CUSTOMER IMPACT ASSESSMENT

A total of three (3) CIAs and Addendums have been completed and finalized by HONI for the four (4) Generation Projects and associated Transmission Facilities. They are described as follows:

Project/Facility	**Date of Final CIA/Addendum**	**Description**
Empire, Martin's Meadows and Abitibi	May 16, 2012	Study of the original connection point of the three (3) sites on 115 kV HONI circuit A5H.
Long Lake	May 16, 2012 (original January 5, 2011)	Study of the original connection point of Long Lake on 115 kV HONI circuit C2H.
Empire, Martin's Meadows, Abitibi and Long Lake	January 5, 2011	Addendum #1 - Study of the combined connection of the four (4) sites on 115 kV HONI circuit C2H (connection of Empire, Martin's Meadows and Abitibi moved to the connection point of Long Lake).

Copies of the above CIAs accompany this Application at Exhibit I, Tab 1, Schedule 2.

CUSTOMER IMPACT ASSESSMENTS

Copies of CIAs

Hydro One Networks Inc.
483 Bay Street
Toronto, Ontario
M5G 2P5

CUSTOMER IMPACT ASSESSMENT

Proposed 30MW
Northland Power
Martin's Meadows, Abitibi, Empire
Solar Generation Project

FIT# FQJ0FUC / FAQLBA0 / FM5F42U
(ID 2010- 403 / 406 / 409)
DRAFT

Revision: **0**

Date: **January 5, 2011**

Issued by: **Transmission Planning Department**
System Development Division
Hydro One Networks Inc.

Prepared by:

Kirpal Bahra
Transmission System Development
Hydro One Networks Inc.

Approved by:

Ibrahim El Nahas
Transmission System Development
Hydro One Networks Inc.

Disclaimer

This Customer Impact Assessment was prepared based on available information about the connection of the proposed Martins Meadows/Abitibi/Empire Solar Farm. It is intended to highlight significant impacts, if any, to affected transmission customers early in the project development process and thus allow an opportunity for these parties to bring forward any concerns that they may have including those needed for the review of the connection and for any possible application for leave to construct. Subsequent changes to the required modifications or the implementation plan may affect the impacts of the proposed connection identified in this Customer Impact Assessment. The results of this Customer Impact Assessment and the estimate of the outage requirements have taken a customer review period into account. The results are however is subject to change to accommodate the requirements of the IESO and other regulatory or municipal authority requirements.

Hydro One Networks shall not be liable to any third party which uses the results of the Customer Impact Assessment under any circumstances whatsoever, for any indirect or consequential damages, loss of profit or revenues, business interruption losses, loss of contract or loss of goodwill, special damages, punitive or exemplary damages, whether any of the said liability, loss or damages, arises in contract, tort or otherwise.

CUSTOMER IMPACT ASSESSMENT

PROPOSED 30MW
NORTHLAND POWER SOLAR – MARTIN'S MEADOWS / ABITIBI / EMPIRE

1.0 INTRODUCTION

1.1 Scope of the Study

This Customer Impact Assessment (CIA) study assesses the potential impacts of the proposed Martin's Meadows, Abitibi, and Empire solar farms on the transmission load customers and generators in the local vicinity. This study is intended to supplement the System Impact Assessment (ID 2010-403 / 406 / 409) by the IESO.

This study covers the impact of the generation addition on the Hydro One Networks system. The primary focus of this study is to identify the impact on the transmission customer connected facilities and operating constraints based on facility voltage performance. The study also assists to determine if any transmission system upgrade will be required to integrate the proposed interconnection during possible system conditions.

This study does not evaluate the overall impact of the Northland Power – Martin's Meadows, Abitibi, and Empire facility on the bulk system or on the distribution network. The impact of the new generator on the bulk system is the subject of the System Impact Assessment (SIA) which is issued by the Independent Electricity System Operator (IESO).

This study does not evaluate the impact of the Northland Power – Martin's Meadows, Abitibi, and Empire facility on the existing network Protection and Control facilities. Protection and Control aspects are reviewed under the Protection Impact Assessment, which is part of the SIA.

1.2 Background

Northland Power Inc. has proposed to develop a 30MW solar farm located in Cochrane, Ontario. The farm will consist of 3 x 10MW solar farms (Martins Meadows, Abitibi, Empire) and will all connect to one common point on the Hydro One System. Each project consists of 20 x 500kW (10MW total) inverters connected to a 27.6kV collector bus. An underground cable will connect the collector bus to its respective substation (consisting of a 12MVA 115/27.6kV transformer, 115kV circuit breaker, motorized disconnect switch). A 115kV collector bus will join all three solar farms, and the customer will build a 10.5km overhead 115kV line to enable connection to the Hydro One owned 115kV A5H (Hunta SS x Ansonville TS) circuit. (Refer to Appendix A – figure 1)

The proposed In-Service date is September 30, 2012

METHODOLOGY & CRITERIA

1.3 Voltage Performance - Planning Criteria

To establish the impact of incorporating the proposed Northland Power facility, the following post-fault voltage decline criteria would have to be observed:

- At the Bulk Electricity System level (115kV and up): The loss of a single transmission circuit should not result in a voltage decline greater than 10% for pre- and post- transformer tap-changer action

- The maximum and minimum phase-to-phase voltages given in the IESO's Transmission Assessment Criteria and Canadian Standard Association document CAN-3-C235-83 were considered. However in Northern Ontario, the maximum continuous voltage for the 230 and 115kV systems can be as high as 260kV and 132kV respectively.

- With all planned facilities in service pre-contingency, system voltage changes in the period immediately following a contingency shall not result in a voltage decline greater than 10% for pre-transformer tap-changer action (including station loads less than 50kV) and 10% post transformer tap-changer action (5% for station loads less than 50kV). In addition, the steady state voltage at station loads less than 50kV are to remain within 6% of the nominal voltage.

1.4 Customers Connected

It has been determined that the busses listed below will have the largest voltage and short circuit variations due to the proposed generation. Thus, the study has been limited to study high voltage customer busses in the area of the proposed generation connection.

Station	Supply Voltage (kV)	Owner / Affected Customer
A5H Tap Point	115	Hydro One Networks
Hunta SS	115	Hydro One Networks
Ansonville TS	115	Hydro One Networks
Cochrane GS	115	Northland Power
Tunis GS	115	Capital Power
Long Sault Rapids GS	115	Algonquin Power
Iroquois Falls DS	115	Hydro One Networks / Distribution
Cochrane West DS	115	Hydro One Networks / Distribution
Cochrane MS	115	Northern Ontario Wires Inc.

