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CONNECTION ASSESSMENT & APPROVAL PROCESS

ASSESSMENT SUMMARY

Applicant: Hydro One Networks Inc.

Project: Essex TS:
Enhance the Existing Windsor Area SPS
Interchange the 115kV Circuits Z7E & E8F at Essex TS
Replace the Existing 115/27.6kV DESN Station at Essex TS

CAA ID No. 2005-EX228

Transmission Assessments & Performance Department

Date: 18th April 2006

HYDRO ONE NETWORKS Inc.:

Replace the Existing 115/27.6kV DESN Station & Modify the 115kV Terminations at Essex TS

ASSESSMENT SUMMARY

1. Introduction

Originally four 115/27.6kV step-down transformers were used to supply the load at Essex TS. However, two of these transformers have since failed and been removed from site: one in 2001 and the other in 2003. The remaining two transformers are more than 50 years old and are considered to have reached their end-of-life.

Hydro One is therefore planning to construct a new DESN station with higher rated transformers to enhance the supply capability of the station.

In addition Hydro One is planning to interchange the terminations of the 115kV circuits Z7E and E8F at Essex TS to provide greater flexibility for splitting the Essex 115kV busbar in response to system contingencies.

The revision of the existing modes for splitting the Essex busbar will involve some related modifications to the existing Windsor Area Special Protection System (SPS). This has provided the opportunity to include some additional enhancements to the Scheme that have been requested by the IESO to address a number of critical operational issues until further reinforcement of the system in the area can be completed.

The scheduled completion dates for the proposed work are as follows:

- | | |
|---|----------------|
| • The enhancements to the Windsor Area SPS | December 2006 |
| • The interchange of the 115kV circuits Z7E & E8F at Essex TS | December 2006 |
| • The replacement of the DESN Station at Essex TS | September 2007 |

2. New 115/27.6kV DESN Station

Diagram 1 shows the arrangement of the existing DESN Station at Essex TS. This is equipped with two 25/41MVA step-down transformers; four 27.6kV feeder positions; and two 21.6MVAr 27.6kV switched shunt capacitor banks.

Although not shown on this Diagram, significant portions of the original Station have been decommissioned but have not been removed. In addition, some of the facilities that remain in-service are due for either replacement or refurbishment.

In recognition of the condition of the existing facilities and to meet EnWin Powerlines requirement for an increase in capacity, Hydro One has decided to construct a new DESN Station to replace the existing Station.

Diagram 2 shows the proposed arrangement for the new Station. This is to be equipped with two 50/66.7/83.3MVA 115/27.6kV step-down transformers; with six 27.6kV feeder positions; and two positions for the 21.6MVAr 27.6kV shunt capacitor banks that are to be relocated from the existing Station.

The new DESN station is also to be equipped with facilities to provide the same capabilities as exist at the present Essex DESN station for under-frequency load rejection; remote initiation of separate voltage reductions of 3% & 5%; and monitoring in accordance with the requirements specified in Appendices 4.16 & 4.17 of the Market Rules.

The protective relaying for the new DESN station is to be functionally identical to that which is presently in use at the existing DESN station.

3. *Retermination of the 115kV Circuits Z7E & E8F*

Diagram 3 shows the existing termination arrangement of the 115kV circuits at Essex TS. Circuits J3E & J4E from Keith TS occupy adjacent positions on the 115kV busbar, while circuits Z1E & Z7E are separated by the termination of circuit E8F.

In response to contingency conditions affecting selected 230kV and 115kV circuits, as well as the 230/115kV auto-transformers within the area, the existing Windsor Area SPS can be used to initiate splitting of the 115kV busbar at Essex TS. The primary objective of this splitting is to interrupt the direct 115kV connection between Keith TS and Lauzon TS, thereby reducing the risk of overloading the existing 115kV facilities.

As shown in Diagram 4, there are presently two Modes available for splitting the 115kV busbar at Essex:

- *A Mode 1 Split* Which disconnects circuits Z1E & Z7E from the Essex 115kV busbar and leaves all of the Essex TS load together with all of the load at the Automotive Plants to be supplied solely from **Keith TS**.
- *A Mode 2 Split* Which disconnects circuits J3E & J4E from the Essex 115kV busbar and leaves the same load as above to be supplied solely from **Lauzon TS**.

The combined load at Essex TS and at the Automotive Plants can exceed 160MW. Transferring this amount of load to either Keith TS or Lauzon TS and adding it to the other loads that are supplied exclusively from either of these sources would be expected to result in the supply capabilities of the recipient source being exceeded.

In addition, as shown in Diagram 5, a Mode 1 split would not be a viable option for a J3E contingency, nor would it be the preferred choice for a J4E contingency. The response to a J3E contingency, which would interrupt the entire load at Essex TS and at the Automotive Plants, is shown in the upper half of the Diagram. The response to a J4E contingency, which would result in the combined load at Essex TS and at the Automotive Plants being supplied solely from circuit J3E is shown in the lower half of this Diagram.

