



CONNECTION ASSESSMENT & APPROVAL PROCESS

ASSESSMENT SUMMARY

Applicant: Hydro One Networks Inc.

*Project: Porcupine TS:
500kV & 115kV Switchyards:
Replace the existing Air-blast Circuit Breakers with SF₆ Units*

CAA ID No. 2004-EX204

***Long Term Forecasts & Assessments Department
Consistent Information Set Department***

*Date: 12th October 2004
Revised: 23rd February 2005*

ASSESSMENT SUMMARY

HYDRO ONE NETWORKS Inc.

Porcupine TS: Replace the existing 500kV & 115kV Air-blast Circuit Breakers with SF₆ Units

1.0 GENERAL DESCRIPTION

Due to concerns regarding the continued reliability of the air-blast circuit breakers (ABCB) that are presently in-service on the system, resulting from their advanced age and obsolescence, as well as the high maintenance costs associated with both the breakers and their ancillary systems, Hydro One has developed a strategy to phase-out this equipment.

The 500kV circuit breakers at Porcupine TS, because of their critical importance to the system, are to be the first breakers to be replaced under the ABCB Phase-out Program.

However, because it is expected to be extremely difficult to schedule all of the required outages with the existing three-breaker arrangement, and also recognising that the present arrangement can result in the loss of the entire 500kV connection north of Hanmer TS due to a breaker failure condition, Hydro One has therefore decided to undertake the following work at Porcupine TS:

- Replace the existing 500kV motorised disconnect switch, H1-H2, with a new 500kV SF₆ breaker, together with two new motorised breaker disconnect switches.

This work is to be completed before the work to replace any of the existing ABCBs is started.

- Replace the existing 500kV ABCBs with new SF₆ units.

This is to include the modification of the existing connections within the 500kV switchyard so that the 500kV circuits P502X & D501P would no longer be terminated on to adjacent positions.

- Refurbish the following 500kV motorised disconnect switches:

- T7-H1 500/230kV auto-transformer T7 - HV Disconnect Switch
- T8-H2 500/230kV auto-transformer T8 - HV Disconnect Switch
- H2L501-H2 Breaker Disconnect Switch

Following the completion of this work in the 500kV switchyard, the four 115kV ABCBs are also to be replaced with SF₆ units.

Once all of the existing 500kV & 115kV ABCBs have been replaced, the existing air-compressors, air-storage receivers and associated facilities at Porcupine TS are to be removed.

Diagram 1 shows the existing facilities at Porcupine TS.

The existing 500kV switchyard consists of a ring busbar with three 500kV air-blast circuit breakers, together with a single 500kV motorised disconnect switch. The 115kV switchyard also consists of a ring busbar, equipped with four 115kV air-blast circuit breakers.

The scheduled completion date for the work at Porcupine TS is end-2005.

2.0 PROPOSED WORK

500kV switchyard

Diagram 2 shows the existing physical layout of the 500kV switchyard at Porcupine TS.

Diagram 3 shows the final arrangement of the 500kV switchyard once the fourth breaker has been installed and the existing breakers have been replaced. The corresponding Single-Line Diagram of the revised connection arrangement is shown in Diagram 4.

This would result in the terminations of the 500kV circuits alternating with those of the auto-transformers, around the ring busbar, thereby eliminating the risk with the present arrangement of losing both 500kV circuits due to a malfunction of the common 500kV ABCB L01L02.

Specification for the new 500kV circuit Breakers

Maximum operating voltage	550kV continuous
Basic Insulation Level	1800kV
Current Rating	2000A continuous
Rated interrupting capability	63kA
Rated Interrupting time	2 cycles (maximum)

115kV switchyard

The proposed replacement of the existing ABCBs with new SF₆ units will have no effect on the present configuration of the 115kV switchyard.

Specification for the new 115kV circuit breakers

Maximum operating voltage	135kV continuous
Basic Insulation Level	650kV
Current Rating	1600A continuous
Rated interrupting capability	50kA
Rated Interrupting time	3 cycles (maximum)

2.1 Associated Work

It is also planned to undertake the following work at Porcupine TS:

- **AC Station Service**

The main supply switchgear of ac Station Service is to be replaced.

- **DC Station Service**

Similarly, the main supply switchgear of the dc Station Service is to be replaced.

- **AC/DC Transfer Scheme**

The ac/dc transfer scheme is also to be replaced.

- **Relay Protection**

Changes to the relay protection will be necessary to account for the revised terminations at Porcupine TS and the modified protection zones.

- **NE LGR Scheme**

The 'contingency detection logic' for the North-east Load & Generation Rejection Scheme will need to be revised.

In addition, a new selection for initiating the tripping of circuit P91G in response to a D501P contingency will be required. This will then allow the 'Full' P91G Cross-Trip feature to be removed.