Table 1 – Study area busses for the subject Customer Impact Assessment

2.0 POWER SYSTEM ANALYSIS

Power System Analysis is an integral part of the transmission planning process. It is used by Hydro One to evaluate the capability of the existing network to deliver power and energy from generating stations to provide a reliable supply to customers. Two relevant aspects of Power System Analysis were used for this assessment, namely:

a. Short-circuit Studies: A Short Circuit Analysis program was used to determine the impact on customers.

b. Load Flow Studies: An AC load flow program was used to set up a base case for the Martins Meadows/Abitibi/Empire connection.

3.0 SHORT- CIRCUIT STUDIES

Short-circuit studies were carried out to assess the fault contribution when the Martins Meadows/Abitibi/Empire solar farm is in-service. The study results are summarized in Table 1 below showing both symmetric and asymmetric fault currents in kA. Table 2 shows the fault levels based on the following assumptions:

- Existing condition assumes all committed FIT generation In-Service
- Does not include Distributed Generation FIT contracts

Fault Level Locations	Voltage (kV)	Existing				With Martin Meadows/Abitibi/Empire I/S			
		3-Phase		Line-Ground		3-Phase		Line-Ground	
		Fault Current (kA)	Asym Current (kA)	Fault Current (kA)	Asym Current (kA)	Fault Current (kA)	Asym Current (kA)	Fault Current (kA)	Asym Current (kA)
A5H Tap Point	115	6.38	6.55	3.94	4.07	6.66	6.92	4.01	4.16
Hunta SS	115	9.22	9.58	5.80	6.11	9.43	9.84	5.86	6.19
Ansonville TS	115	8.47	9.52	8.97	10.47	8.55	9.61	9.03	10.54
Cochrane GS	115	5.27	5.56	2.99	3.05	5.32	5.61	3.00	3.06
Tunis GS	115	6.11	6.50	3.81	3.96	6.21	6.62	3.84	4.00
Long Sault Rapids GS	115	3.85	3.87	2.77	2.86	3.89	3.90	2.78	2.87
Iroquois Falls DS	115	8.10	8.81	7.99	8.76	8.18	8.90	8.04	8.81
Iroquois Falls DS	12.5	3.90	4.41	4.09	4.78	3.90	4.41	4.09	4.78
Cochrane West DS	115	4.71	4.72	2.77	2.78	4.75	4.76	2.78	2.79
Cochrane West DS	12.5	2.55	2.80	2.60	2.95	2.55	2.80	2.60	2.95
Cochrane MS	115	4.55	4.56	2.68	2.68	4.59	4.60	2.69	2.70
Cochrane MS	24.9	3.53	3.83	3.85	4.35	3.54	3.83	3.86	4.36

Table 2 – Short Circuit Levels of Buses with Martin Meadows/Abitibi/Empire Facility I/S

Table 2 shows the fault levels after the incorporation of the new Martins Meadows/Abitibi/Empire L.P Solar farm. The project meets the maximum symmetrical three-phase and single line-to-ground faults (kA) as set out in Appendix 2 of the *Transmission System Code* and reproduced below. It also meets the requirements of Hydro One equipment in the stations identified.

Nominal Voltage (kV)	Max. 3-Phase Fault (kA)	Max. SLG Fault (kA)
230	63	80(1)
115	50	50
44	20(2)	19(2)
27.6 (4-wire)	17(2)	12(2)
13.8	21(2)	10(2)

Table 3 – Transmission System Connection Point Performance Standards

Notes :

(1) – Usually limited to 63 kA

(2) – Effective September 1, 2010, Hydro One requires a 5 % margin on the acceptable TSC limits at voltage levels of <50kV to account for other sources of fault current on the distribution system such as unmodelled synchronous motors and data inaccuracies.

3.1 Impact at Stations Mitigated for Fault Level

Customer Impact Assessment studies conducted for projects that have either previously connected or plan to connect prior to the connection date planned for this project have identified stations where the fault level has exceeded the limits contained in Appendix B of the Transmission System Code (TSC), and it was necessary to install measures to reduce the fault level to within those contained in the TSC. The

customer whose project caused the fault level to exceed the TSC limit either funded or will be required to fund the cost of this mitigation measure. The TSC requires that any customer that benefits from such an installation that connects within five calendar years of the in-service date of the mitigation measure also contribute towards the cost of the measure, and that any such payments be refunded to the original contribution customers(s). This section reports the impact of this project on previously mitigated stations to see if this project is required to financially contribute to the cost for any of those measures.

		3P Fault (kA Symm)			SLG Fault (kA Symm)		
Station	Voltage (kV)	Without Martins Meadows/ Abitibi/Empire Facility *	With Martins Meadows/ Abitibi/ Empire Facility	Difference	Without Martins Meadows/ Abitibi/Empire Facility *	With Martins Meadows/ Abitibi/ Empire Facility	Difference
Martindale Z Bus	44	14.885	14.886	0.001	19.753	19.754	0.001
Windsor Walker TS#1	27.6	17.189	17.189	0	3.493	3.493	0
Kingsville TS	27.6	16.125	16.125	0	11.65	11.65	0
Caledonia TS	27.6	16.56	16.56	0	9.919	9.919	0

*: Short circuit value of all FIT projects In-Service prior to Martins Meadows/Abitibi/Empire Facility.

Table 4 – Impact of Martins Meadows/Abitibi/Empire Facility on Hydro One Stations previously identified with Short Circuit Violations

The results of the fault levels studies shown on these tables above show that the Northgate Minerals' Martin Meadows/Abitibi/Empire facilty does not have a measureable (>= 0.01kA) impact at the fault level at any of the stations (Windsor Walker #1 TS, Kingsville TS, Caledonia TS & Martindale TS) where mitigation measures are necessary to limit fault levels to acceptable values.

4.0 LOAD FLOW STUDIES

Load flow studies were carried out to analyze the impact of the new facilities on the voltage performance of Hydro One customers in the affected area. Minimum area generation in the north occurs during off peak (night) hours. During those hours, the solar farm inverters shut off and do not produce any real power. The inverter logic is automatically changed to supply load to their small 25kVA station service transformers. Thus, minimum conditions were not studied due to the inherent nature of the facility during night hours.

