



# **CONNECTION ASSESSMENT & APPROVAL PROCESS**

## ***ASSESSMENT SUMMARY***

*Applicant: Hydro One Networks Inc.*

*Project: Installation of a new 125MVar 128kV Capacitor Bank  
at Leaside TS*

***CAA ID No. 2002-EX043***

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

*Date: 18<sup>th</sup> June 2002*

## **ASSESSMENT SUMMARY**

### **HYDRO ONE NETWORKS Inc.**

#### ***LEASIDE TS - Install New 125MVA<sub>r</sub> 128kV Capacitor Bank***

##### ***1.0 GENERAL DESCRIPTION***

The increasing load in the Leaside sector, together with the associated increase in the reactive power requirements of the area, will require additional shunt capacitors to be installed to maintain the present voltage levels.

Hydro One Networks Inc. is therefore proposing to install a 125MVA<sub>r</sub> 128kV shunt capacitor bank at Hearn TS followed by two identical banks at Leaside TS. The respective in-service dates for the new capacitor banks are as follows:

- Hearn TS - 125MVA<sub>r</sub> capacitor bank                      Scheduled in-service date: 1<sup>st</sup> May 2003
- Leaside TS - 1<sup>st</sup> 125MVA<sub>r</sub> capacitor bank              Scheduled in-service date: 1<sup>st</sup> May 2004
- Leaside TS - 2<sup>nd</sup> 125MVA<sub>r</sub> capacitor bank              Scheduled in-service date: 1<sup>st</sup> May 2006

Approval of the proposed 125MVA<sub>r</sub> capacitor bank at Hearn TGS was issued on 27<sup>th</sup> March 2002.

Hydro One is now seeking approval for the installation of the first of the two, 125MVA<sub>r</sub> capacitor banks that they are proposing to install at Leaside TS to complement the two, existing 96MVA<sub>r</sub> capacitor bank at that location.

##### ***2.0 PROPOSED FACILITIES***

The new capacitor bank, SC13, rated at 125MVA<sub>r</sub> 128kV is to be connected directly to the existing E-busbar at Leaside TS through two series-connected breakers as shown in Diagram 1.

To minimise the effect on local customers of switching the new capacitor bank into service, an independent pole operated breaker is to be used as the principal breaker on the new capacitor bank.

Hydro One is also proposing to equip the existing 96MVA<sub>r</sub> capacitor bank, SC11, with an identical IPO breaker at the same time that the new capacitor bank is installed. This would allow the existing, conventional SC11SC breaker to be used as the back-up breaker for the new capacitor bank, to complement its new IPO principal breaker.

Series reactors rated at 3.5mH are to be installed on the new capacitor bank to limit the out-rush current from the individual capacitor banks due to close-in faults at Leaside TS. These are to be installed between the disconnect switch and the back-up breaker, as shown in Diagram 2.

The existing SC11 capacitor bank is already equipped with 1.0mH series reactors. These are either to be replaced with new 3.5mH series reactors or additional, complementary 2.5mH reactors are to be installed to provide a combined reactance of 3.5mH. The preferred location for the new 2.5mH or the replacement 3.5mH series reactors is between the disconnect switch and the back-up breaker. However, should space constraints preclude their installation in this location, then the preferred alternative would be between the two breakers.

In the event that the series reactors cannot be located at either of the positions above, then they would need to be installed either between the IPO Breaker and the SC11 capacitor bank, or in its neutral connection.

Each capacitor bank is to be equipped with surge arresters and these are to be located between the IPO breaker and the actual capacitor bank.

The new capacitor bank is to be connected to the E-busbar through a motor-operated disconnect switch, as shown in Diagram 2.

### *Specifications*

- Capacitor Bank:

125MVA <sub>r</sub> ±5% at 128kV ±1kV	
Maximum operating voltage	128kV
Configuration	Double Y ungrounded - fuseless
Symmetrical short-circuit rating	63kA
Insulation level	550kV BIL

- Discharge Devices:

None required.  
 [Each capacitor unit is equipped with a 5-minute discharge resistor]

- Series Reactors:

Rating at 60Hz	3.5mH per phase <i>and</i> 2.5mH per phase, if the existing reactors are not to be replaced
Maximum operating voltage	127kV continuous 150kV for 5 minutes
Continuous current	625A rms
Symmetrical short-circuit rating	63kA for 12 cycles
Asymmetrical short-circuit rating	160kA peak
Insulation level	550kV BIL

- Circuit Breakers:

Type	SF <sub>6</sub> - Independent pole operation (IPO) equipped with control units for synchronised closing.
Maximum operating voltage	128kV continuous
Rated interrupting capability	63kA symmetrical
Rated interrupting time	3-cycles (maximum)
Insulation level	550kV BIL
TRV across pole	310kV peak

- Disconnect Switch:

Continuous current	625A (minimum)
Maximum operating voltage	127kV continuous 150kV for 5 minutes
Symmetrical short-circuit rating	63kA
Insulation level	550kV BIL

### 3.0 ASSESSMENT

The two existing 96MVAR capacitor banks are connected directly to the *J* and *P* 115kV busbars at Leaside TS. With the capacitor banks connected to these particular busbars, contingencies involving either of the 230kV circuits, C2L & C15L, or their associated transformers, T11 & T15, will result in the simultaneous loss of the associated capacitor bank. This means that at the very time voltage support could be required, one of the capacitor banks would be automatically removed from service.

The arrangement that Hydro One has proposed for the connection of their new 125MVAR capacitor bank would extend this situation so that contingencies involving the 230kV circuit-transformer combination, C3L/T12, would also result in a similar loss of reactive support.

At the request of the IMO, Hydro One has reviewed the following alternatives that are shown in Diagram 3, to determine whether they could be adopted to avoid this situation:

- Install an additional 115kV breaker at Leaside TS so that transformer T12 could then be reterminated on to the centre position on the JL14 diameter.

#### *Hydro One's Response*

While Hydro One acknowledges that this would be the preferred arrangement in terms of system reliability, it would be very expensive to implement. This arrangement would require both an additional 115kV breaker to be installed in the existing diameter at Leaside TS and the retermination of the auto-transformer to be made via a cable because of space constraints in the switchyard.

- Connect the new capacitor bank to the idle position between breakers L5L16 & KL5

#### *Hydro One's Response*

Although this would be a suitable position for connecting a capacitor bank, studies have confirmed that the first new capacitor bank needs to be installed on the other half of the Leaside busbar. Hydro One is therefore proposing to install the second 125MVAR capacitor bank (in 2006) in this position.

- Connect the new capacitor bank on to the same terminal point as the radial circuits L5D or L2Y

#### *Hydro One's Response*

Due to the age of the cables and the fact that the loads at Duplex TS (supplied via cable L5D) and Glengrove TS (supplied via cable L2Y) are not transferable, there are concerns that any over-voltages could damage the cables and would therefore result in an extensive supply interruption.

#### *Future Development Plans*

There are a number of proposals that the IMO has reviewed, or is in the process of reviewing, that could have an impact on the future status of the equipment installed at Leaside TS.

These Projects are as follows:

- The Hearn New Generation Project
- The Portlands Generation Project
- The 3<sup>rd</sup> Supply to Downtown Toronto Project

Should either the Hearn or the Portlands Project be developed, it is expected that a considerable number of the existing breakers at Leaside TS would need to be replaced because their fault interrupting capability would be inadequate. In addition, it is expected that some of the existing 115kV buswork at the station would also need to be replaced. During the course of completing this work there would be an opportunity to reconfigure the switchyard to eliminate recognised contingencies that result in the simultaneous loss of a capacitor bank with one of the 230/115kV auto-transformers at Leaside TS.

Similarly, if the 3<sup>rd</sup> Supply to Downtown Toronto were to be developed, then the amount of load to be supplied from Leaside TS would be reduced. This would result in a reduced need for reactive support at that busbar while also reducing the impact of losing a 230kV circuit together with its associated transformer and capacitor bank, simultaneously.

However, should there be a subsequent decision to operate with some of the existing 230kV circuits from Cherrywood TS normally-open at their Leaside terminals and to double-bank the affected auto-transformers, then this would require a review of the transformer terminations and the location of the capacitor banks. Open-ending the 230kV circuits would be beneficial since not only would it reduce the fault levels at Leaside TS but it would also allow these radial circuits to be used to supply a greater proportion of the 230kV-connected load at the DESN stations on the Cherrywood TS to Leaside TS corridor. However, a 230kV line-contingency would then result in the loss of two auto-transformers. For this situation, the simultaneous loss of a capacitor bank may be unacceptable.

#### *IMO's Position*

Since there is considerable uncertainty regarding future changes that could possibly occur at Leaside TS, it is proposed to approve the connection of the new 125MVAR capacitor bank at Leaside TS on to the E-busbar, but for the IMO to reserve the right to review the connection arrangement at a future date once decisions have been made regarding enhancements to the supply to downtown Toronto.