A set of revised Diagrams for the NE 115kV L/R & G/R Scheme have been produced to show these changes and they are attached. *To avoid confusion, the same numbers have been retained for these Diagrams as used in the Facilities Description Document for this SPS.*

- Diagram 1 NE 115kV L/R & G/R Scheme: Overview
- Diagram 1-A NE 115kV L/R & G/R Scheme: Facilities at Porcupine TS
- Diagram 3 Porcupine TS: Contingency Detection Logic

3.0 ASSESSMENT

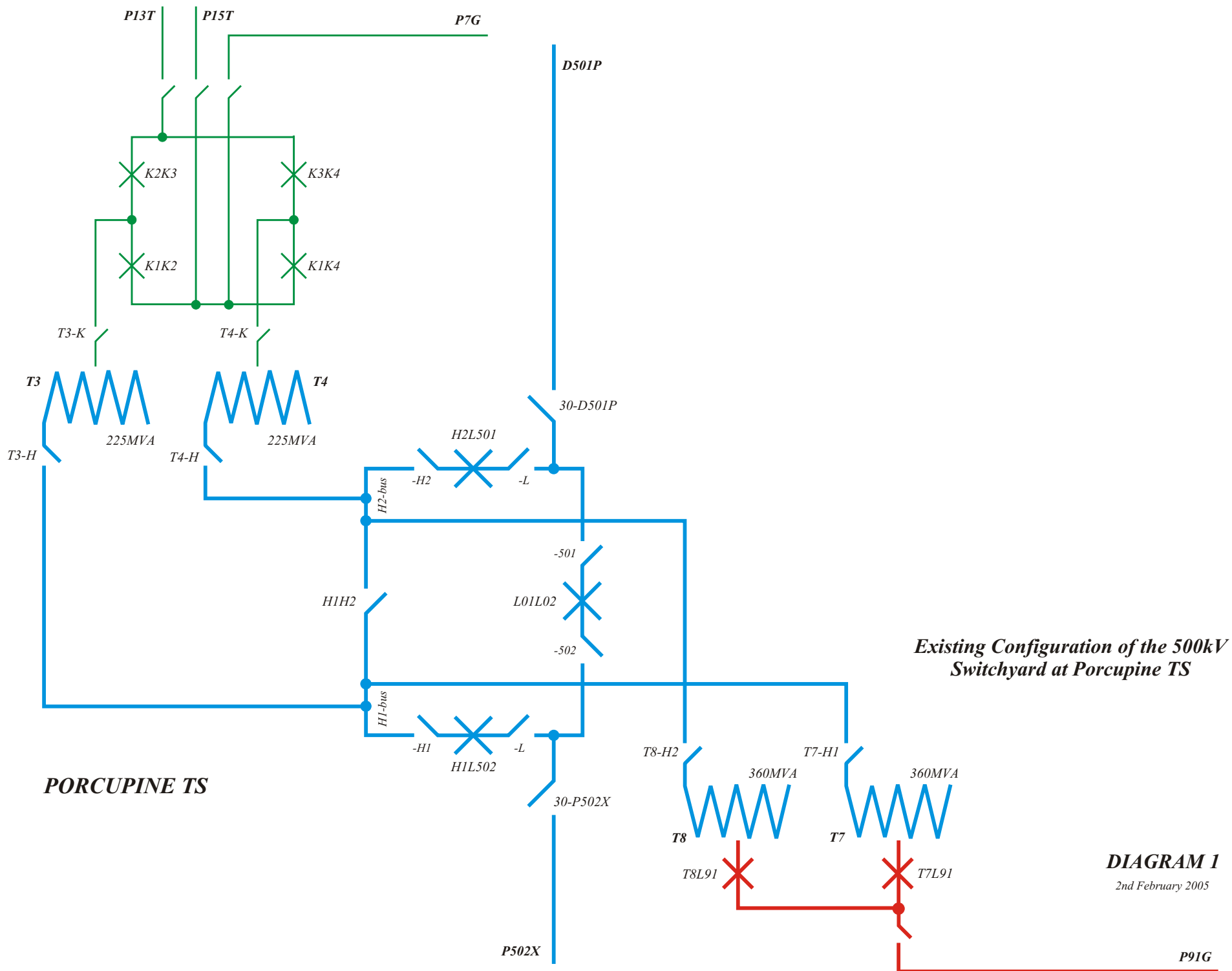
The installation of a fourth 500kV breaker, together with the replacement of the three existing 500kV breakers and the reconfiguration of the terminations at Porcupine TS, would have the following impact:

- It would eliminate the risk of losing both 500kV circuits due to a breaker failure condition.
- It would allow the 500kV ring busbar at Porcupine TS to be operated closed (the existing H1-H2 disconnect switch is operated normally-open). This would avoid the automatic loss of one 500/230kV and one 500/115kV auto-transformer in response to a 500kV contingency involving either of the 500kV circuits, P502X or D501P.
- It would significantly improve the operation of the system under outage conditions involving the 500kV breaker L01L02. With the present arrangement, this outage requires the H1-H2 disconnect switch to be operated closed, which results in all four auto-transformers at Porcupine TS being connected to a common busbar. A contingency involving one of these auto-transformers would effectively collapse the system in the north-east.
- There would also be benefits during outages involving the 500kV breakers H1L502 & H2L501, by allowing all four auto-transformers to remain in-service. With the present arrangement, either two of the auto-transformers have to be removed from service or the H1-H2 disconnect switch has to be operated closed with a resulting increase in the exposure.

