IMO_REP_0110

CONNECTION ASSESSMENT & APPROVAL PROCESS

Preliminary Assessment Report

Project: *Kalar MTS*

Applicant: *Niagara Falls Inc.*

CAA ID 2002-064

Final Report

Long Term Forecasts & Assessments Department
Consistent Information Set Department

July 30, 2003

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Preliminary Assessment Report

Kalar MTS

Acknowledgement

The IMO wished to acknowledge the assistance of Hydro One in completing this assessment.

Disclaimers

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.

HYDRO ONE

Special Notes and Limitations of Study Results

The results reported in this preliminary feasibility study 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 preliminary feasibility study, 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 rating 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 IMO 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.

Preliminary Assessment Report

1.0 Project Description

Niagara Falls Hydro Inc. is proposing to build a new 115/14.5 kV Transformer Station in the Allanburg area. The proposed site for Kalar MTS, the new station, is located adjacent to the 115 kV circuits A36/37N right-of-way between Allanburg TS and Beck #1 GS. The new station will be located about 4 km east of Murray TS and connected to the two 115 kV circuit A36N and A37N in a dual-supply arrangement.
A schematic diagram of the 115 kV transmission in the Niagara-Hamilton area and the location of the proposed Kalar MTS are shown in Figure 1.

The proposed new Kalar MTS will be a standard DESN arrangement with two 45/60/75 MVA transformers and associated HV and LV equipment as displayed in Figure 2.

The *connection applicant* has indicated that the initial load supplied from the new TS is expected to be approximately 30 MVA and composed of existing loads that will be transferred from Murray TS (20 MW) and Stanley TS (10 MW). The ultimate station loading is expected to be about 83 MW.

The proposed ready for service date for the new TS is May 31, 2004.

2.0 Review of Connection Proposal

2.1 Connection Arrangement

The proposed Kalar MTS will be equipped with two new 110 kV-14.2 kV-14.2 kV dual winding transformers that will be connected to the 115 kV circuits A36N and A37N.

Each transformer is to be connected to the *IMO-controlled grid* via one 115 kV disconnect switch with the following ratings:

- Maximum operating voltage 127 kV
- Continuous current rating N/A
- Limited Time current rating N/A

The transformers are both identical and configured with a delta winding on the high side and double wye (neutral grounded via 1ohms reactor) windings on the low voltage side. A typical value for the transformer impedance of 10% on 45 MVA base will be in this assessment. Each transformer is rated for 45/60/75 MVA.

Each transformer is equipped with under-load tap changer with a range of about +20.0% to –20.0% that is to be achieved in ±33 steps.

Low voltage side isolation of each transformer is to be provided by two (one for each secondary winding) 3000A, 14.2kV circuit breakers. The LV bus-tie breaker, also rated for 3000 A, is to be operated normally closed. The station will have sixteen feeders and each feeder position is to be equipped with one 1200 A, breaker. The short circuit interrupting capability of these breakers has not been provided by the connection applicant.

It is required that the 14.2 kV circuit breakers have an interrupting capability of 21 kA as recommended by the TSC.

Figure 2 shows a detailed single line diagram of the proposed Transformer Station.

The line taps from the station to the 115 kV circuit will be provided by a short span; thus their impedance was considered negligible in this assessment. The points of connection or *defined meter points* will be located on the high voltage side of the transformer.

The exact location of the revenue meter has to be provided by the connection applicant as part of the Facility Registration process.

2.2 Power Factor

The *Market Rules* require that wholesale customers and distributors connected to the IMO-controlled grid shall operate at a power factor within the range 90% lagging to 90% leading as measured at the *defined meter point.*
Niagara Falls Hydro Inc. has indicated in their application that the load power factor will be maintained at 95%. The information received with the connection application indicates that station design provides for installation of sixteen 14.2 kV feeders, but does not indicate that any space might be allocated for future installation of shunt capacitors if necessary.

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 does not show the presence of the UFLS scheme.

The *Connection Applicant* has confirmed that underfrequency load shedding would be provided by tripping of the 13.8 kV feeder breakers. It is intended that each feeder be operated with A GE Multilin style UR F60 relay which provides an inherent underfrequency trip which would be set to 59.3 Hz or 58.8 Hz. When 13.8 kV feeder integration is resolved, specific feeder loadings will be identified so that 12% of the station total load is shed at 59.3 Hz and an additional 23% of station load at 58.8 Hz (i.e. 12%+23%). Niagara Falls Hydro would identify the UFLS feeder selection closer to the commissioning date and review the selection through the initial loading stages.