4.1 Base Case and Study Assumptions

- Studies were conducted using the winter 08/09 PSS/E model.
- Generator data was acquired from SIA application and correspondence from proponent.
- Hanmer TS reactors R1 and R2 In-Service (not capable of being switched on load)
- Maximum Generation Conditions assumes all local area generation at full output including future Lower Mattagami generating facility.
- Model assumed second 230kV capacitor bank installed at Hamner TS / Porcupine TS
- Model assumed steady state Var contribution from 230kV Porcupine SVC
- Detour Gold assumed in-service at the Pinard 230kV bus.
- The Martins Meadows/Abitibi/Empire solar farm load flow studies were completed with the Martins Meadows, Abitibi and Empire solar farm (CAA ID 403/406/409) already I/S. (Committed Generation) – This is consistent with the methodology used by the IESO for their SIA study.
- Inverters operating in 0.95 lag – 0.95 lead mode.
- Scheduled voltage on customer collector bus set at 1.0 pu.

- Cochrane GS, Tunis GS, Abitibi Canyon G2/G3 out of service for A4H contingency. (As per existing generation rejection scheme)

Voltage Study

Results of the voltage study can be seen in the table below. The voltage study has thus been limited to the high voltage delivery busses listed below. The voltages at these busses are acceptable and thus the associated step down transformer is equipped with ULTC which will regulate the low voltage to be within limits set forth by the IESO market rules.

Voltage performance was assessed for the loss of the A4H circuit and with the sudden loss of the entire Northgate facility.

Bus (115kV) *	Martins Meadows/ Abitibi/Empire O/S (kV)	Martins Meadows/ Abitibi/Empire I/S (kV)	ΔV post ULTC (%)	Loss of Martins Meadows/Abitibi/ Empire pre ULTC (kV)	ΔV pre ULTC (%)
	All Elements I/S				
A5H Tap Point	127.94	126.95	-0.77	127.93	0.77
Ansonville TS	130.94	130.13	-0.62	130.93	0.61
C.P. Tunis GS	129.79	129.00	-0.61	129.79	0.61
Cochrane GS	129.44	128.81	-0.49	129.43	0.48
Cochrane MTS	128.76	128.09	-0.52	128.75	0.52
Cochrane West DS	128.81	128.14	-0.52	128.80	0.52
Hunta SS	126.68	125.89	-0.62	126.68	0.63
Iroquois Falls DS	130.87	130.06	-0.62	130.86	0.62
Long Sault Rapids GS	126.68	125.97	-0.56	126.67	0.56
	A4H O/S				
A5H Tap Point	127.90	126.80	-0.86	127.90	0.87
Ansonville TS	131.69	130.99	-0.53	131.69	0.53
C.P. Tunis GS	129.84	128.95	-0.69	129.84	0.69
Cochrane GS	De-energized during A4H outage				
Cochrane MTS					
Cochrane West DS					
Hunta SS	126.53	125.61	-0.73	126.53	0.73
Iroquois Falls DS	131.57	130.86	-0.54	131.57	0.54
Long Sault Rapids GS	126.55	125.71	-0.66	126.55	0.67

*Base Case Voltages of 115kV busses are 118.05

Table 5 – Voltage Study Results

Customers and Hydro One transmission busses will experience voltage variations within the acceptable limits outlined in the Transmission System Code and IESO market rules.

4.0 Customer Reliability

Each of the three substations (Martin's Meadows, Abitibi, Empire) will be equipped with a high voltage circuit breaker to isolate any faults occurring at the customer site. (TH1, TH2, TH3) The circuit breaker along with a motorized disconnect switch (89-1, 89-2, 89-3) can provide individual solar farm isolation for any maintenance activities, without adversely affecting other transmission customers.

In addition, a secondary high voltage interrupting device (52-1) will be installed closer to the A5H circuit to provide isolation of the entire three-farm facility for any faults on the 10.5km customer owned line or circuit breaker failure of the individual solar farm breakers (TH1, TH2, or TH3)

Protection settings will be modified at Hydro One terminal stations to ensure Northland facility will be isolated for faults to avoid any interruption on the A5H circuit.

5.0 Conclusions and Recommendations

The proposed 30MW connection of Northland Power generating facility (includes Martin's Meadows, Abitibi, Empire) can be incorporated into the 115kV A5H transmission line. Hydro One customers connected to this line will experience voltage variations within acceptable limits. Short Circuit levels across the Hydro One system are also within acceptable range with the incorporation the Northland Power – Martin Meadows, Abitibi, and Empire Solar farms.