The replacement of the four 115kV air-blast breakers with SF₆ units, since there will be no associated change in the configuration of the 115kV busbar, will have no adverse impact.

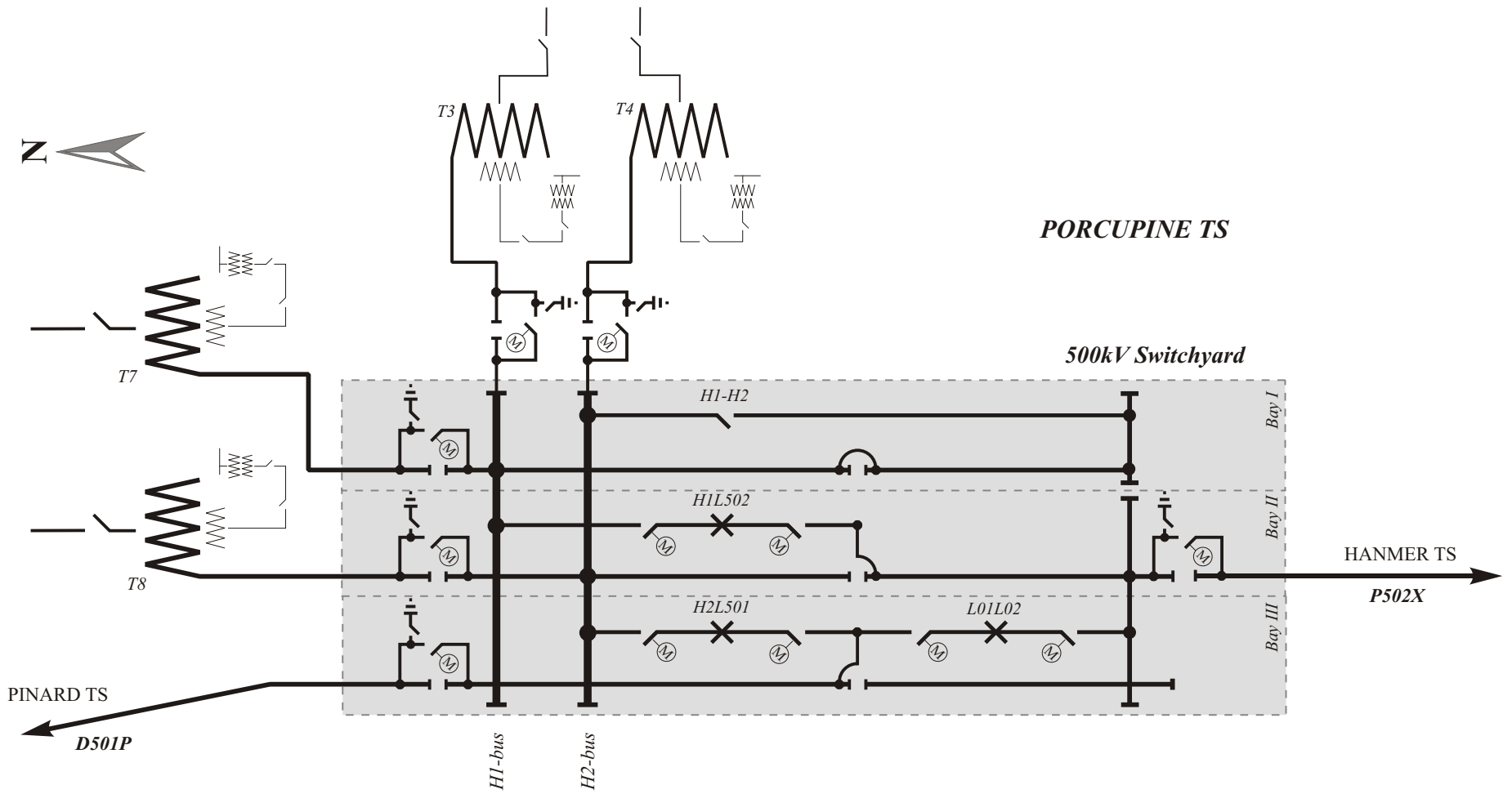
4.0 NOTIFICATION OF APPROVAL

Since the proposed work at Porcupine TS will have no adverse impact on the IMO-controlled grid, it is therefore recommended that a Notification of Approval of the Connection Proposal be issued.



