



# **CONNECTION ASSESSMENT & APPROVAL PROCESS**

## ***PRELIMINARY ASSESSMENT REPORT***

### ***For the Increased Supply to the Lac des Iles Mine***

***CAA ID N<sup>o</sup>. 2000-016***

***Long Term Forecasts & Assessments Department***

***Date: 25<sup>th</sup> January 2001***

## ***Preliminary Assessment Report***

*For the Increased Supply to the Lac des Iles Mine*

### Acknowledgement

The IMO wishes to acknowledge the assistance of Hydro One in completing some of the studies for this assessment.

### Disclaimers

#### ***IMO***

This report has been prepared solely for the purpose of assessing, on a preliminary basis, 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 a System Impact Assessment of the proposed connection should be conducted under Chapter 4, section 6 of the Market Rules. 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, Hydro One 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. 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. The IMO expects the connection applicant and affected transmitter to discuss the connection project with any persons located in the vicinity of the project and to advise the IMO of any concerns they might express about the impact of the project on system reliability.

#### ***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.

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The short circuit and thermal loading levels have been computed based on the information provided by the connection proponent 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. Additional facility studies may be necessary to confirm constructability and the time required for construction. System impact or further studies at more advanced stages of the project development may identify additional facilities that need to be provided or that require upgrading.

***North American Palladium – Lac des Iles Development in Thunder Bay  
Preliminary Assessment for an Increased Level of Supply***

***1. Introduction***

The Lac des Iles mine, northwest of Thunder Bay, is currently supplied via a privately-owned, 63.5km 115kV line that is tapped on to the 115kV circuit S1C, which together with circuit P5M, provides a direct connection between Port Arthur TS No. 1 and Silver Falls GS. The tapping point for the Lac des Iles line is approximately 33km from Port Arthur TS and 14km from Silver Falls GS. The maximum load that is presently supplied is approximately 4MW, and this includes the supply to the single 600HP synchronous motor.

Diagram 1 shows the existing supply arrangement.

North American Palladium (NAP), the mine's owner, has submitted a proposal for an increase in the supply to their Lac des Iles mining facility to 32MW. The new load is to include three 8500HP synchronous motors that are to be started direct-on-line.

This report summarises the results of the analysis that has been performed to determine the impact of the new facilities on short circuit levels; on voltage profiles during normal operation, as well as during the start-up period for the large synchronous motors; and to examine the adequacy of the ratings of both the existing and committed facilities in the area to meet the increased demand.

The system model used for these studies is based on the existing transmission facilities, together with any new transmission facilities that have received approval and have been committed.

In addition, North American Palladium had indicated that the low voltage busbars at the Lac des Iles mine would be operated normally-open, and this was the arrangement considered in the initial studies. For some of the later studies that examined the effect of starting the first 8500HP motor at the mine, a common LV busbar arrangement was considered.

***2. Connection Arrangement***

The Hydro One facilities at the point where the 115kV circuit to the Lac des Iles mine, is tapped on to the 115kV circuit S1C, are terminated at an MSO. This is connected to a motorised disconnect, which is owned by North American Palladium.

Operational difficulties have been experienced when attempting to de-energise the 63.5km line to the mine, using this disconnect. North American Palladium is therefore proposing to add a further 115kV SF<sub>6</sub> circuit breaker and a manually-operated disconnect on the line-side of the existing facilities.

Although provision has been made for the addition of line protection to the new breaker should it be required, the intention is to use the circuit breaker initially solely for 'switching' rather than for fault-interrupting duties. The role of the existing line protection will therefore remain unchanged.

At the mine site, North American Palladium is proposing to complete the following installations:

- extend the existing 115kV transmission line by 1.5km from the existing on-site substation to the new substation at the new mill.

*In the substation at the new mill:*

- install a new 115kV SF<sub>6</sub> circuit breaker
- install two new 20/27/33MVA, 120/4.16kV step-down transformers
- install 4.16kV connections to the following locations:
  - the SAG mill with one 8500HP synchronous motor
  - the ball mill with two 8500HP synchronous motors

- the dewatering area with two 600HP, three 500HP & two 350HP motors
- the grinding area with three 1250HP & two 700HP motors
- the flotation area with two 400HP motors
- the crusher area with two 600HP motors
- the pebble crusher with one 400HP motor

The fault interrupting capability of the 4.16kV switchgear is 350MVA. North American Palladium has determined that with all three 8500HP motors in-service the fault level will exceed the equipment rating if the LV busbar is operated closed.

The proposed arrangement at the tapping point on to 115kV circuit P5M, and the revised arrangement at the mine site are shown in Diagram 2.