APPENDIX A – DIAGRAMS

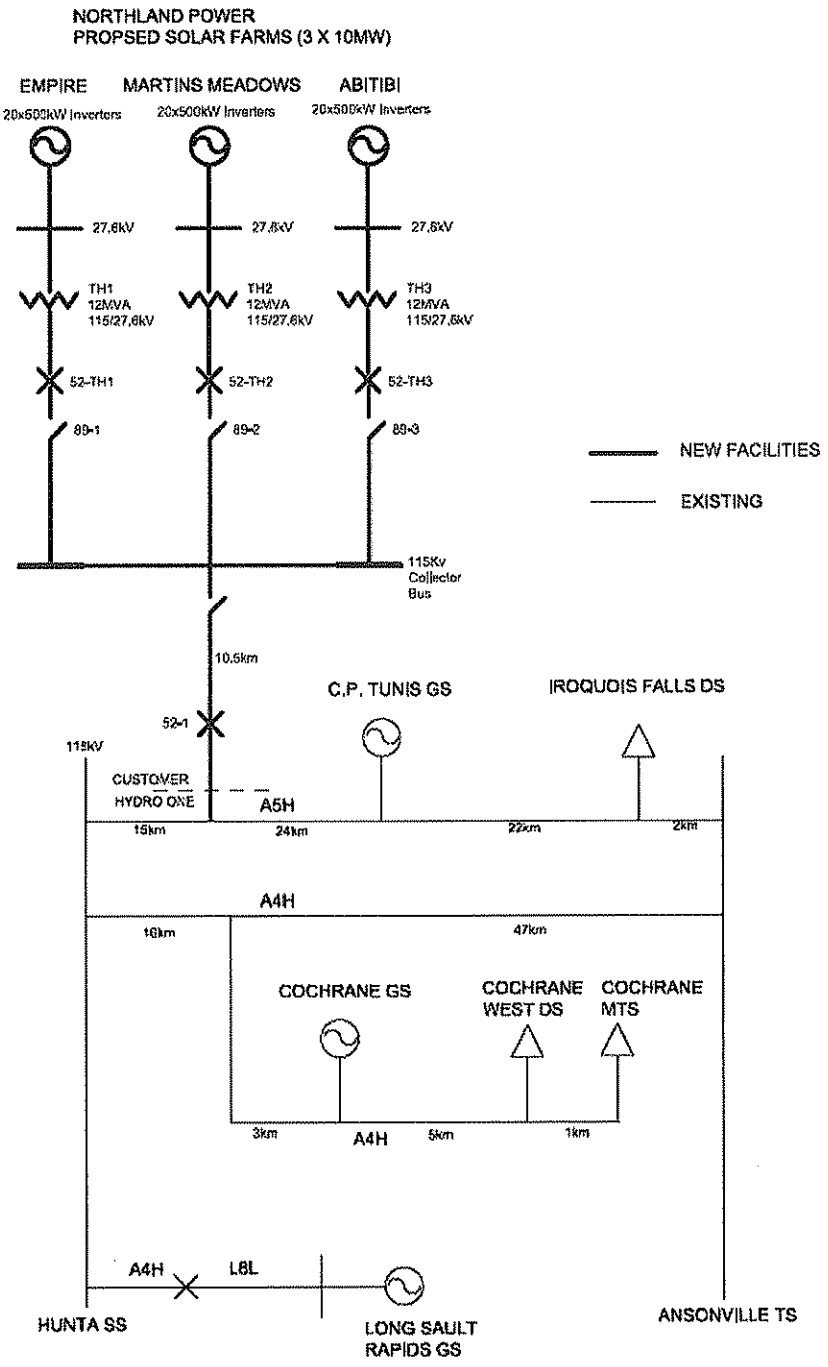

Figure 1 –Northland Power Martin's Meadows / Abitibi / Empire Solar farm connection to Hydro One.

Hydro One Networks Inc.
483 Bay Street
Toronto, Ontario
M5G 2P5

CUSTOMER IMPACT ASSESSMENT

Proposed 10MW
Northland Power Solar Long Lake LP
Solar Generation Project

FIT# FE8GSGA (ID 2010-408)

Revision: **0**

Date: **January 5, 2011**

Issued by: **Transmission Planning Department**
System Development Division
Hydro One Networks Inc.

Prepared by:

Kirpal Bahra
Transmission System Development
Hydro One Networks Inc.

Approved by:

Ibrahim El Nahas
Transmission System Development
Hydro One Networks Inc.

Disclaimer

This Customer Impact Assessment was prepared based on available information about the connection of the proposed Long Lake Solar Farm. It is intended to highlight significant impacts, if any, to affected transmission customers early in the project development process and thus allow an opportunity for these parties to bring forward any concerns that they may have including those needed for the review of the connection and for any possible application for leave to construct. Subsequent changes to the required modifications or the implementation plan may affect the impacts of the proposed connection identified in this Customer Impact Assessment. The results of this Customer Impact Assessment and the estimate of the outage requirements have taken a customer review period into account. The results are however is subject to change to accommodate the requirements of the IESO and other regulatory or municipal authority requirements.

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CUSTOMER IMPACT ASSESSMENT

PROPOSED 10MW
NORTHLAND POWER SOLAR – LONG LAKE LP

1.0 INTRODUCTION

1.1 Scope of the Study

This Customer Impact Assessment (CIA) study assesses the potential impacts of the proposed Long Lake LP project on the transmission load customers and generators in the local vicinity. This study is intended to supplement the System Impact Assessment (ID 2010-408) by the IESO.

This study covers the impact of the generation addition on the Hydro One Networks system in the area. The primary focus of this study is to identify the impact on the transmission customer connected facilities and operating constraints based on facility voltage performance. The study also assists to determine if any transmission system upgrade will be required to integrate the proposed interconnection during possible system conditions.

This study does not evaluate the overall impact of the Northland Power – Long Lake facility on the bulk system or on the distribution network. The impact of the new generator on the bulk system is the subject of the System Impact Assessment (SIA) which is issued by the Independent Electricity System Operator (IESO).

This study does not evaluate the impact of the Northland Power – Long Lake facility on the existing network Protection and Control facilities. Protection and Control aspects are reviewed under the Protection Impact Assessment, which is part of the SIA.

1.2 Background

Northland Power Inc. has proposed to develop a 10MW solar farm located in the town of Hunta. The farm will consist of 20 x 500kW (10MW total) inverters connected to a 27.6kV collector bus. An underground cable will connect the collector bus to Long Lake Farm Substation (consisting of a 12MVA 115/27.6kV transformer, 115kV circuit breaker, motorized disconnect switch) The customer will build 500m overhead 115kV line to enable connection to the Hydro One owned 115kV C2H (Hunta SS x Abitibi Canyon SS) circuit. (Refer to Appendix A - figure 1)

The proposed In-Service date is September 30, 2012

METHODOLOGY & CRITERIA

1.3 Voltage Performance - Planning Criteria

To establish the impact of incorporating the proposed Northland Power Long Lake facility, the following post-fault voltage decline criteria would have to be observed:

- At the Bulk Electricity System level (115kV and up): The loss of a single transmission circuit should not result in a voltage decline greater than 10% for pre- and post- transformer tap-changer action

- The maximum and minimum phase-to-phase voltages given in the IESO's Transmission Assessment Criteria were considered. However in Northern Ontario, the maximum continuous voltage for the 230kV and 115kV systems can be as high as 260kV and 132kV respectively.

- With all planned facilities in service pre-contingency, system voltage changes in the period immediately following a contingency shall not result in a voltage decline greater than 10% for pre-transformer tap-changer action (including station loads less than 50kV) and 10% post transformer tap-changer action (5% for station loads less than 50kV). In addition, the steady state voltage at station loads less than 50kV are to remain within 6% of the nominal voltage.

1.4 Customers Connected

It has been determined that the busses listed below will have the largest voltage and short circuit variations due to the proposed generation. Thus, the study has been limited to study high voltage customer busses in the area of the proposed generation connection.

Station	Voltage (kV)	Owner
Hunta SS	115	Hydro One Networks
Abitibi Canyon GS	115	Ontario Power Generation
C3H Customer Tap	115	Hydro One Networks

Table 1 – Study area busses for the subject Customer Impact Assessment

2.0 POWER SYSTEM ANALYSIS

Power System Analysis is an integral part of the transmission planning process. It is used by Hydro One to evaluate the capability of the existing network to deliver power and energy from generating stations to provide a reliable supply to customers. Two relevant aspects of Power System Analysis were used for this assessment, namely:

a. Short-circuit Studies: A Short Circuit Analysis program was used to determine the impact on customers.

b. Load Flow Studies: An AC load flow program was used to set up a base case for the Long Lake connection.