Existing Configuration of the 500kV Switchyard at Porcupine TS

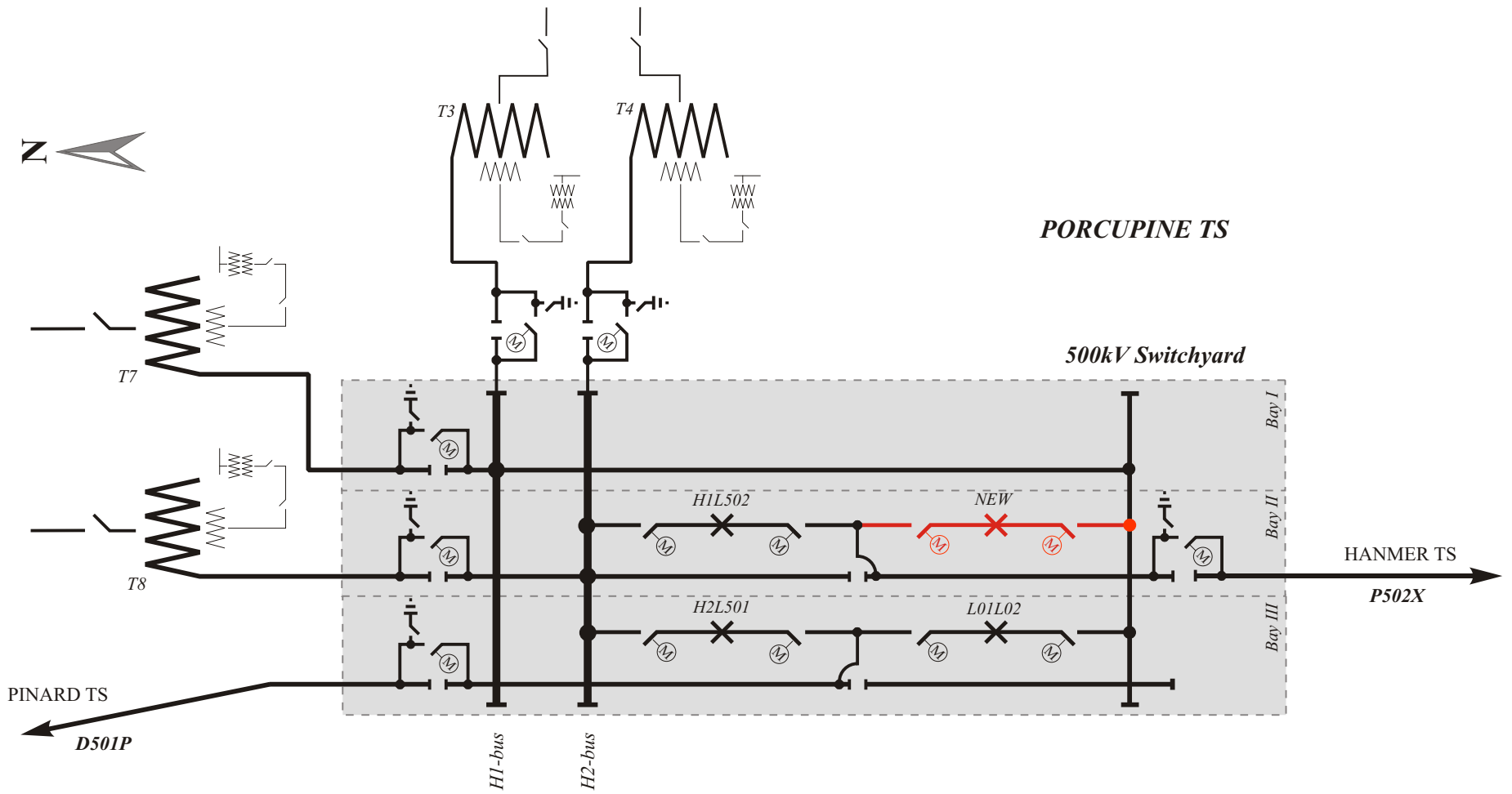
DIAGRAM 1
2nd February 2005



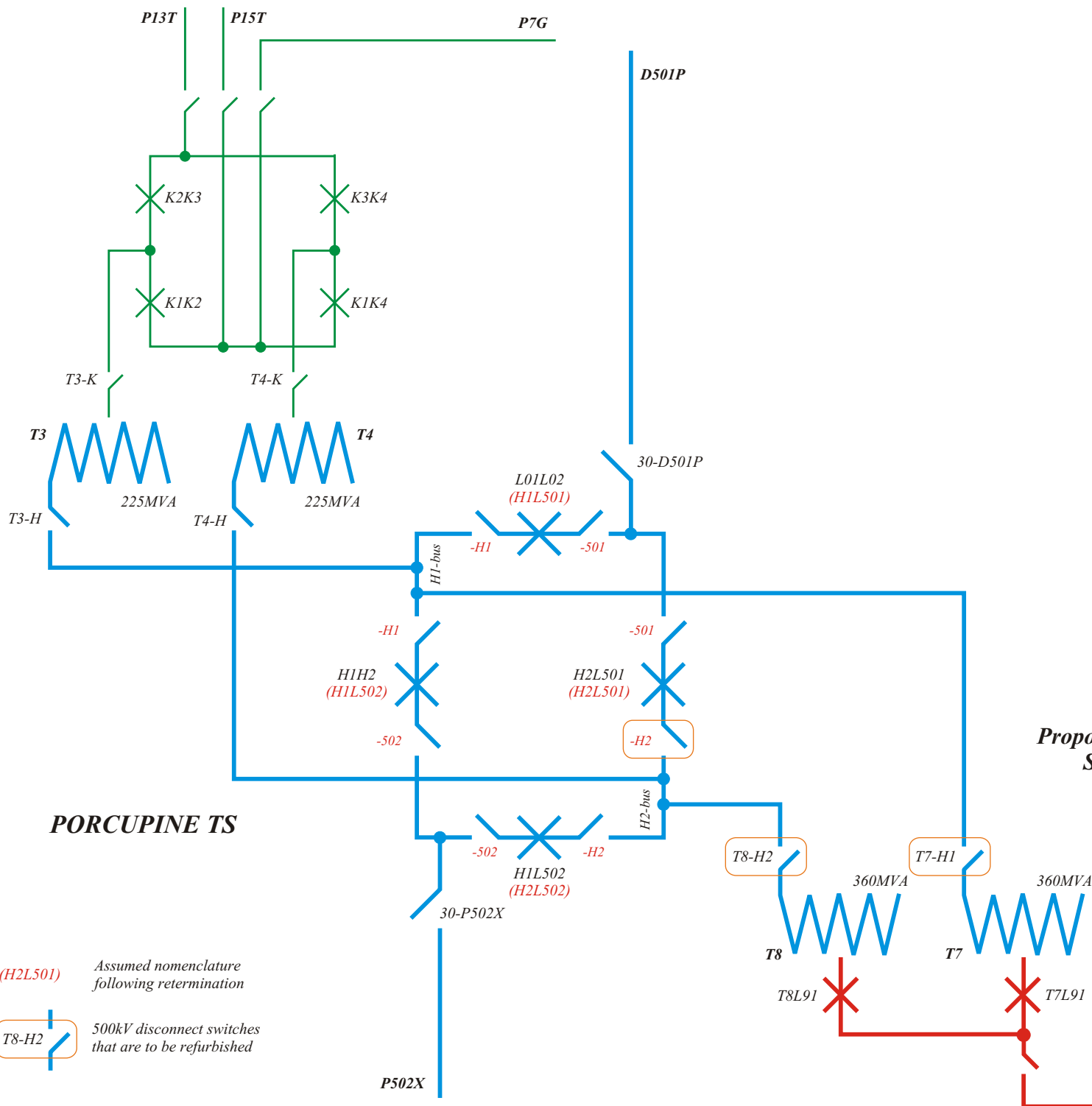
Existing 'Physical' Arrangement of the 500kV Switchyard at Porcupine TS