The IESO had therefore requested Hydro One to consider including the modification of the 115kV terminations for circuits Z7E and E8F in the work that they were planning to undertake for the new DESN Station at Essex TS. By interchanging the terminations of these two circuits, different options for splitting the busbar at Essex TS would become available.

Diagram 6 shows the configuration of Essex TS following the interchange of circuits Z7E and E8F, while Diagram 7 shows the following two Modes for splitting the Essex 115kV busbar:

- *A Mode A Split* Which would result in the entire load at the **Automotive Plants** being supplied from **Keith TS**, and
- *A Mode AE Split* Which would result in the combined load at the **Automotive Plants** and at **Essex TS** being supplied from **Keith TS**.

For both Modes, since the same two 115kV breakers would be tripped, the only difference between the two Modes would be the particular 27.6kV breaker at Essex TS that is selected for tripping. This results in a much simpler response, no 115kV circuits and only one of the step-down transformers at Essex TS being isolated as a result of the busbar splitting.

The following Table summarises the selections that would be available in response to specific contingencies, and the resulting load distribution. It has been assumed that under peak load conditions, the combined load at the Automotive Plants and at Essex TS would be beyond the capability of one of the JxE circuits. Hence, the AE Mode has not been included in the Table for a JxE contingency. However, during periods of light load this Mode would remain a viable alternative.

<i>Response to the Splitting of the 115kV Busbar at Essex TS</i>			
<i>Contingency</i>	<i>Mode Selected</i>	<i>Subsequent Source of Supply for the loads at Essex TS & at the Automotive Plants</i>	
		<i>Keith TS</i>	<i>Lauzon TS</i>
J3E	A	Automotive Plants load via circuit J4E	Essex TS load via circuits Z1E & Z7E
J4E	A	Automotive Plants load via circuit J3E	
Z1E	A	Automotive Plants load via circuits J3E & J4E	Essex TS load via circuit Z7E
	AE	Automotive Plants load & Essex TS load via circuits J3E & J4E	None
Z7E	AE	Automotive Plants load & Essex TS load via circuits J3E & J4E	None

4. Enhancements to the Windsor Area SPS

During the summer-2005, the IESO had experienced serious difficulties with managing the transmission system in the Windsor area. In particular, determining appropriate responses to possible system contingencies that would then allow re-preparation of the system, was found to be especially challenging. This was further complicated by the limited scope of the existing Modes for splitting the 115kV busbar at Essex TS.

Since changes will be required to the Windsor Area SPS to accommodate the two new Modes for splitting the 115kV busbar at Essex TS, the IESO had requested Hydro One to include further enhancements to the Scheme to address some of the operational issues that had arisen during the past summer.

Diagram 8 shows the present arrangement of the Windsor Area SPS, with monitoring of selected contingency conditions performed only at Keith TS and Essex TS. The responses that are available for those contingencies that are addressed by the existing Scheme are limited to rejection of the Brighton Beach Power generating units and/or splitting of the 115kV busbar at Essex TS.

Although not an integral part of the Windsor Area SPS, facilities are also available at Kingsville TS to initiate load-rejection for under-voltage conditions. While this feature remains armed for the majority of the time, there are concerns that the declines in the post-contingency voltages will not always be sufficient to initiate load rejection.

Diagrams 9 and 10 show the proposed enhancements to the Windsor Area SPS. Since this work is expected to be completed before the interchange of the terminations of the 115kV circuits Z7E & E8F and the associated introduction of the new Modes for splitting the 115kV busbar at Essex TS, Diagram 8 provides details of the interim arrangement.

Apart from the introduction of the two new Modes for splitting Essex TS, the principal changes to the Scheme are as follows:

- The addition of contingency monitoring at Lauzon TS.
- The enhancement of the facilities at Kingsville TS so that load rejection can be initiated in response to specific contingency conditions.

The existing under-voltage based facilities will be retained as back-up, although a capability to allow remote arming of this feature, via SCADA, is to be included.

- The addition of load rejection at the new Belle River TS, with provision for future load rejection at Tilbury West TS.

5. Windsor Area Loads experienced during the Summer-2005

During the last summer, the following coincident loads were recorded in the Windsor Area:

<i>Loadings Recorded on 27th June 2005</i>		
<i>On Circuits:</i>	<i>Supplying:</i>	<i>Combined Load</i>
Z1E & Z7E	Walker TS & Ford Engine Plant	197MW
K2Z & K6Z	Kingsville TS & Tilbury TS	179MW
E8F & E9F	Automotive Plants	94MW
	Essex TS	45MW
	<i>Sub-Total</i>	<i>515MW (~ 570MVA at 0.9 power factor)</i>
J3E & J4E	Crawford TS	95MW

6. Assessment

The two original Modes for splitting the 115kV busbar at Essex TS were established prior to the installation of the two 115kV cabled circuits, E8F & E9F, to supply the new loads at the Automotive Plants. In addition, the splitting of the 115kV busbar at Essex TS was originally initiated either by an overload of the 230/115kV auto-transformers at Keith TS or by overloading of the 115kV circuits Z1E & Z7E at Lauzon TS.