### **3. Fault Levels**

A review of the existing fault levels on the A2 busbar at Port Arthur TS No. 1 has indicated that the fault interrupting capability of two of the existing circuit breakers could be exceeded if the busbar is operated at voltages in excess of 123kV, when all facilities are in-service.

Since it is desirable for the A2 busbar at Port Arthur TS No. 1 to be operated at as high a voltage as possible when the increased load at the Lac des Iles mine is imposed on the system, Hydro One is arranging for these two breakers to be replaced. In the event that it is not possible to complete this work in time to meet the increased load at the Lac des Iles mine, Hydro One is proposing to implement other measures which will allow the busbar to be operated at higher voltages.

Short-circuit analysis was also performed to determine the fault levels at all the major busbars in the area, with all three 8500 HP motors in-service at the Lac des Iles mine, and with the LV busbars operated 'split'.

The calculated fault levels were compared with the ratings of the existing circuit breakers on the A2 busbar at Port Arthur TS No. 1 and at Lakehead TS. Apart from the two breakers that are to be replaced, the projected fault levels are all within the ratings of the existing equipment.

The results of the fault level analysis are summarised in the following Table:

Table 1: Short Circuit Levels

<i>Fault Type</i>	<i>Bus Name</i>	<i>Maximum Fault Levels with the LV busbars split (for a pre-fault voltage of 124kV)</i>
<i>Three Phase Fault</i>	Lakehead TS	19.33kA
	Port Arthur No. 1 A2 Bus	15.04kA
	Hydro One Jct.	3.85kA
	NAP 115kV Bus	1.53kA
	NAP 4.16kV Bus	37.1kA
<i>Line-Ground Fault</i>	Lakehead TS	20.90kA
	Port Arthur No. 1 A2 Bus	13.14kA
	Hydro One Jct.	3.59kA
	NAP 115kV Bus	0.84kA
	NAP 4.16kV Bus	0kA

**4. Normal Voltage Profile Under Full Load Conditions**

The Table below shows the results from the loadflow analysis for different operating conditions, with the full 32MW load at the Lac des Iles mine. It has been assumed that the low voltage bus-tie breaker at the Lac des Iles mine is open:

Table 2: Steady State Voltage Profile with a 32 MW Load at the Lac des Iles Mine

<i>Bus Name</i>	<i>With all facilities in-service</i>	<i>With facilities out-of-service</i>		
		<i>Thunder Bay G2</i>	<i>Silver Falls GS</i>	<i>Thunder Bay G2 &amp; Silver Falls GS</i>
Port Arthur 115kV A2 Bus	125kV	124kV	124kV	124kV
NAP 115kV tap to Hydro One	123kV	123kV	120kV	120kV
NAP - Lac des Iles 115kV Bus	111kV	111kV	108kV	108kV

It is expected that the under-load tap-changers on the customer’s transformers at the Lac des Iles mine will be able to provide adequate compensation for these voltages, even under outage conditions, to permit normal operation at the mine.

**5. Motor Starting Voltage Profile**

The manufacturer of the 8500HP motors that North American Palladium is planning to install at their Lac des Iles mine has indicated that the motors can be started at voltages as low as 60% of nominal.

For the system conditions that were considered, the studies show that the minimum voltages that are expected to occur will be well in excess of this limiting value.

However, North American Palladium has indicated that they expect problems with their contactors ‘dropping-out’ at voltage declines of around 28%, and that they also anticipate problems with the lighting at the mine site for voltage declines of between 24% and 25%.

The following Table shows the expected voltages for various operating conditions, immediately prior to starting the first 8500HP motor, and also upon start-up of the first motor.

For the pre-start-up condition a nominal load of 1MW has been assumed on each of the LV busbars at the Lac des Iles facility. During start-up the tap-changers on the step-down transformers were assumed to be 'locked'.

*Voltage Profiles upon start-up of the first 8500HP motor at the Lac des Iles Mine*