DIAGRAM 2

Revised: 3rd February 2005



Proposed 'Physical' Arrangement of the 500kV Switchyard at Porcupine TS

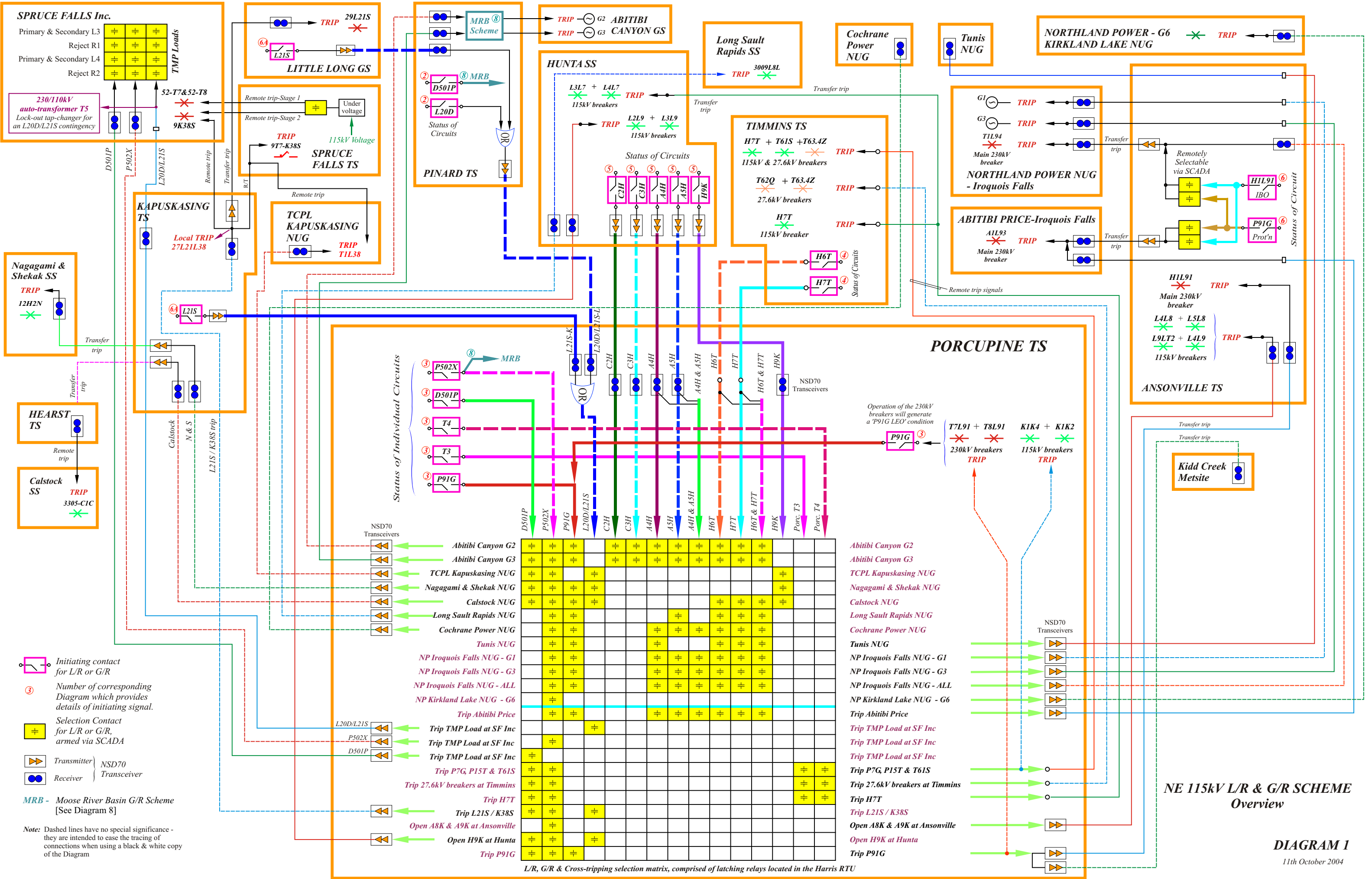


Proposed Configuration of the 500kV Switchyard at Porcupine TS

DIAGRAM 4

2nd February 2005

P91G



- Initiating contact for L/R or G/R
- Number of corresponding Diagram which provides details of initiating signal.
- Selection Contact for L/R or G/R, armed via SCADA
- Transmitter } NSD70 Transceiver
- Receiver }
- MRB** - Moose River Basin G/R Scheme [See Diagram 8]

Note: Dashed lines have no special significance - they are intended to ease the tracing of connections when using a black & white copy of the Diagram