2.4 Voltage Reduction Facilities Requirements

The *Market Rules* (Chapter 4 Appendix 4.3) requires that distributors connected to the *IMO 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* represents the capability of reducing demand by lowering the customer voltage by 3% and 5% and having the controlling authority to be able to effect the voltage reduction within five minutes of receipt of the direction from the IMO.

The *Connection Applicant* confirmed that voltage control would be available from local or remote location to provide 3% or 5% reduction to support the operating obligations.

2.5 On-line Monitoring

The *Market Rules* (Chapter 4 section 7.4) require that each transmitter shall provide the IMO on a continual basis with on-line monitored quantities as specified in Appendix 4.16. It is required that Niagara Falls Hydro Inc. install all the equipment needed to monitor the information required by the IMO on a continuous basis. The IMO requires that the status of all isolating disconnect switches and breakers as well as voltages and power flows be monitored on a continual 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 for tapped transformer stations supplying load.

Based on the single line diagram J02031CA provided by Niagara Falls Hydro Inc., each transformer is separated from the transmission system via a disconnect switch. For this particular arrangement the Transmission System Code requires that transfer trip of the Transmitter's breakers at the terminal stations be provided for transformer faults or for a condition of failure to operate of the LV breakers.

The *Connection Applicant* confirmed that the transfer trip protection scheme would comply with the Transmission System Code and the specific requirements from Hydro One.

3.0 Data Verification

Based on standards for supply of municipal electrical utilities the capability of a DESN station is defined as the maximum load that one transformer can carry for a predefined period of time. This value is usually computed using specific transformer data and daily load curves, and temperature data specific to the transformer location. Niagara Falls Hydro Inc. has provided a 10 day summer Limited Time Rating of 95.5 MVA.

Information of the projected ultimate load supplied from Kalar MTS will be below the DESN load capability.

The system performance standards listed in the Transmission System Code requires that the 115 kV and 14.2 kV systems fault levels not exceed 50 kA and 21 kA, respectively. The LV breakers proposed for installation at Kalar MTS have to comply with the interrupting capability recommended by the Transmission System Code.

The disconnect switch proposed to be installed on the 115 kV side of each station transformer is required to be motorized.

The 14.2 kV breakers are required to meet the interrupting capability of 21 kA recommended by the Transmission System Code.

Since the design and specifications of the transformers and the associated breakers and disconnect switches have not been yet finalized, it is expected that the proponent will provide when available, the "as built" transformer information to meet the requirements of the facility registration process.

4.0 Fault Level Assessment

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. In the case of Kalar MTS the high voltage winding is ungrounded, hence line-to-ground faults occurring on the distribution side will have no impact on the short circuit levels.

The customer has advised that there is no generation or large synchronous motors connected to their distribution system.

5.0 Impact on System Reliability

This connection assessment study concentrated on identifying the effect of the proposed DESN on thermal loading of the transmission lines and transformers, and system voltages for pre and post contingency situations.

The study was performed for a system with all elements in service under the assumption presented in section 5.2.

5.1 Description of Area Transmission

The 115 kV and 230 kV area transmission is shown in Figure 1 together with the proposed location of Kalar MTS. The Allanburg area load is supplied via a number of 115 kV circuits connecting Allanburg TS to Decew Falls to Beck No.1 and to Beach TS. The load is supplied from the four 230/115 kV autotransformers at Allanburg TS and the area local generation comprising of Beck No.1 GS generation connected to the E bus and Decew Falls GS,
The local 115 kV transmission comprises of:

- the double circuit 115 kV line Q4N/Q3L from Beck No.1 to Stanley TS; from Stanley TS, the 115 kV line Q4N continues as a single circuit to Niagara Murray TS, where it connects into the double circuit line A37N/A36N, which terminates at Allanburg,
- the double circuit 115 kV line Q12S/Q11S to Glendale TS supplying Niagara-on-the-Lake TS, Bunting TS and GlendaleTS, which continues to Decew Falls GS as D9S/D10HS and supplies Carlton TS and Vansickle TS,
- the three-ended 115 kV single circuit extending from Beck GS to Allanburg TS and to Beach TS, Q2AH which normally supplies Dunville TS, Vineland TS and Beamsville TS and
- the double circuit 115 kV line D1A/D3A between Decew Falls GS and Allanburg TS supplying Thorold TS, Georgian Pacific, Atlas Steel and Donohue TS.