*Table 3: With the LV Busbars at the Lac des Iles Mine 'split'*

Bus Name	With all facilities in-service	Facilities out-of-service		
		Thunder Bay G2	Silver Falls GS	Thunder Bay G2 & Silver Falls GS
<b><i>Voltage Profile, with a nominal 1MW load on each LV busbar, prior to start-up of first 8500HP motor</i></b>				
Port Arthur 115kV A2 Bus	125kV	124kV	125kV	125kV
Hydro One tap to NAP	125kV	125kV	125kV	125kV
NAP - Lac des Iles 115kV Bus	125kV	125kV	125kV	125kV
NAP 4.16kV Bus A	4.4kV	4.38kV	4.4kV	4.39kV
NAP 4.16kV Bus B	4.4kV	4.38kV	4.4kV	4.39kV
<b><i>Voltage Profile upon start-up of the first 8500HP motor on LV Bus A, with a 1MW load on each LV busbar (No ULTC action occurs)</i></b>				
Port Arthur 115kV A2 Bus	124kV	124kV	124kV	124kV
	-1%	0%	-1%	-1%
Hydro One tap to NAP	121kV	121kV	117kV	117kV
	-3.2%	-3.2%	-6.4%	-6.4%
NAP 115kV Bus	108kV	108kV	102kV	102kV
	-13.6%	-13.6%	-18.4%	-18.4%
NAP 4.16kV Bus 1	3.03kV	3.02kV	2.78kV	2.76kV
	-31.1%	-31.1%	-36.8%	-37.1%
NAP 4.16kV Bus 2	3.78kV	3.77kV	3.59kV	3.57kV
	-14.1%	-13.9%	-18.4%	-18.7%

With the LV busbars operated 'split' the voltage declines on the LV busbar, to which the motor that is being started is connected, clearly exceed the 28% limit for the contactors as well as the 25% limit for the lighting.

North American Palladium has determined that the fault interrupting capability of the switchgear at the Lac des Iles mine site will be adequate for the situation with the LV busbars 'commoned' and with only a single 8500HP motor in-service. North American Palladium therefore requested that the studies be repeated with the LV busbars 'commoned' and with an initial load of 3.5MW at a power factor of 0.83. The results from the repeated studies are summarised in the Table below.

Table 4: With the LV Busbars at the Lac des Iles Mine ‘commoned’

Bus Name	With all facilities in-service	Facilities out-of-service	
		Thunder Bay G2	Silver Falls GS
<b>Voltage Profile, with a 3.5MW (0.83pf) load on the common LV busbar, prior to start-up of first 8500HP motor</b>			
Port Arthur 115kV A2 Bus	124.7kV	124.4kV	124.8kV
Hydro One tap to NAP	125.0kV	124.9kV	124.9kV
NAP - Lac des Iles 115kV Bus	123.9kV	123.8kV	123.8kV
NAP 4.16kV Bus ( <i>commoned</i> )	4.36kV	4.42kV	4.41kV
<b>Voltage Profile upon start-up of the first 8500HP motor, with a 3.5MW (0.83 pf) load on the LV busbar (No ULTC action occurs)</b>			
Port Arthur 115kV A2 Bus	124.4kV	124.1kV	124.1kV
	-0.2%	-0.3%	-0.5%
Hydro One tap to NAP	121.3kV	121.1kV	117.5kV
	-3.0%	-3.0%	-5.9%
NAP - Lac des Iles 115kV Bus	108.3kV	108.1kV	103.8kV
	-12.6%	-12.6%	-16.2%
NAP 4.16kV Bus	3.54kV	3.53kV	3.35kV
	-19.0%	-20.1%	-24.0%

Although these results show an improvement of between 0.5kV & 0.57kV in the minimum voltage on the LV busbar, this would still represent a voltage decline of 24.0% upon start-up of the first 8500HP motor whenever Silver Falls GS is out-of-service. It is understood that this decline would be at the limit for maintaining the on-site lighting in-service.

However, while the proposed solution involving connecting both step-down transformers in parallel prior to the starting the first 8500HP motor would help reduce the voltage decline, this reduced voltage would now be imposed on *all* the equipment that is connected to the common LV busbar.

With *all facilities in-service* the maximum voltage decline on the ‘common’ LV busbar would improve to 19.0%, which is understood to be acceptable to North American Palladium. With unit G2 at Thunder Bay GS out-of-service, the maximum voltage decline would be expected to increase to 20.0%, indicating that the presence of this generating unit has little impact due to its remoteness from the tapping point of circuit S1C.

These results also confirm the importance of Silver Falls GS to the starting performance of the motors at the Lac des Iles mine.

*Impact on other customers in the area*

The results show that the affect on other customers in the area of starting the first 8500HP motor at the mine site is expected to be minimal and within the range of normal voltage variations that could be experienced on the system -

- At Port Arthur No. 1 TS, a maximum voltage decline of 0.5%, and
- At Silver Falls GS, with the single generating unit at that location in-service, a voltage decline of 3.0%. This would be expected to increase to 5.9% whenever the first motor is started while the single generating unit is out-of-service. Although this exceeds the normal 4% guideline it is unlikely to be an issue since the generating unit will not be operating.

## **6. *Equipment Ratings***

The ampacity rating of all the Hydro One facilities associated with the supply to the Lac des Iles mine were found to be adequate for the increase load, for all the operating conditions that have been examined.