Status of Individual Circuits

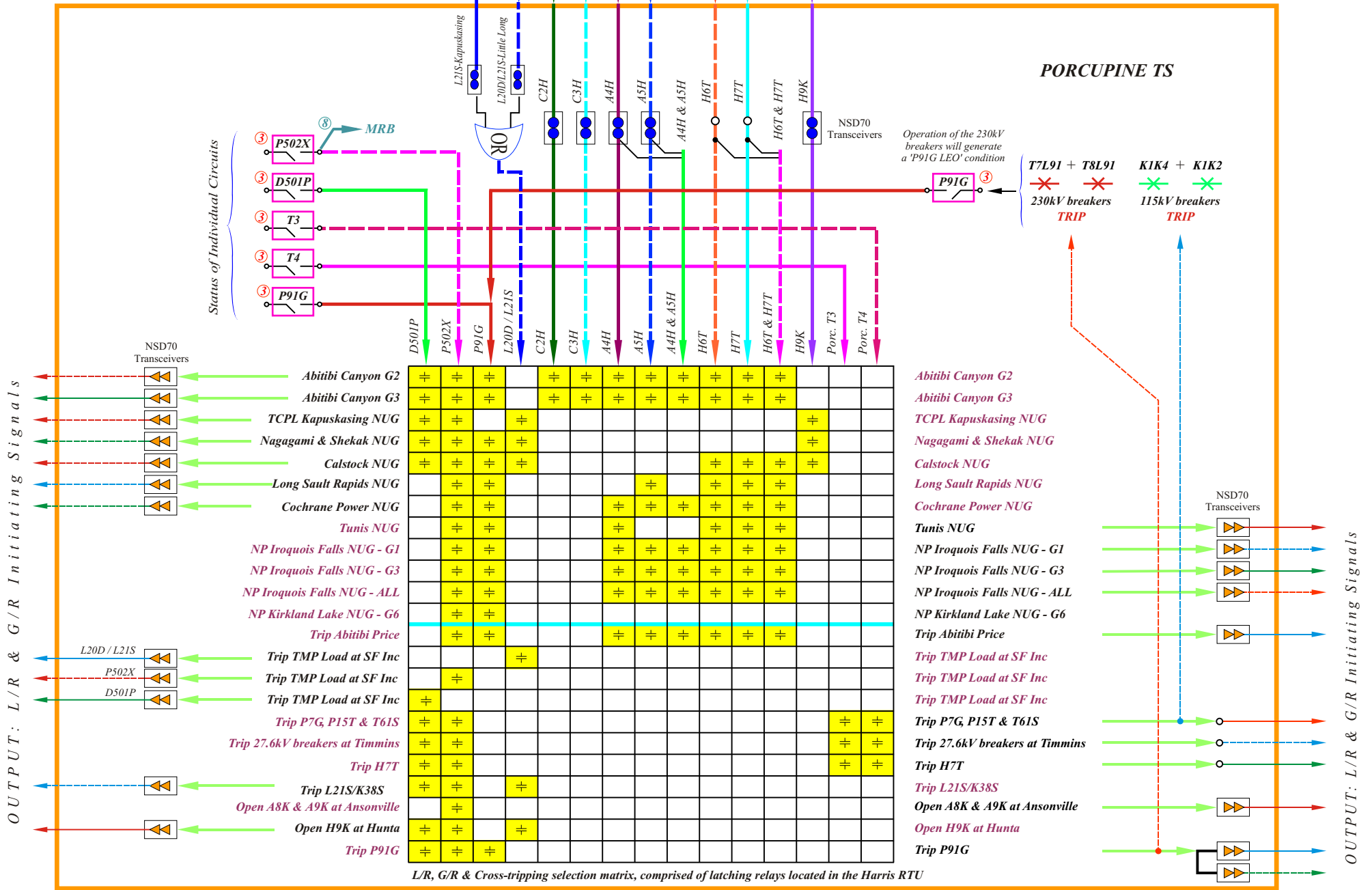
Abitibi Canyon G2	Abitibi Canyon G3	TCPL Kapuskasing NUG	Nagagami & Shekak NUG	Calstock NUG	Long Sault Rapids NUG	Cochrane Power NUG	Tunis NUG	NP Iroquois Falls NUG - G1	NP Iroquois Falls NUG - G3	NP Iroquois Falls NUG - ALL	NP Kirkland Lake NUG - G6	Trip Abitibi Price	Trip TMP Load at SF Inc	Trip TMP Load at SF Inc	Trip TMP Load at SF Inc	Trip P7G, P15T & T61S
																Trip 27.6kV breakers at Timmins
																Trip H7T
																Trip L21S / K38S
																Open A8K & A9K at Ansonville
																Open H9K at Hunta
																Trip P91G