The area peak load is about 1000 MW, the maximum generating capabilities at Beck No.1 GS and Decew Falls GS are about 350 MW and 160 MW, respectively.

5.2 Study Assumptions

The analysis was performed for system peak load conditions in years 2004 and 2013.

Table 1 below lists the expected summer peak load growth at the stations that are connected to the double 115 kV circuit line A36/37N, Q4N and Q3L.

Table 1. Load Growth Forecast to 2013

Station	Forecast Summer Peak Loads (MVA) for Station Connected to A36/37N, Q4N, Q3L									
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
" Kalar MTS"	30	30.8	31.5	32.3	33.1	33.9	34.8	35.7	36.6	37.5
Murray TS	93.2	95.5	97.9	100.4	102.9	105.4	108.1	110.8	113.5	116.4
Stanley TS	44.5	45.6	46.8	48.0	49.2	50.4	51.6	52.9	54.2	55.6
Rankine & Stevensville TS	64.3	65.9	67.6	69.3	71.0	72.8	74.6	76.5	78.4	80.3
Total Load	**232.0**	**237.8**	**243.8**	**249.9**	**256.1**	**262.5**	**269.1**	**275.8**	**282.7**	**289.8**
Total Allanburg 115 kV Area Load										
Load(MW)	972	988	1004	1020	1036	1053	1071	1088	1106	1124

The assumptions used in determining the total 115 kV area loads were as follows:

- All loads were escalated based on the load forecast provided by Niagara Falls Hydro Inc. corresponding to 2.5% peak load growth per year,
- Starting in 2004 Norfolk TS load was removed from the Allanburg load pocket under the assumption that Caledonia TS will be in service by summer 2004,
- All loads were modeled with a power factor equal or close to 0.9 measured at the 115 kV connection point.

For the Allanburg 115 kV area, it was observed that by 2010 the load will be only about 9 MW higher that the 2003 peak load (1062 MW) due to the Norfolk load transfer to Caledonia and the capping that will be imposed on the Beamsville and Vineland stations to respect ten day LTR.

For the 115 kV circuits affected by the proposed connection in the Allanburg area the following ratings were used:

Table 2. 115 kV Lines Thermal Ratings

Circuit, Sections (Conductor)		Max Op. Temp. (^{0}C)	Thermal ratings		
			Continuous (30^{0}C ambient) at 93^{0}C Amps MVA @118 kV	**Emergency** Continuous at Max Op Temp or 127 C Amps, MVA @118 kV	**15 min LTR** At Max Operating Temperature Amps, MVA @118 kV
Q4N	Beck GS x Stanley TS	150	950 **194 MVA**	1,220 **249 MVA**	1,702 **348 MVA**
	Stanley TS x Murray TS (single line)	127	690 **141 MVA**	880 **180 MVA**	1,010 **206 MVA**
Q3L	Beck GS x Stanley (the limiting section)	150	690 **141 MVA**	880 **180 MVA**	1,010 **206 MVA**
A36N/ A37N	Allanburg TS x Murray TS	125	1,080 **221 MVA**	1,390 **284 MVA**	1,740 **356 MVA**

The power flowing over the 115 kV lines A36/37N, Q4N and Q3L is determined by the load connected to these circuits and the Beck 1GS generation dispatch.

Two generation resource patterns for Decew GS and Beck No.1 GS were selected for these studies, to create extreme power flow patterns on the 115 kV circuits between Allanburg TS and Beck No.1 GS.

Case A

- seven unit in service at Beck No.1 GS amounting to a total of 415 MW and
- Decew Falls GS out of service.

Case B

- six unit in service at Beck No.1 GS amounting to a total output of 254 MW and
- Decew Falls GS in service at full output, with a total generation of 151.5 MW.

5.3 Impact on 115 kV Transmission

This section covers the effect that the proposed development is going to have on the reliability of the area transmission system.

5.3.1 Thermal Loading Assessment

For each generation dispatch scenario (A and B) power flow analysis was performed for conditions of 2003 and 2013 summer peak load. All transmission elements were assumed to be in service. The analysis was performed for the loss of a single critical transmission element. The transmission system losses were assumed to be 5% and were included in the total MVA flows.

For a single line contingency involving Q3L, the entire Stanley TS load will be supplied from Q4L.

