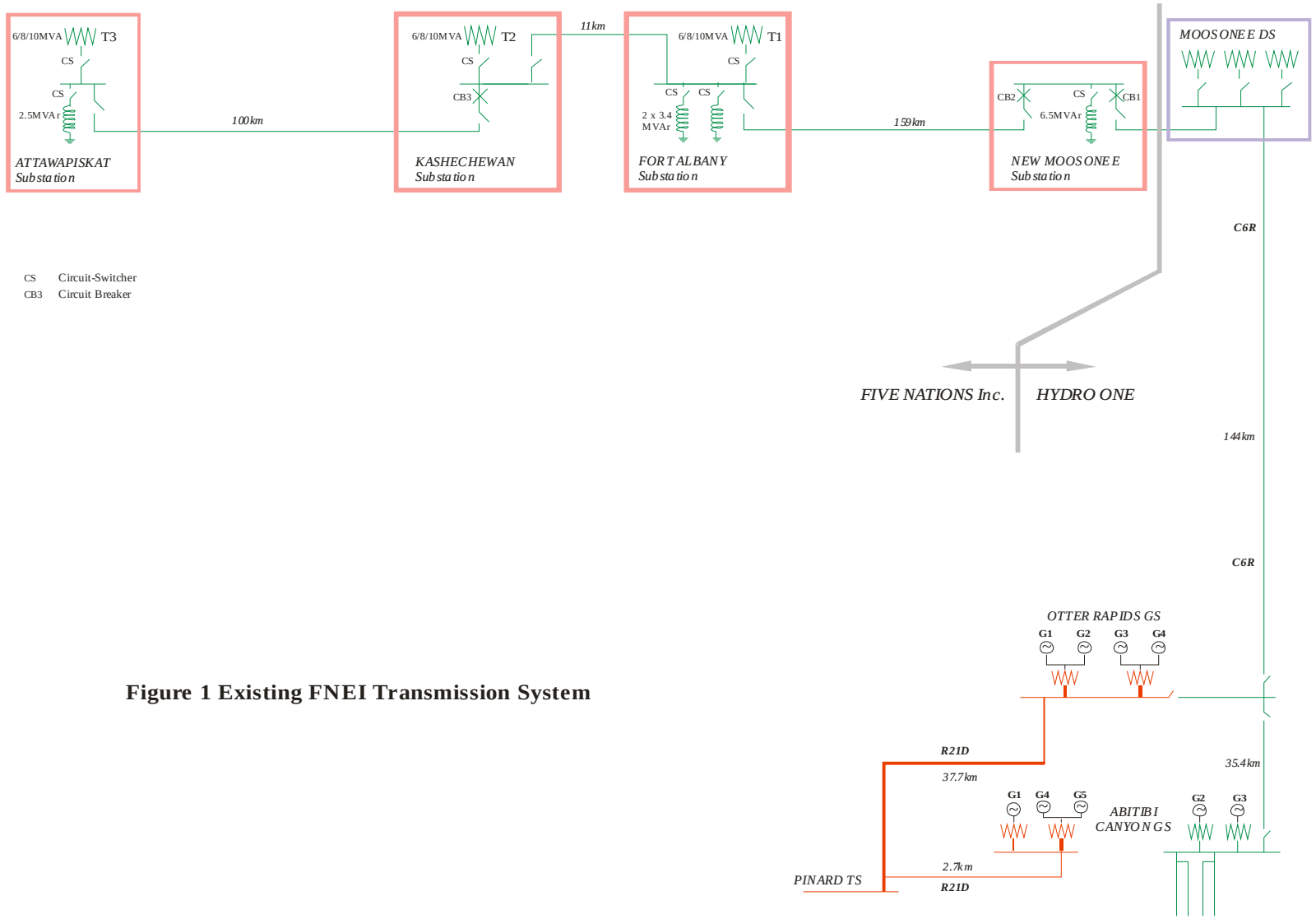

Figure 1 Existing FNEI Transmission System

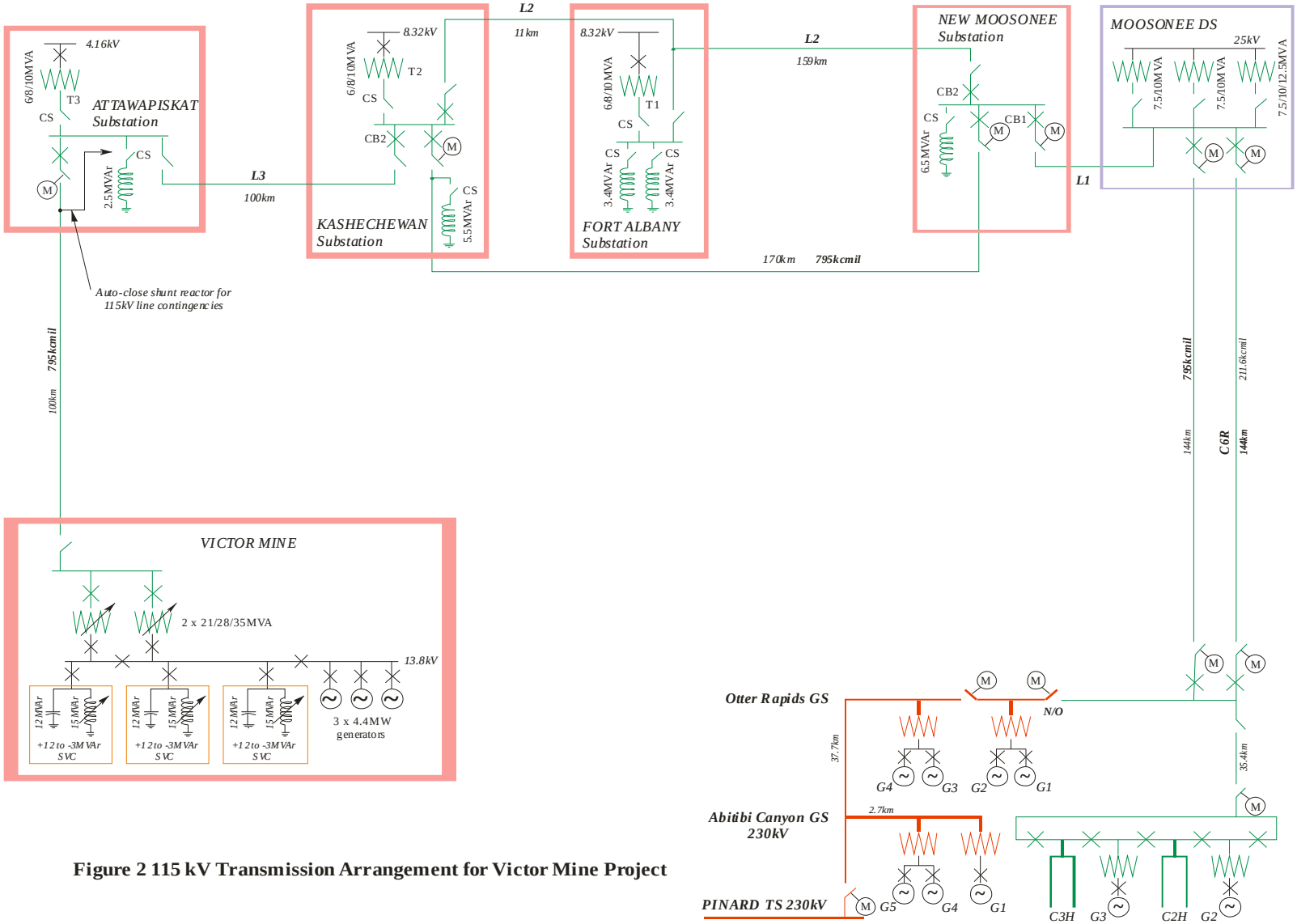