This subsequent review could possibly coincide with Hydro One's application to install the second 125MVAR capacitor bank at Leaside TS.

#### *Voltage Change on Switching the Capacitor Bank*

Based on the fault level at Leaside TS, the voltage change upon switching a 125MVAR capacitor bank either in- or out-of-service is expected to be approximately 2%.

This would comply with the maximum limit of 4% for capacitor switching that is quoted in the Market Rules

#### *Auto-Reclosure*

All six of the 230kV circuits between Cherrywood TS and Leaside TS (C2L, C3L, C14L, C15L, C16L & C17L) are equipped with auto-reclosure from the Cherrywood TS end only, following a line fault.

Similarly, all six of the 115kV circuits between Leaside TS and Hearn TGS (H1L, H3L, H6LC, H7L, H8LC & H11L) are equipped for auto-reclosure from the Leaside TS end only, following a line fault.

There are no known problems associated with auto-reclosing any of these 230kV & 115kV circuits. Furthermore, the new capacitor bank at Leaside TGS is not expected to create any problems or affect the ability to deploy auto-reclosure on the 230kV & 115kV circuits in the Leaside sector.

#### ***4.0 CUSTOMER IMPACT ASSESSMENT***

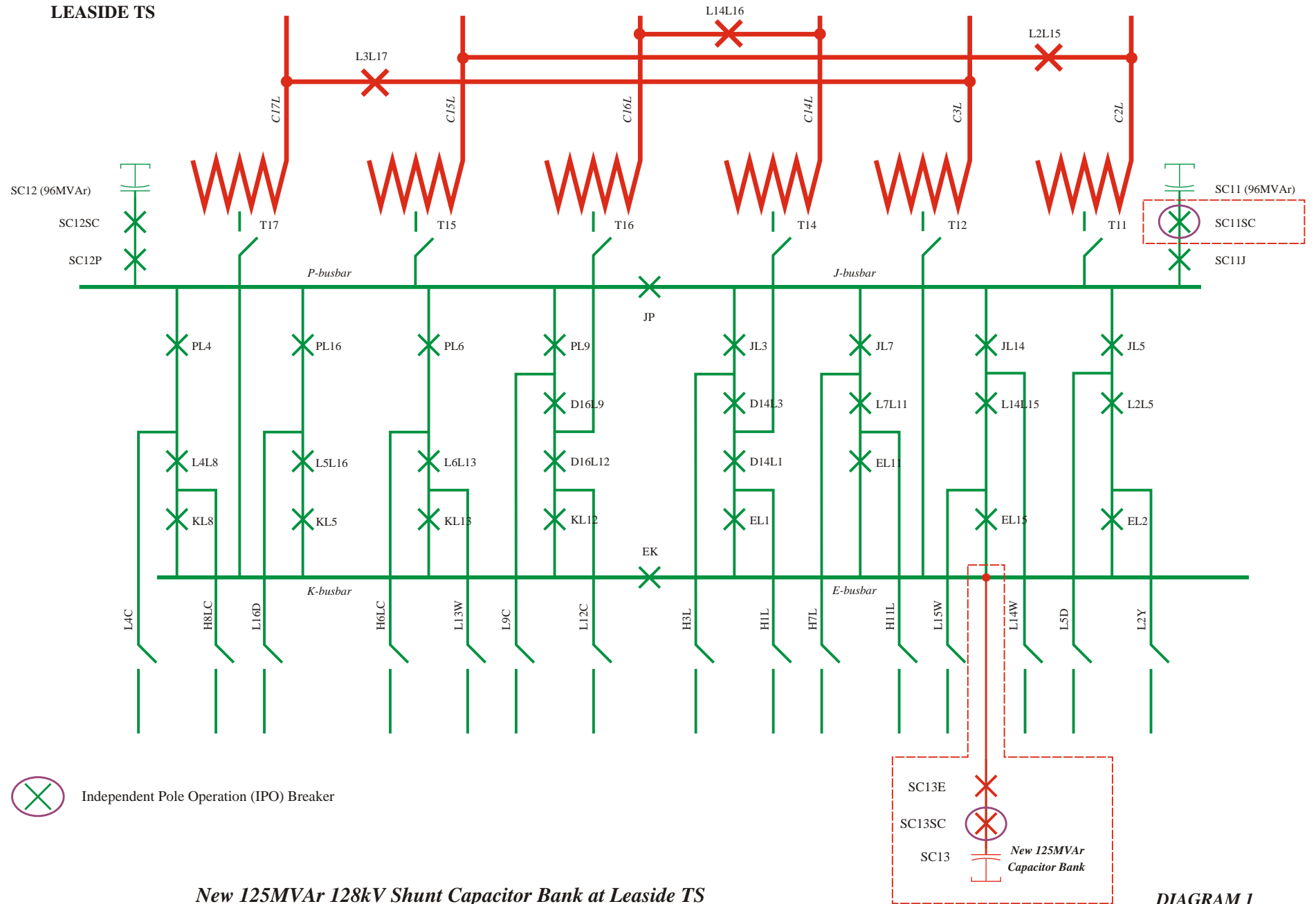
Hydro One has notified the IMO that a Customer Impact Assessment will not be required for this Project since the switching transients when the IPO breaker is used to switch the new capacitor bank into service will be less than those for the existing installations.