For a single line contingency involving A36N or A37N the entire load at Kalar MTS, Murray TS, the Rankine and Stevensville tap, and a portion of Stanley load will be supplied from the remaining AxN 115 kV circuit and Q4N.

For each of these cases, the resulting loading of various sections of the 115 kV Q2AH line are shown in table below for years 2004 and 2013.

Table 3. Impact of Kalar MTS on the 115 kV Lines Loading

Transmission Element (Cont. Rating, Emerg. Rating)	**2004 System Loads**					
	Case A			**Case B**		
	Actual flow (MVA) % Loading of Cont Rating	**Loss of Q3L % Loading of Emerg. Rating**	**Loss of A36N or A37N % Loading of Emerg. Rating**	**Actual flow (MVA) % Loading of Cont Rating**	**Loss of Q3L % Loading of Emerg. Rating**	**Loss of A36N or A37N % Loading of Emerg. Rating**
Q4N @B Beck GS x Stanley TS (194,249 MVA)	**111.3** **57%**	**136** **55%**	**136.3** **55%**	**75.7** **39%**	**99.6** **40%**	**110.5** **44%**
Q4N Stanley TS x Murray TS (single line) (141,180 MVA)	**86.3** **61%**	**80** **45%**	**111.0** **62%**	**50.1** **36%**	**44** **25%**	**85** **47%**
Q3L @ B Beck GS x Stanley (141,180 MVA)	**30.7** **22%**	**-**	**30.7** **22%**	**29.7** **21%**	**-**	**29.7** **21%**
A36N &A37N @A Allanburg TS x Murray TS (221,284MVA)	**47.2, 47.8** **22%**	**50.2, 50.8** **18%**	**67** **24%**	**63.9, 64.7** **29%**	**68.2, 66.3** **24%**	**94** **33%**
Transmission Element (Cont. Rating, Emerg. Rating)	**2013 System Loads**					
	Case C			**Case D**		
	Actual flow (MVA) % Loading of Cont Rating	**Loss of Q3L % Loading of Emerg. Rating**	**Loss of A36N or A37N % Loading of Emerg. Rating**	**Actual flow (MVA) % Loading of Cont Rating**	**Loss of Q3L % Loading of Emerg. Rating**	**Loss of A36N or A37N % Loading of Emerg. Rating**
Q4N Beck GS x Stanley TS (194,249 MVA)	**117** **47%**	**148.2** **60%**	**154.7** **62%**	**76.6** **31%**	**106.8** **43%**	**127.0** **51%**
Q4N Stanley TS x Murray TS (single line) (141,180 MVA)	**84.3** **47%**	**76.4** **42%**	**122** **68%**	**42.6** **24%**	**34.9** **20%**	**93** **52%**
Q3L Beck GS x Stanley (141,180 MVA)	**38.7** **27%**	**-**	**38.7** **27%**	**37.5** **21%**	**-**	**37.5** **21%**
A36N & A37N Allanburg TS x Murray TS (221,184MVA)	**75.1, 76** **41%**	**78.2, 80.6** **44%**	**113.6** **62%**	**94, 95.3** **52%**	**97, 99.8** **54%**	**142.4** **78%**

The results of this assessment indicate that for peak load conditions the thermal capability of the 115 kV circuits A36N/A37N, Q4N and Q3L will be adequate to supply the load connected to them until 2013 and beyond. These circuits have

5.3.2 Voltage Assessment

Examination of the results show that system voltages along this transmission corridor are around 123 kV and meet the Market Rules requirements.

6. Conclusions and Recommendations

This Preliminary Assessment has examined the impact of supplying an additional DESN, Kalar MTS off the 115 kV line A36N/A37N emanating from Allanburg TS, on the reliability of the *IMO-controlled grid*. The studies concluded that:

1. the proposed project will not materially affect the reliability of the IMO-controlled grid or the load-meeting capability of the existing system,

2. the addition of the new supply point does not have a significant effect on the short circuit currents observed at the other transformer stations connected to this circuit,

3. the thermal capability of the 115 kV circuits A36N/A37N, Q4N and Q3L with all elements in service and in post-contingency situations will be adequate to supply the load connected to them.

7. IMO's Requirements for Connection

The applicant is required to ensure that the load will meet the Market Rules power factor requirements at all times. If future load growth at the station will result in a violation of the 0.9 pu power factor then Niagara Falls Hydro Inc. will be required to provide voltage support devices on the station LV side.