3.0 SHORT- CIRCUIT STUDIES

Short-circuit studies were carried out to assess the fault contribution when the Long Lake solar farm is in-service. The study results are summarized in Table 1 below showing both symmetric and asymmetric fault currents in kA. Table 2 shows the fault levels based on the following assumptions:

- Existing condition assumes all committed FIT generation In-Service
- Does not include Distributed Generation FIT contracts

Fault Level Locations	Bus Voltage (kV)	Existing				With Long Lake L.P. Solar Farm I/S			
		3-Phase		Line-Ground		3-Phase		Line-Ground	
		Fault Current (kA)	Asym Current (kA)	Fault Current (kA)	Asym Current (kA)	Fault Current (kA)	Asym Current (kA)	Fault Current (kA)	Asym Current (kA)
Abitibi Canyon GS	115	5.65	6.50	5.80	7.03	5.68	6.54	5.82	7.06
Hunta SS	115	9.33	9.68	5.83	6.14	9.43	9.84	5.86	6.19
C2H Tap	115	9.27	9.62	5.79	6.10	9.38	9.78	5.82	6.15

Table 2 – Short Circuit Levels of Buses with Long Lake Solar Facility I/S

Table 2 shows the fault levels after the incorporation of the new Long Lake L.P Solar farm. The project meets the maximum symmetrical three-phase and single line-to-ground faults (kA) of 115 kV stations as set out in Appendix 2 of the *Transmission System Code* and reproduced below. It also meets the requirements of Hydro One equipment in the stations identified.

Nominal Voltage (kV)	Max. 3-Phase Fault (kA)	Max. SLG Fault (kA)
230	63	80(1)
115	50	50
44	20(2)	19(2)
27.6 (4-wire)	17(2)	12(2)
13.8	21(2)	10(2)

Table 3 – Transmission System Connection Point Performance Standards

Notes :
(1) – Usually limited to 63 kA
(2) – Effective September 1, 2010, Hydro One requires a 5 % margin on the acceptable TSC limits at voltage levels of <50kV to account for other sources of fault current on the distribution system such as unmodelled synchronous motors and data inaccuracies.

3.1 Impact at Stations Mitigated for Fault Level

Customer Impact Assessment studies conducted for projects that have either previously connected or plan to connect prior to the connection date planned for this project have identified stations where the fault level has exceeded the limits contained in Appendix B of the Transmission System Code (TSC), and it was necessary to install measures to reduce the fault level to within those contained in the TSC. The customer whose project caused the fault level to exceed the TSC limit either funded or will be required to fund the cost of this mitigation measure. The TSC requires that any customer that benefits from such an installation that connects within five calendar years of the in-service date of the mitigation measure also contribute towards the cost of the measure, and that any such payments be refunded to the original contribution customers(s). This section reports the impact of this project on previously mitigated stations to see if this project is required to financially contribute to the cost for any of those measures.

		3P Fault (kA Symm)			SLG Fault (kA Symm)		
Station	Voltage (kV)	Without Long Lake Facility *	With Long Lake Facility	Difference	Without Long Lake Facility *	With Long Lake Facility	Difference
Martindale Z Bus	44	14.886	14.886	0	19.754	19.754	0
Windsor Walker TS#1	27.6	17.189	17.189	0	3.493	3.493	0
Kingsville TS	27.6	16.125	16.125	0	11.65	11.65	0
Caledonia TS	27.6	16.56	16.56	0	9.919	9.919	0

*: Short circuit value of all FIT projects In-Service prior to Long Lake Facility.

Table 4 – Impact of Long Lake Facility on Hydro One Stations previously identified with Short Circuit Violations

The results of the fault levels studies shown on these tables above show that the Long Lake Solar project does not have a measureable (>= 0.01kA) impact at the fault level at any of the stations (Windsor Walker #1 TS, Kingsville TS, Caledonia TS & Martindale TS) where mitigation measures are necessary to limit fault levels to acceptable values.

4.0 LOAD FLOW STUDIES

Load flow studies were carried out to analyze the impact of the new facilities on the voltage performance of Hydro One customers in the affected area. Minimum area generation in the north occurs during off peak (night) hours. During those hours, the solar farm inverters shut off and do not produce any real power. The inverter logic is automatically changed to supply load to their small 25kVA station service transformers. Thus, minimum conditions were not studied due to the inherent nature of the facility during night hours.

4.1 Base Case and Study Assumptions

- Studies were conducted using the winter 08/09 PSS/E model.
- Generator data was acquired from SIA application and correspondence from proponent.
- Hanmer TS reactors R1 and R2 In-Service (not capable of being switched on load)
- Maximum generation conditions assumes all local area generation at full output including future Lower Mattagami generating facility.
- Model assumed second 230kV capacitor bank installed at Hamner TS / Porcupine TS
- Model assumed steady state contribution from 230kV Porcupine SVC
- Detour Gold assumed in-service at the Pinard 230kV bus.
- The Long Lake solar farm load flow studies were completed with the Martins Meadows, Abitibi and Empire solar farm (CAA ID 403/406/409) already I/S. (Committed Generation) – This is consistent with the methodology used by the IESO for their SIA study.
- Inverters operating in 0.95 lag – 0.95 lead mode.
- Scheduled voltage on customer collector bus set at 1.0 pu.

Voltage Study

Results of the voltage study can be seen in the table below. The three 115kV busses which are most affected by the incorporation of the Long Lake facility are the Abitibi Canyon SS, Hunta SS, and the C2H tap point. The voltage study has thus been limited to study these voltages. Voltage performance was also assessed for the loss of A5H and L21S circuits and the sudden loss of the long lake facility.

Bus (115kV) *	Long Lake O/S (kV)	Long Lake I/S (kV)	ΔV post ULTC (%)	Loss of Long Lake pre ULTC (kV)	ΔV pre ULTC (%)
	All Elements I/S				
Abitibi Canyon GS	126.25	126.07	-0.15	126.23	0.13
Hunta SS	126.17	125.89	-0.23	126.12	0.19
C2H Tap	126.17	125.89	-0.23	126.12	0.19
	L21S O/S				
Abitibi Canyon GS	126.29	126.08	-0.17	126.28	0.16
Hunta SS	126.21	125.91	-0.23	126.20	0.23
C2H Tap	126.21	125.91	-0.23	126.21	0.23
	A4H O/S				
Abitibi Canyon GS	125.43	125.19	-0.19	125.42	0.18
Hunta SS	124.97	124.63	-0.27	124.94	0.26
C2H Tap	124.97	124.63	-0.27	124.96	0.27

*Base Case Voltages of 115kV busses are 118.05

Table 5 – Voltage Study Results

Customers and Hydro One transmission busses will experience voltage variations within the acceptable limits outlined in the Transmission System Code and IESO market rules.