## **7. *Assessment of the Impact on the IMO-controlled grid***

The result of the Preliminary Assessment study show that the existing transmission facilities would be adequate for the proposed increase in the load at the Lac des Iles mine to 32MW.

Furthermore, although there is expected to be a significant voltage drop at the Lac des Iles facility during start-up of the first 8500HP motor, particularly under outage conditions involving the single unit at Silver Falls, this is not expected to have any adverse impact on other customers within the area.

## **8. *System Impact Assessment***

This Preliminary Assessment has concluded that no further analysis is required for this Project and it is therefore recommended that the System Impact assessment be foregone.

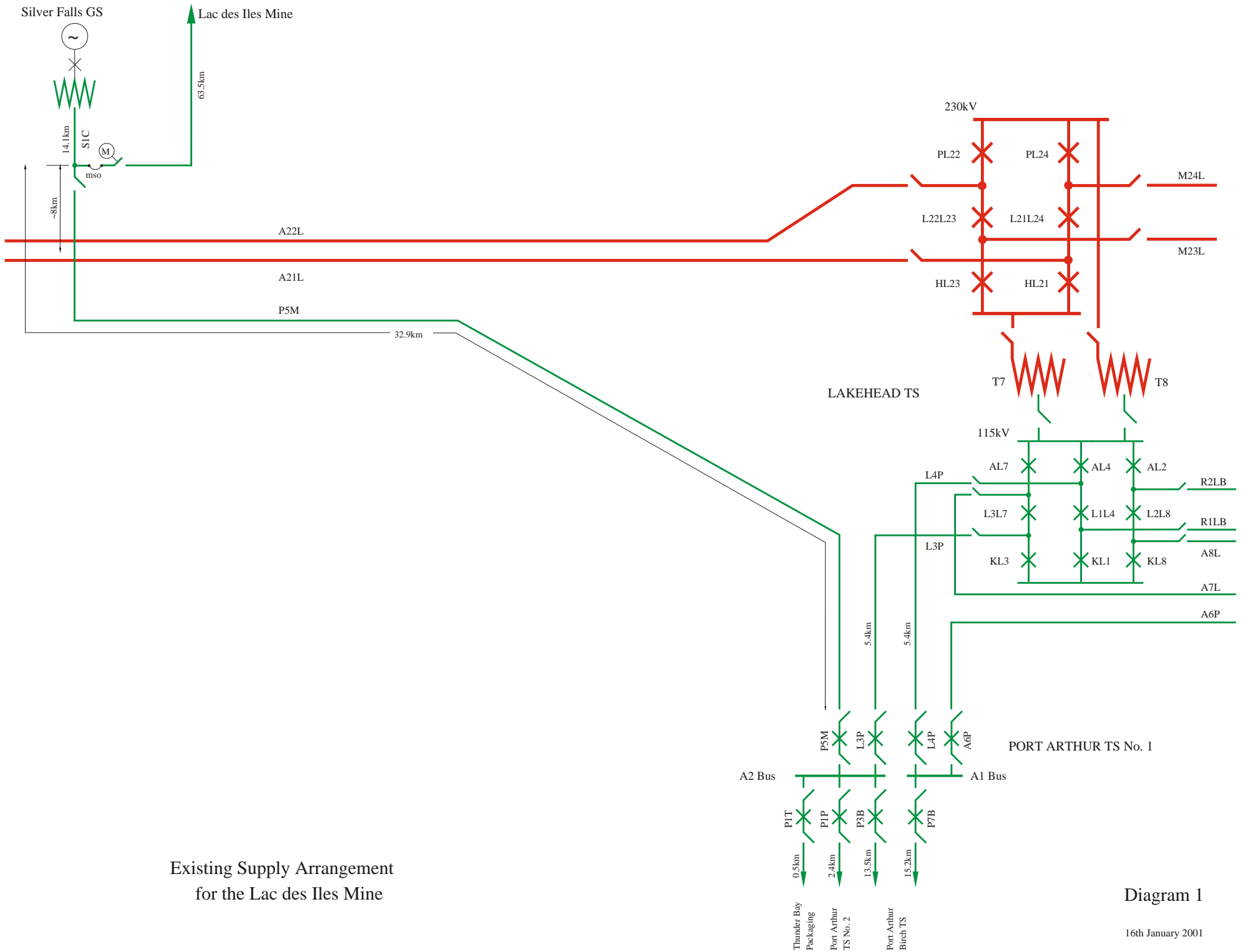
## **9. *'Enhanced' Supply Arrangement***

While North American Palladium has determined that they will be able to operate at the voltage levels indicated in this Preliminary Assessment whenever Silver Falls GS in-service, they have concerns regarding the situation should the single generating unit at that location be out-of-service. In order to avoid any dependence on the operational status of Silver Falls GS, they are considering a separate connection arrangement that would provide an enhanced supply capability to the Lac des Iles mine site from the 230kV system.