Figure 2 115 kV Transmission Arrangement for Victor Mine Project

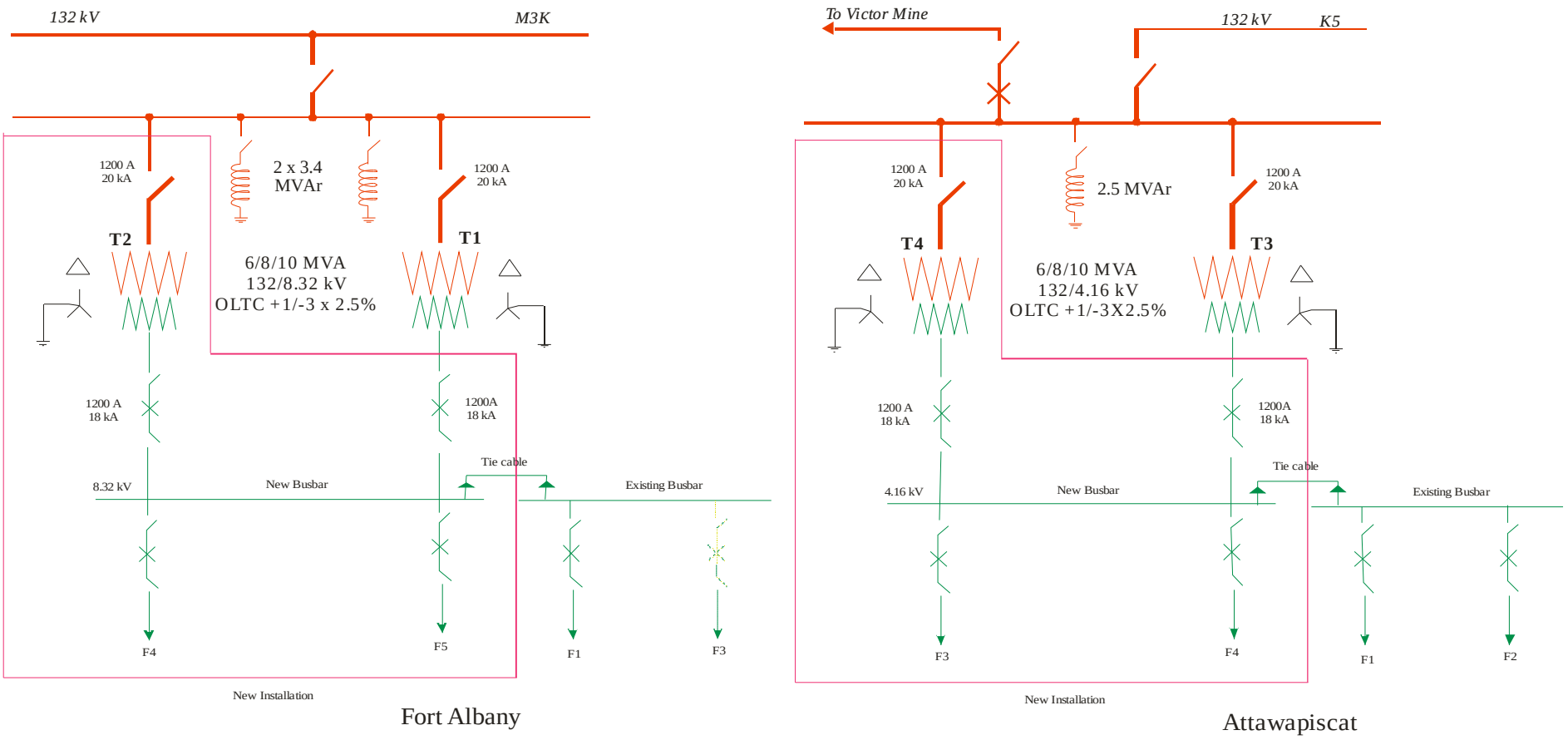

Figure 3. Proposed Connection of Second Transformers at Fort Albany and Attawapiscat

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