4.0 Customer Reliability

The Long Lake substation will be equipped with a high voltage circuit breaker (52-TH1) to isolate any faults occurring at the customer site. The circuit breaker along with a motorized disconnect switch (89-1) will also ensure that maintenance activities at the Long Lake substation will also not affect any other transmission connected customers. Protection settings will be modified at Hunta SS and Abitibi Canyon SS to ensure faults are first isolated at the customer owned circuit breaker, without any interruption of the C2H circuit.

5.0 Conclusions and Recommendation

The proposed connection of Northland Power Long Lake generating facility can be incorporated into the 115kV C2H transmission line. Hydro One customers connected to this line will experience voltage variations within acceptable limits. Short Circuit levels across the Hydro One system are within acceptable range with the incorporation of the Long Lake facility.

APPENDIX A – DIAGRAMS

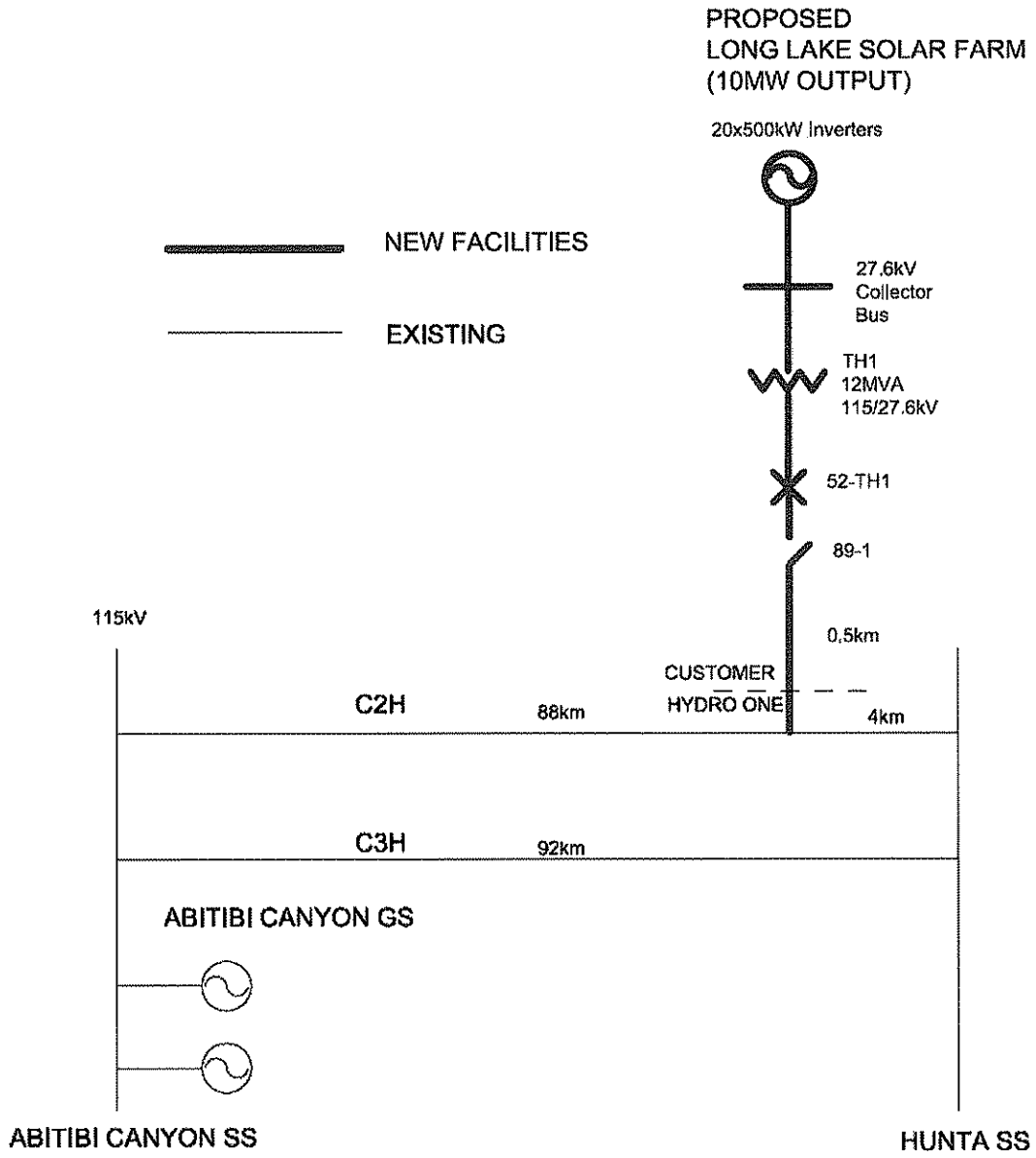

Figure 1 –Northland Power Long Lake facility connection to Hydro One.

Hydro One Networks Inc.
483 Bay Street
Toronto, Ontario
M5G 2P5

Addendum #2

May 16, 2012

Customer Impact Assessment - Northland Power
(Martins Meadows #FQJ0FUC, Abitibi #FAQLBA0, Empire #FM5F42U)

Background

This document is an addendum to the Customer Impact Assessment titled *CIA-Northland Power (Martins Meadows-Abitibi-Empire (#FQJ0FUC,FAQLBA0,FM5F42U)-FINAL* dated January 5, 2011.
This document replaces the previous addendum dated June 27, 2011

Reason for Addendum

Northland Power will not proceed with the connection of the 30MW solar generating facility (Abitibi / Martins Meadows / Empire) to the Hydro One A5H circuit. This generating project will be connected to the Hydro One C2H circuit. Study results for this connection can be found in *CIA - Addendum #2 – Long Lake #FE8GSGA*

Conclusion

The Northland Power solar generating facility (Long Lake, Martins Meadows, Abitibi, and Empire solar farms) can be incorporated into the 115kV C2H transmission line.

Hydro One customers connected to neighboring circuits will not be impacted by this proposed connection. Short circuit levels and voltage variations are within acceptable limits.