1. It is required that Niagara Falls Hydro Inc. install *motorized* disconnect switches on the 115 kV side of each station transformer.
2. It is required that the 14.2 kV circuit breakers have an interrupting capability of 21 kA as recommended by the TSC.

Niagara Falls Hydro Inc. provided to the IMO with the following information:

3. A confirmation that an underfrequency load shedding relays, which will have the capability of tripping up to 35% of the station load (12% at 59.3 Hz and additional 23% at 58.8 Hz) is to be installed. Appropriate settings for the relays will be provided by the IMO prior to commissioning.
4. A confirmation that voltage reduction facilities will be provided, with the capability of reducing the distribution voltage by 3% to 5%.
5. A confirmation that the transfer trip protection scheme was installed as required by the Transmission System Code.

8. Need for System Impact Assessment

The analysis that was performed under this Preliminary Assessment has covered all the system reliability issues related to the connection of the proposed development to the *IMO-controlled grid*. Therefore, a System Impact Assessment is considered to be unnecessary for this project.

9. Customer Impact Assessment

The customer has advised that there is no generation or large synchronous motors connected to their distribution system. Hence, Hydro One Networks Inc., has concluded that the new MTS will not have an adverse impact on any of the existing connected customers in the area. Consequently a Customer Impact Assessment (CIA) for this project is not required.

10. Notification of Approval for Connection Proposal

It is recommended that Notification of Approval be granted for this connection proposal, subject to the implementation by Niagara Falls Hydro Inc. of all the requirements listed in section 7 and any further requirements that could be identified by Hydro One Networks Inc. in the Customer Impact Assessment.