Furthermore, Hydro One has indicated that they are not aware of any customer concerns associated with the switching of either of the existing 96MVAR capacitor banks that is performed using conventional breakers.

#### ***5.0 NOTIFICATION OF APPROVAL***

It is therefore recommended that a Notification of Approval of the Connection Proposal be issued.

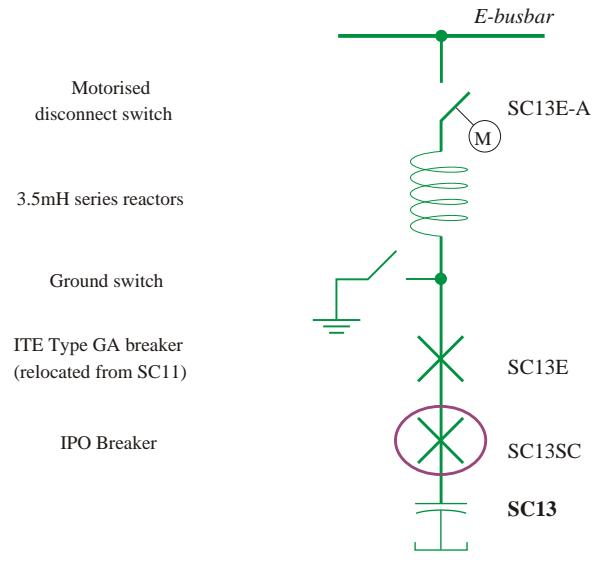
**LEASIDE TS**



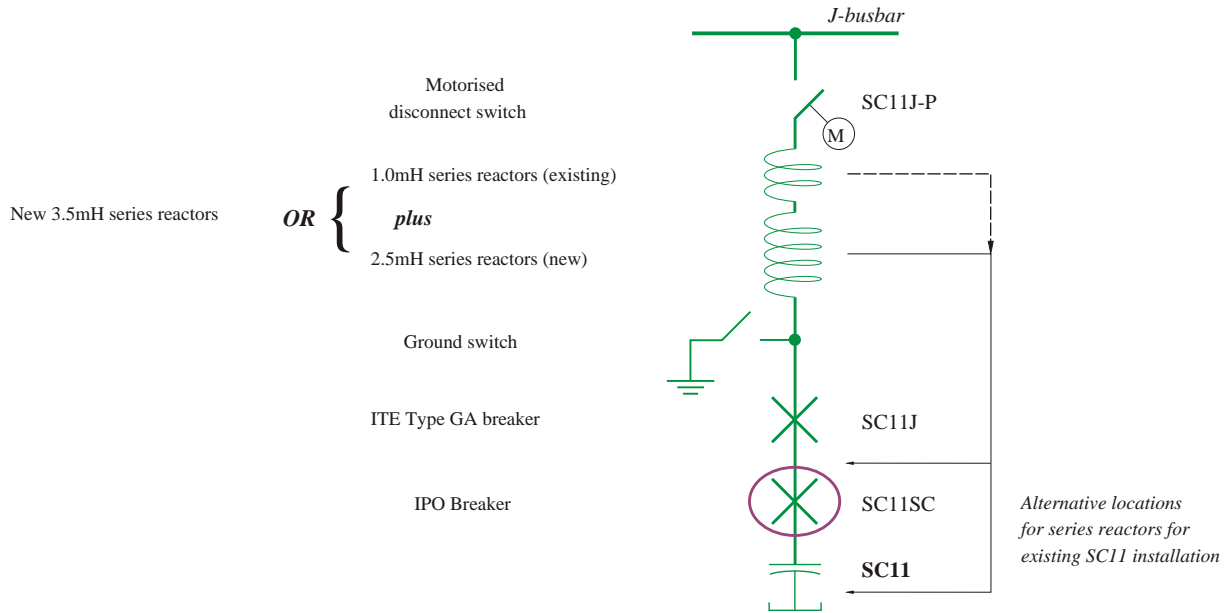
*New 125MVar 128kV Shunt Capacitor Bank at Leaside TS*