L/R, G/R & Cross-tripping selection matrix, comprised of latching relays located in the Harris RTU

NE 115kV L/R & G/R SCHEME Overview

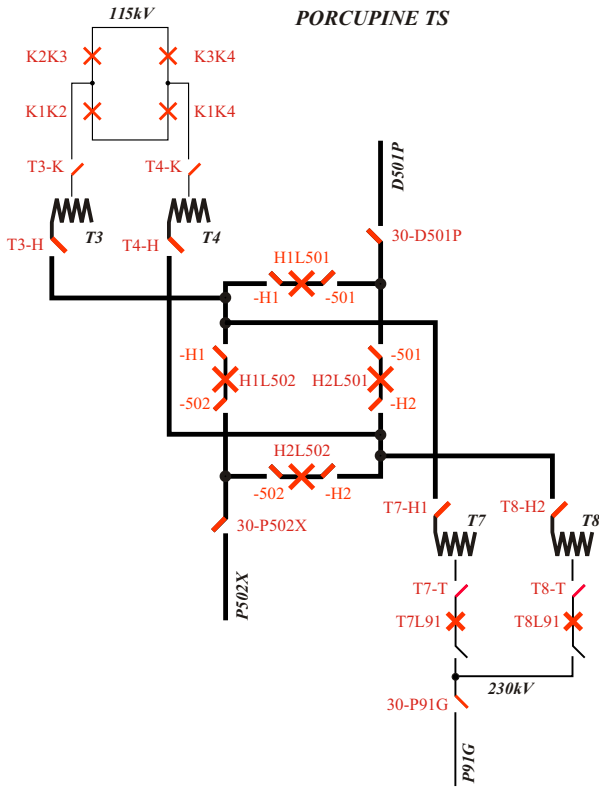
INPUT: CONTINGENCY SIGNALS

PORCUPINE TS

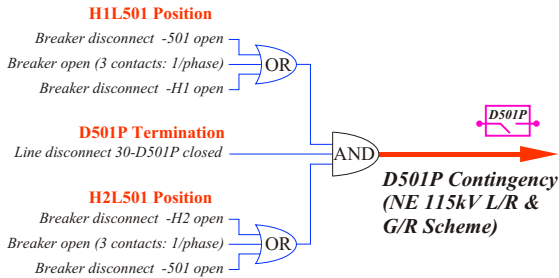


NE 115kV L/R & G/R SCHEME - Facilities at Porcupine TS

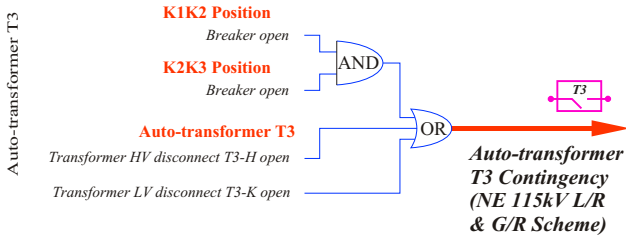
DIAGRAM 1-A



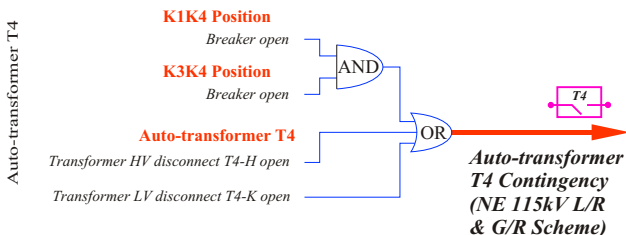