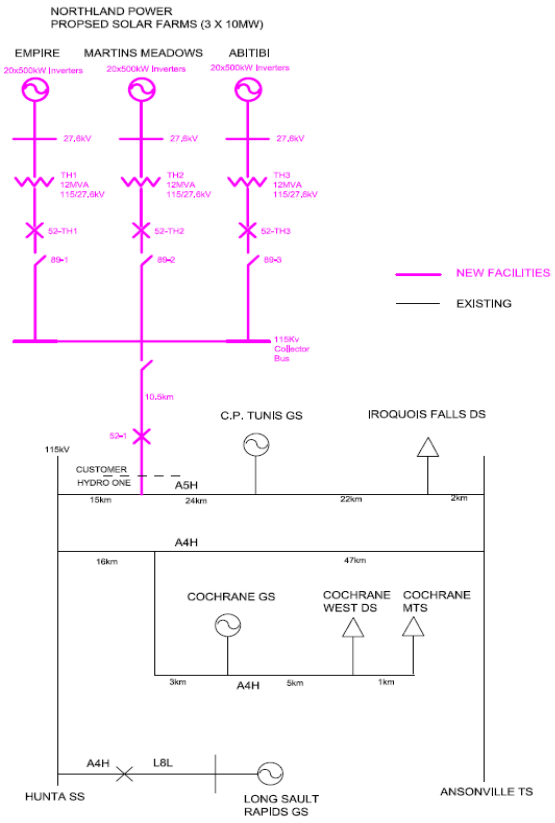

Figure 1- Original Proposal for 30MW Northland Power Solar Farm Connection to Hydro One A5H circuit

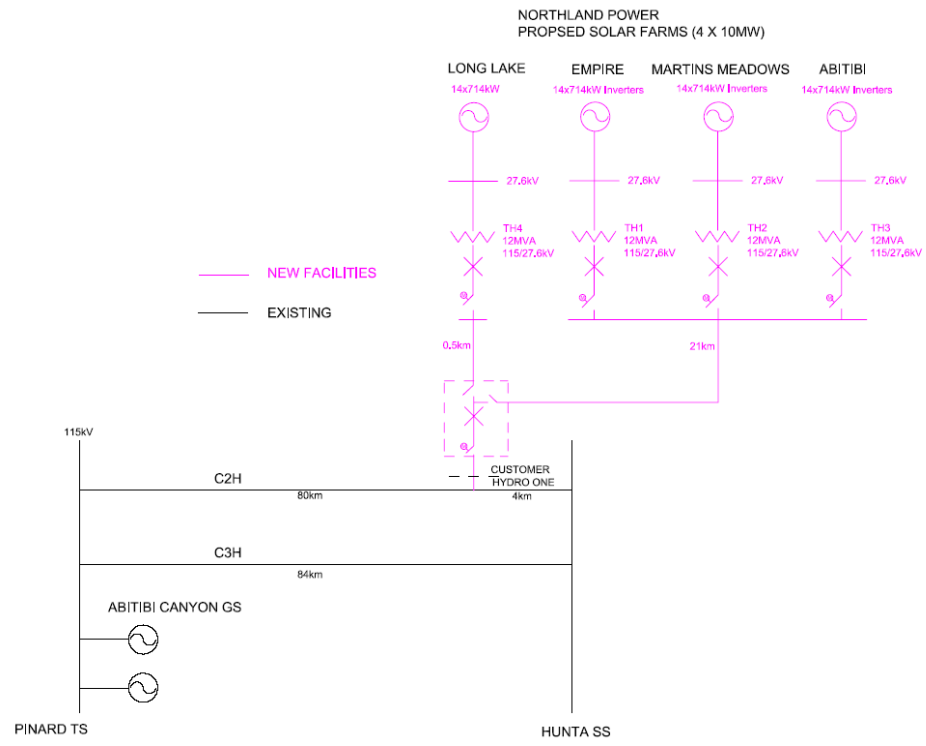

Figure 1 – Proposed Application for Northland Power Solar Farm Connection to Hydro One C2H circuit. (40MW Total)

Hydro One Networks Inc.
483 Bay Street
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Addendum #2

May 16, 2012

Customer Impact Assessment - Northland Power
(Long Lake #FE8GSGA)

Background

This document is an addendum to the Customer Impact Assessment titled *CIA-Northland Power (Long Lake (#FE8GSGA)-FINAL* dated January 5, 2011.
This document complements the previous addendum dated June 27, 2011

Reason for Addendum

Northland Power confirmed on November 21, 2011 that in addition to the existing 10MW *Long Lake LP Solar Farm* application, 3x10MW solar farms will also be constructed, increasing the total generating capacity of the Northland Power facility from 10MW to 40MW.

As seen in figure 1, the Long Lake Solar farm will connect to the Hydro One system through a customer owned switching station. Three other solar farms (Abitibi, Martins Meadows, Empire) will also connect to the switching station via a 21km transmission line. The customer switching station will consist of a motorized disconnect switch and a circuit breaker which will be used to isolate the entire Northland Power facility during faults or maintenance activities.

Hydro One is presently working to re-terminate the 115kV C2H / C3H circuits from Abitibi Canyon SS to Pinard TS. This reconfiguration is expected to be completed prior to Northland Power energizing their 40MW generating facility, thus, all studies below have taken this reconfiguration into consideration.

Short Circuit Impact

1) Short circuit values shown are shown in the table below.

Fault Level Locations	Bus Voltage (kV)	Existing				With Northland Power Facility I/S on C2H (40MW)			
		3-Phase		Line-Ground		3-Phase		Line-Ground	
		Fault Current (kA)	Asym Current (kA)	Fault Current (kA)	Asym Current (kA)	Fault Current (kA)	Asym Current (kA)	Fault Current (kA)	Asym Current (kA)
Pinard TS	115	5.64	6.60	5.55	6.49	5.79	6.76	5.65	6.57
Hunta SS	115	9.32	9.32	5.88	5.91	10.0	10.0	6.04	6.10
C2H Tap	115	7.88	7.88	4.93	4.93	8.54	8.54	5.10	5.10
Abitibi Canyon GS	115	5.59	6.67	5.77	7.04	5.74	6.82	5.87	7.15

*Existing scenario assumes all other FIT projects In-Service
*Study assumes C2H will be terminated at 115kV Pinard SS. Original CIA assumed C2H termination at Abitibi Canyon GS.

Result
Customer Busses are not significantly impacted by the incorporation of the 40MW Northland Power Solar Generating facility on the C2H Hydro One circuit.

2) Short Circuit at Previously Identified Stations

		3P Fault (kA Symm)			SLG Fault (kA Symm)		
Station	Voltage (kV)	Without NP Facility	With NP Facility	Difference	Without NP Facility	With NP Facility	Difference
Martindale Z Bus	44	15.13	15.13	0	20.03	20.03	0
Windsor Walker TS#1	27.6	17.57	17.57	0	3.50	3.500	0
Kingsville TS	27.6	16.91	16.91	0	11.92	11.92	0
Caledonia TS	27.6	16.53	15.53	0	9.91	9.91	0

* All FIT projects with a queue position that precedes NP, is assumed I/S
* NP – Northland Power Facility (Long Lake, Abitibi, Martins Meadows, Empire)

Result
Short Circuit values at the above busses are not impacted by the incorporation of Northland Power facility on the C2H circuit.