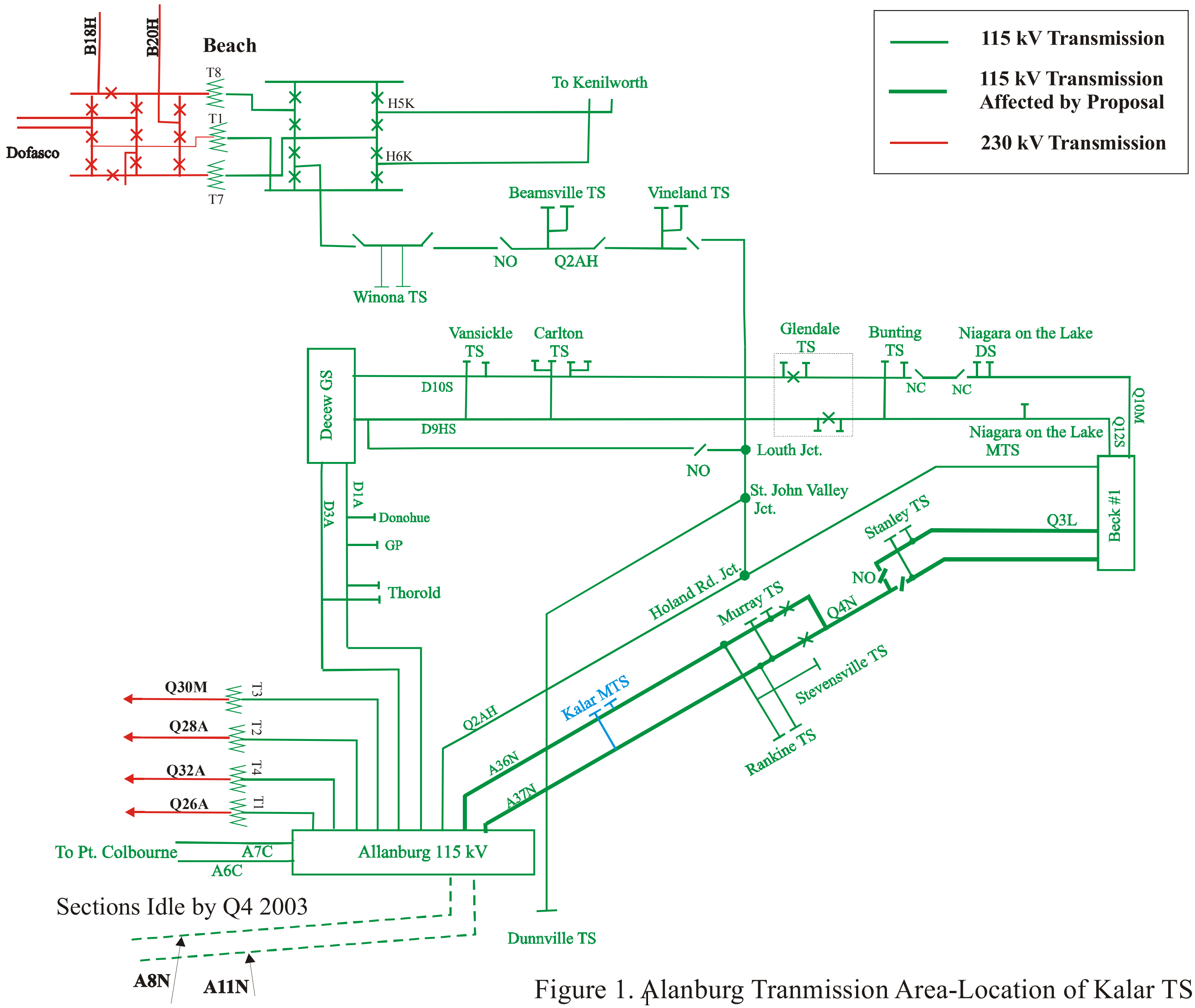

Figure 1. Alanburg Tranmission Area-Location of Kalar TS

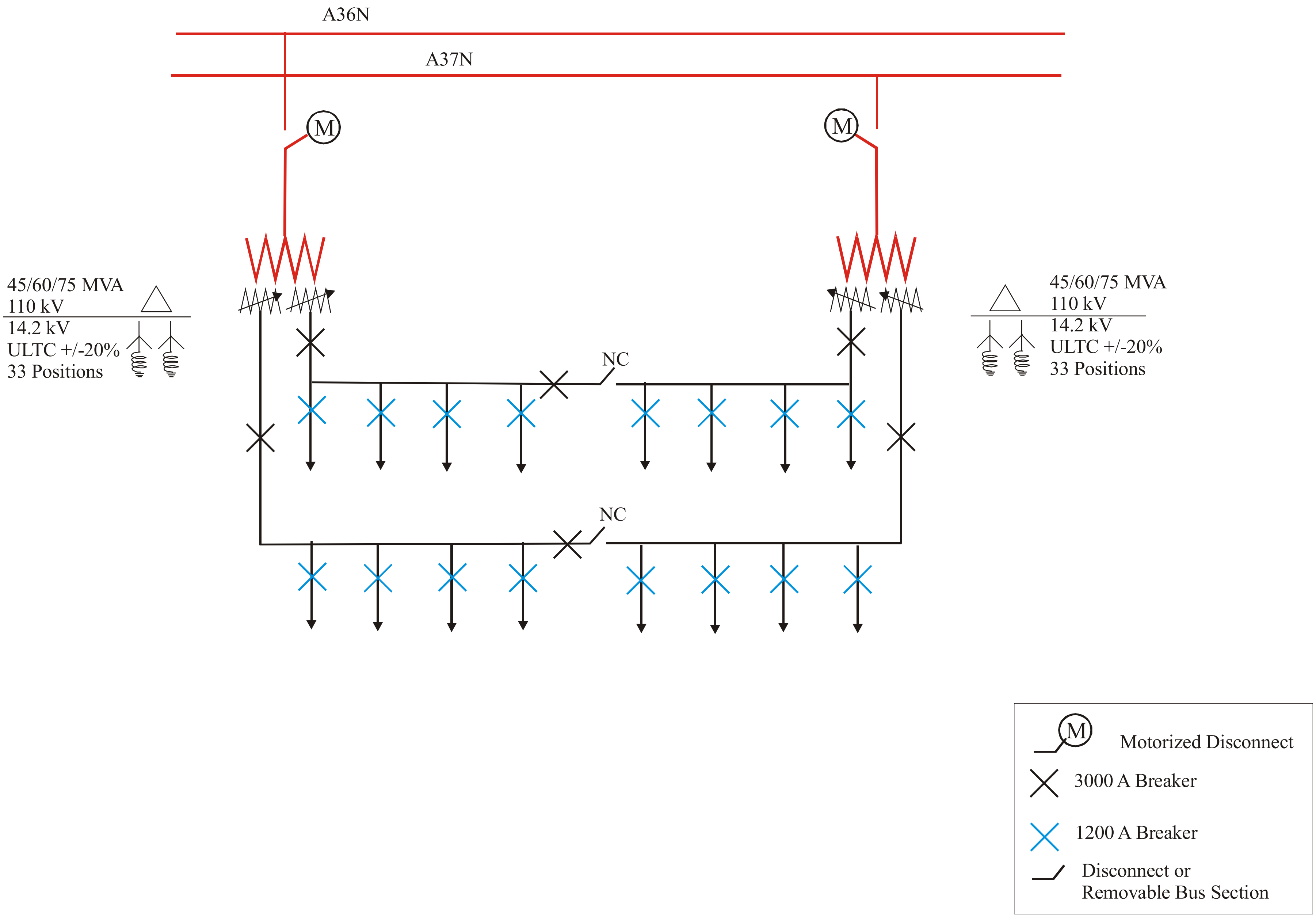