This will be the subject of a separate Connection Application.

## **10. *Notification of Approval of the Connection Proposal***

Based on the results of this Assessment it is recommended that this Project should receive a *Notification of Approval of the Connection Proposal*.



Existing Supply Arrangement  
for the Lac des Iles Mine

Diagram 1

16th January 2001

# Lac des Iles Mine

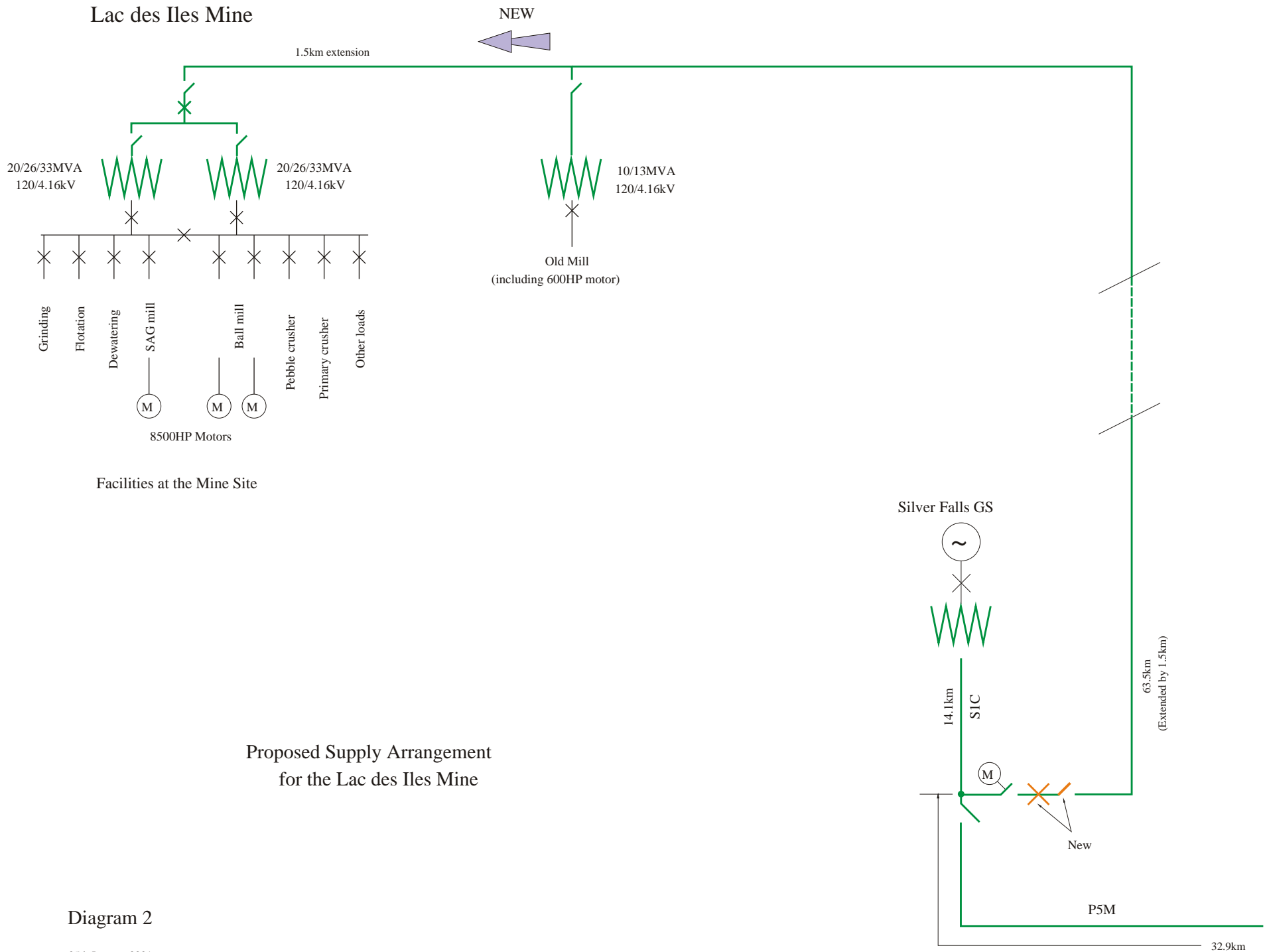


Diagram 2