Voltage Variations

115kV Bus	NP O/S (kV)	NP I/S (kV)	ΔV post ULTC (%)	Loss of NP Facility pre-ULTC (kV)	ΔV pre ULTC (%)
	All Elements I/S				
Canyon GS	129.24	130.17	0.72	129.28	-0.68
Hunta SS	127.67	128.91	0.97	127.71	-0.93
Pinard TS	125.95	126.91	0.76	125.98	-0.73
C2H Tap	127.67	128.99	1.03	127.71	-0.99
	L21S O/S				
Canyon GS	130.14	130.99	0.65	130.11	-0.67
Hunta SS	128.86	130.00	0.88	128.84	-0.89
Pinard TS	126.87	127.74	0.69	126.84	-0.70
C2H Tap	128.88	130.01	0.88	128.84	-0.90
	A4H O/S				
Canyon GS	128.35	129.94	1.24	128.74	-0.92
Hunta SS	126.54	128.59	1.62	127.00	-1.24
Pinard TS	125.05	126.66	1.29	125.44	-0.96
C2H Tap	126.55	128.61	1.63	127.01	-1.24

Table 3 – Voltage Variations on Customer Busses

*NP (Northland Power Generating Facility – 40MW – Long Lake, Abitibi, Martins Meadows, Empire)
*Base case study voltage 118.05kV on the Hydro One 115kV system
*Study assumes C2H will be terminated at 115kV Pinard SS
*Inverters capable of operating 0.9 lag – 0.95 lead pf. (above table assumed 0.9 lag)

Result

Voltage variations at customer busses are within acceptable limits with the incorporation of the 40MW Northland Power solar generating facility on the 115kV C2H circuit. Voltage results for original application can be found in Customer Impact Assessment dated January 5, 2011 page 7.

Conclusion

The Northland Power solar generating facility (Long Lake, Martins Meadows, Abitibi, and Empire solar farms) can be incorporated into the 115kV C2H transmission line.

Hydro One customers connected to this line will not be impacted by this proposed connection. Short circuit levels and voltage variations are within acceptable limits.

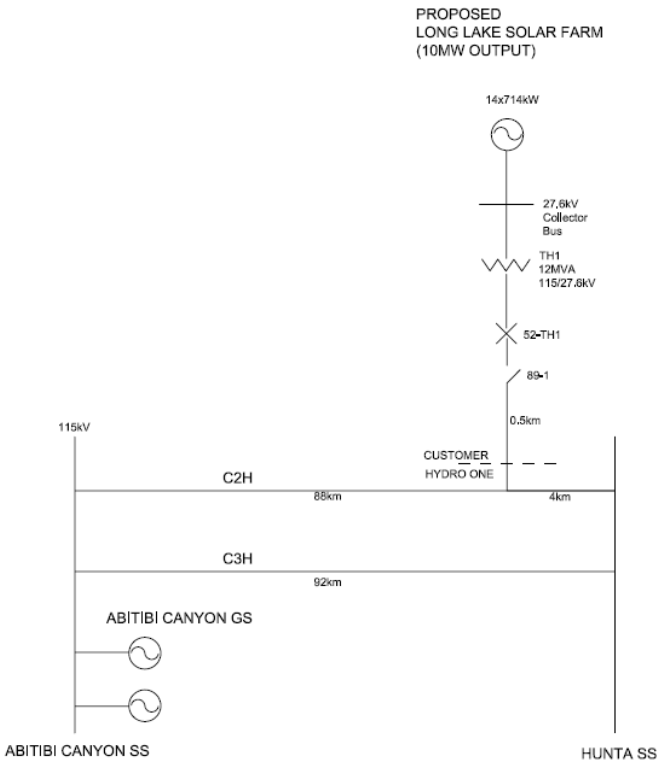

Figure 1 – Original Application for 10MW Northland Power Solar Farm Connection to Hydro One C2H circuit

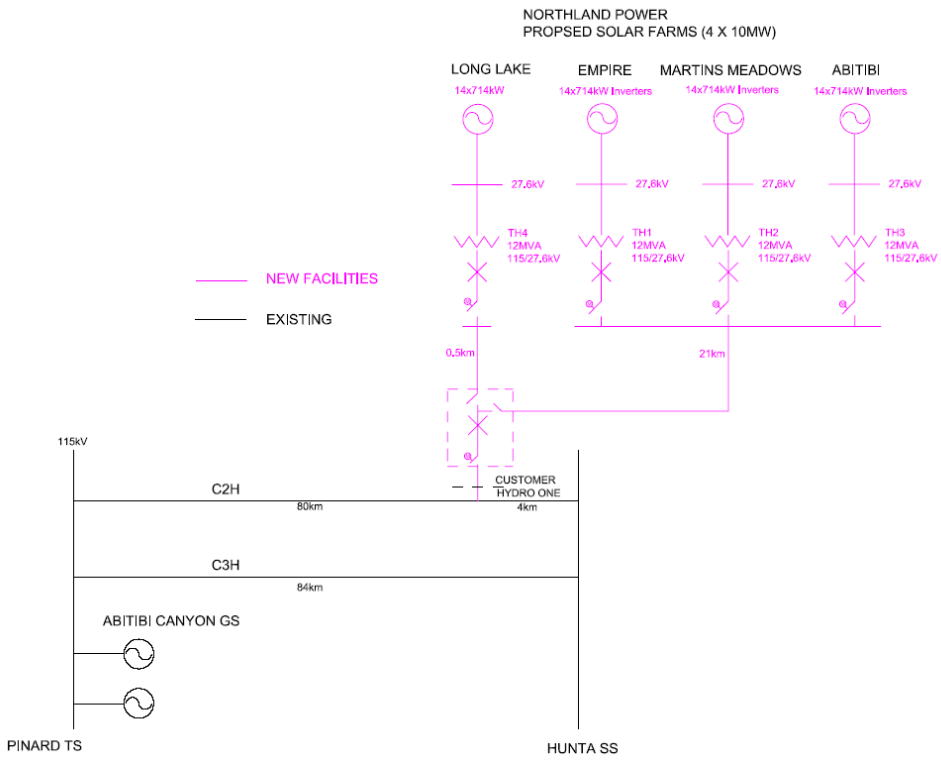

Figure 2- Proposed Northland Power Solar Farm Connection to Hydro One C2H circuit (40MW Total)