**DIAGRAM 1**

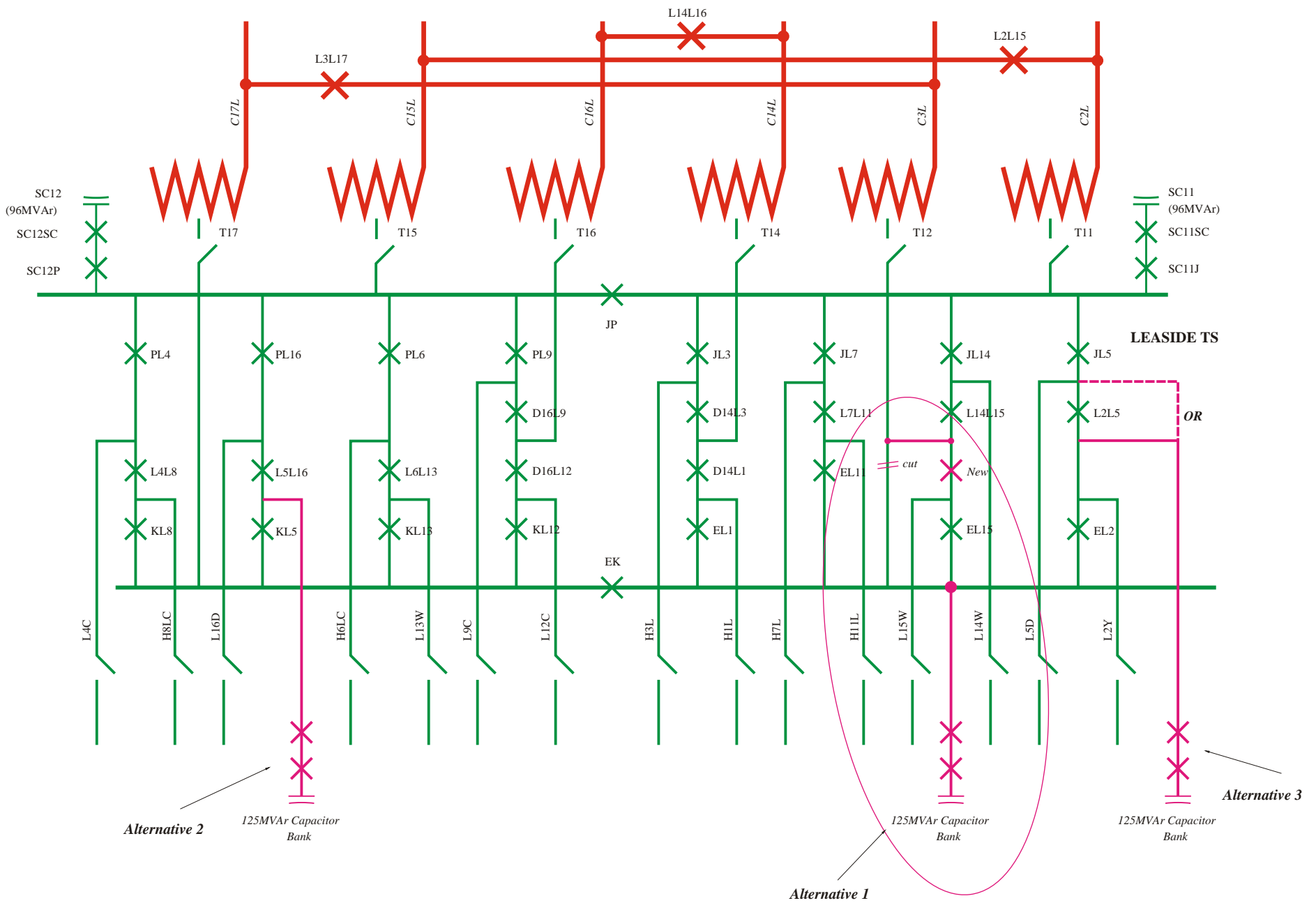
**New 125MVar Shunt Capacitor Bank Installation: SC13**



**Existing 96MVar Shunt Capacitor Bank Installation: SC11**



**DIAGRAM 2**



**DIAGRAM 3**

13th June 2002