Figure 2. Kalar TS Single Line Diagram

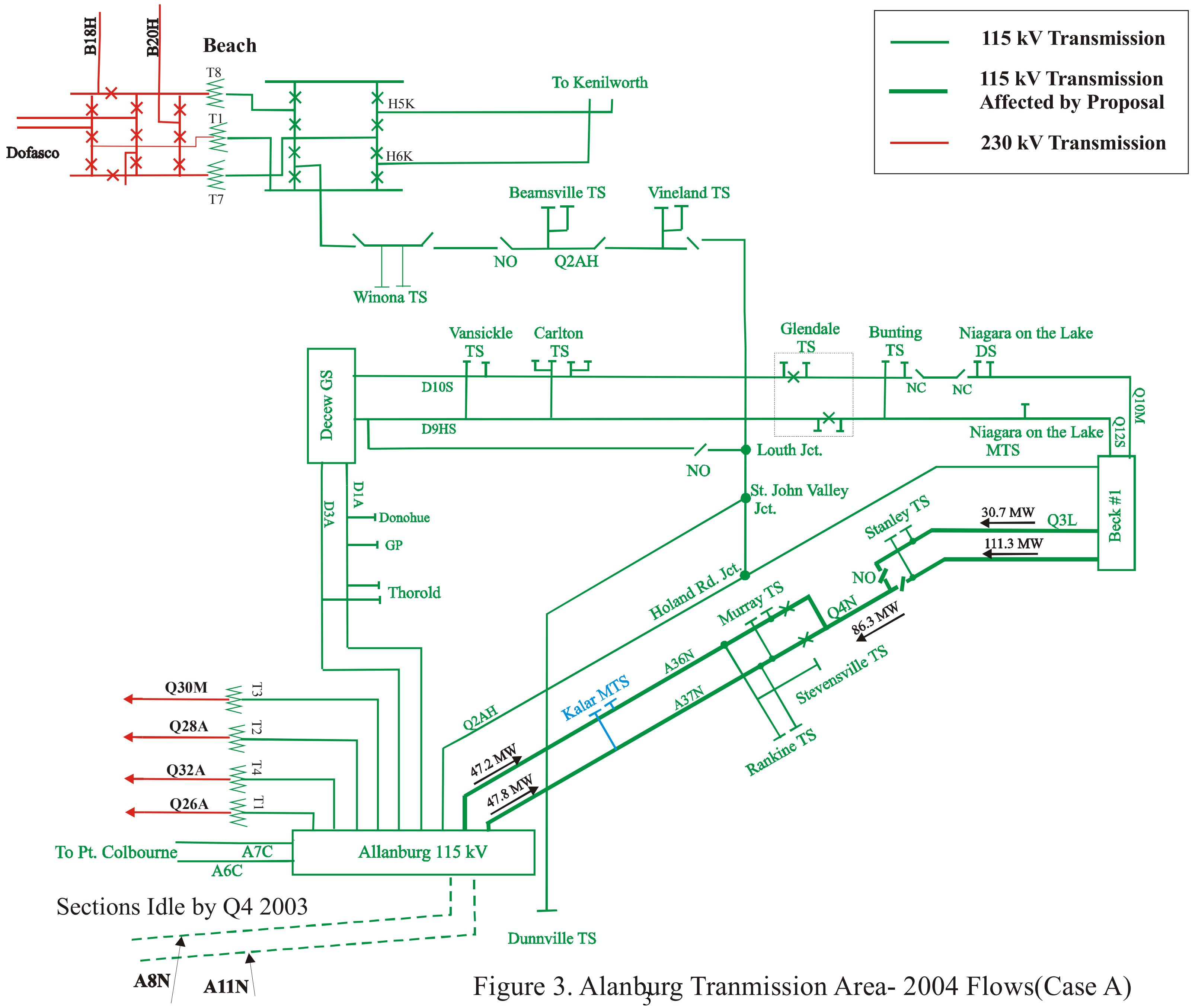

Figure 3. Alanburg Tranmission Area- 2004 Flows(Case A)