For a D501P Contingency



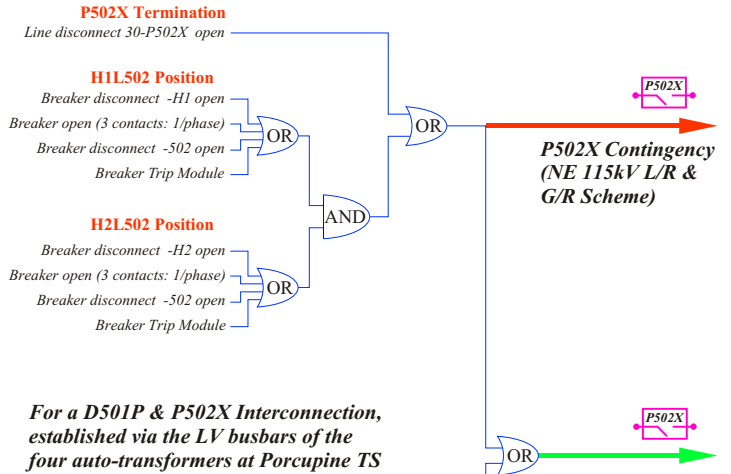
For an Auto-transformer T3 Contingency



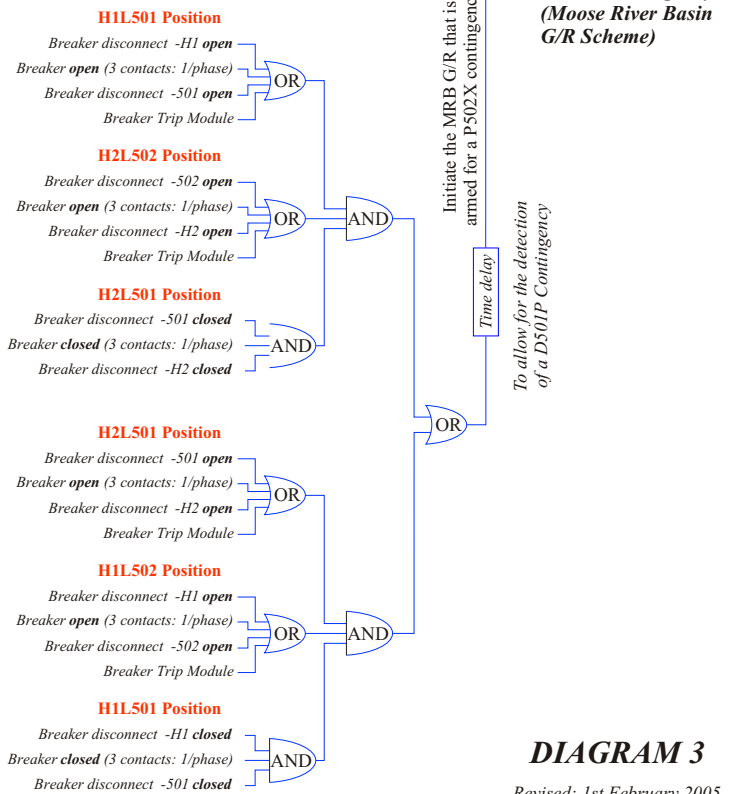
For an Auto-transformer T4 Contingency



For a P502X Contingency



For a D501P & P502X Interconnection, established via the LV busbars of the four auto-transformers at Porcupine TS



For a P91G Contingency

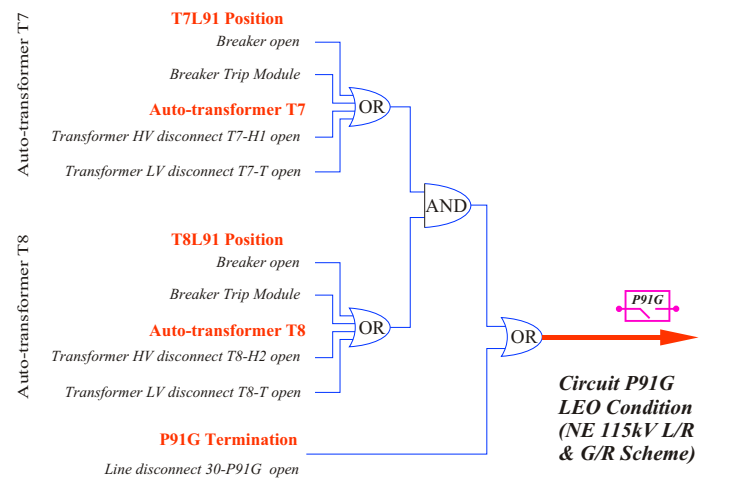


DIAGRAM 3
Revised: 1st February 2005