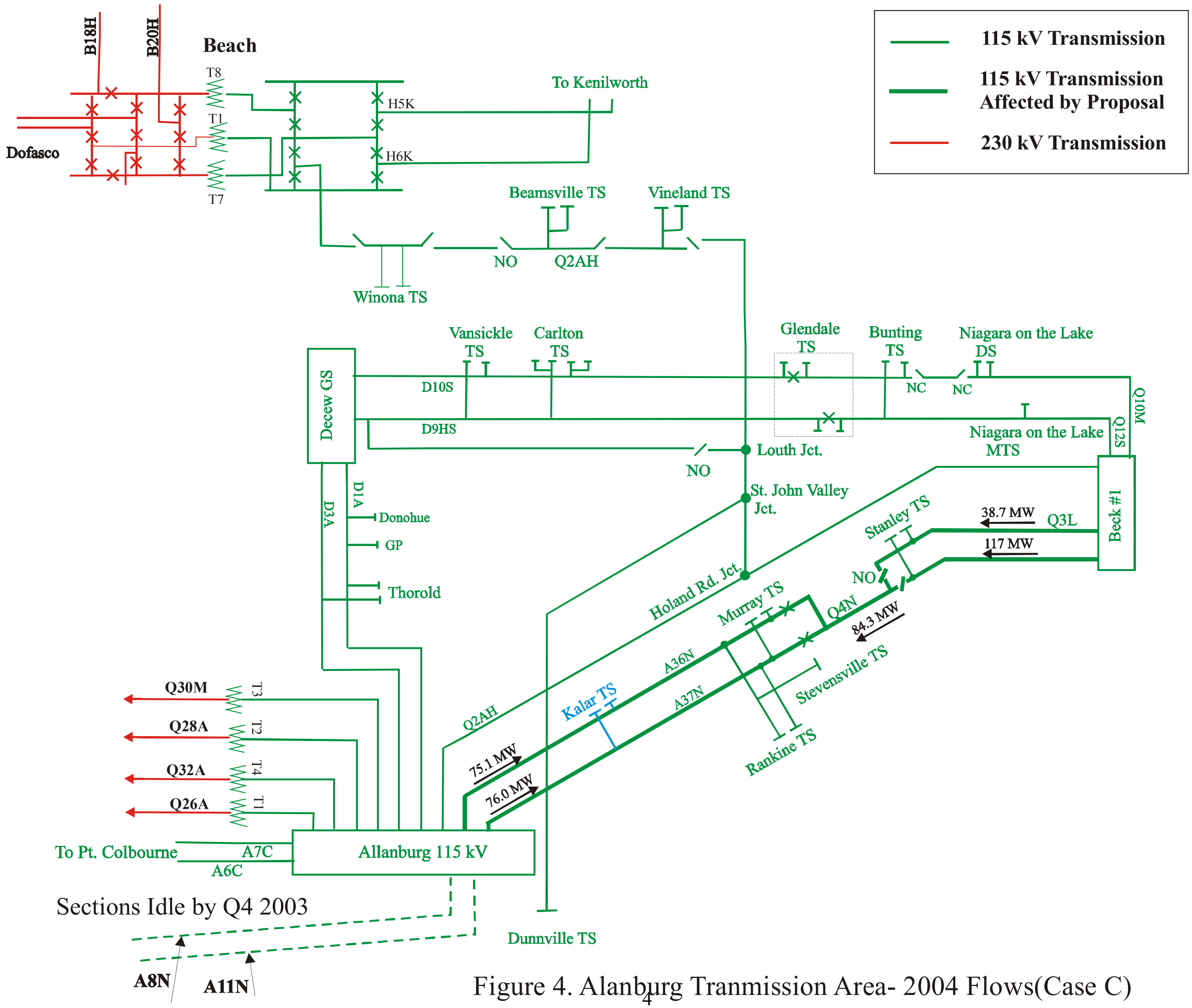

Figure 4. Alanburg Tranmission Area- 2004 Flows(Case C)