The incorporation of one of the three generating units of the Brighton Beach Project directly on to the 115kV busbar at Keith TS meant that monitoring the flows through the auto-transformers at Keith TS would no longer be sufficient to detect an overload condition involving the 115kV circuits J3E or J4E from Keith TS. Consequently, the Windsor Area SPS was changed from an overload-based design to a contingency-based one. The enhanced Scheme now allows splitting of the Essex 115kV busbar as well as rejection of the individual generating units at the Brighton Beach Project to be initiated in response to a range of specific contingency conditions.

However, with the increase in demand at Essex TS and at the Automotive Plants supplied from circuits E8F & E9F, the combined peak load would exceed the capability of a single Keith TS-to-Essex TS circuit. The summer ratings for circuits J3E & J4E are approximately 227MVA & 212MVA, respectively. However, from the Table above, the combined load to be supplied from Keith TS via the remaining 115kV circuit would total approximately 234MW (or 260MVA at 0.9 power factor).

For a contingency involving circuit J4E, a Mode 1 split of the Essex 115kV busbar would therefore require load to be interrupted so that the emergency rating of the companion circuit J3E could be respected. [As discussed in Section 3, the use of a Mode 1 Split for a J3E contingency would not be a viable option since it would result in an automatic supply interruption for the load at Essex TS and at the Automotive Plants.]

Similarly, if a Mode 2 split of the Essex 115kV busbar were to be used for either a J3E or a J4E contingency, then the load at Essex TS together with the entire load of the Automotive Plants on circuits E8F & E9F would be supplied via circuits Z1E & Z7E. As shown in the Table above, even with the transmission losses excluded this would result in a combined load of approximately 570MVA being imposed on the two auto-transformers at Lauzon TS. This would not only exceed the 10-day limited-time-rating of 526MVA for the two auto-transformers (based on the rating of the T2 unit), but it would also be well in excess of the 15-minute limited-time-rating of either 323MVA for the T2 unit or 359MVA for the T1 unit, with the companion auto-transformer out-of-service.

Since the existing Windsor Area SPS does not address a contingency involving either of the Lauzon auto-transformers (or to the individual 230kV circuits to which each auto-transformer is connected), a Mode 2 split of the Essex 115kV busbar during peak load periods would therefore require load to be interrupted in preparation for the next most-critical contingency.

The proposed interchange of the terminations of circuits Z7E & E8F at Essex TS and the introduction of the two new Modes for splitting the 115kV busbar will provide greater flexibility for responding to contingency conditions while avoiding possible overloads of system elements. In addition, the enhancement of the Windsor Area SPS to provide responses for additional contingency conditions will allow the system in the Windsor Area to be re-prepared for subsequent contingencies without the need to interrupt load.

Together, the proposed interchange of circuits Z7E & E8F; the introduction of new Modes for splitting the 115kV busbar at Essex TS; and the enhancement of the Windsor Area SPS are all intended to improve the operational flexibility of the transmission system in the Windsor area. No adverse impacts are expected as a consequence of implementing these changes.

The proposed replacement of the existing DESN station at Essex TS with a new facility will also be beneficial, particularly following the failure of two of the step-down transformers; one in 2001 and the other in 2003. Since the new DESN station is to be equipped with two 50/66.7/83.3MVA transformers it will therefore have essentially the same capacity as the original facility when all four 25/41MVA transformers were in operation.

However, while these changes to the system will ease many of the operational problems, they will not address the fundamental weakness of the 115kV system in the Windsor area which supplies a peak load of over 600MW via just four primary 115kV circuits: the two through circuits between Keith TS & Lauzon TS, via Essex TS; and the two radial circuits from Lauzon TS to Kingsville TS.

Following the incorporation of the 625MW Brighton Beach Project during 2004, the supply situation in the Windsor area has improved. However, the area is becoming increasingly dependent on the presence of this Project together with the 72MW TransAlta-Windsor Project and the 118MW West Windsor Power Project to ensure that the loadings on some of the more critical system elements remain within their ratings.

The IESO therefore has concerns regarding the effect that the non-availability of these Projects would have on supply reliability not only to the 600MW of 115kV-connected load, but also to the more than 400MW of load that is supplied from the 230kV facilities in the area. Any further increases in the load within the area will only aggravate an already difficult situation and limit the benefits expected from the proposed changes considered in this Assessment.

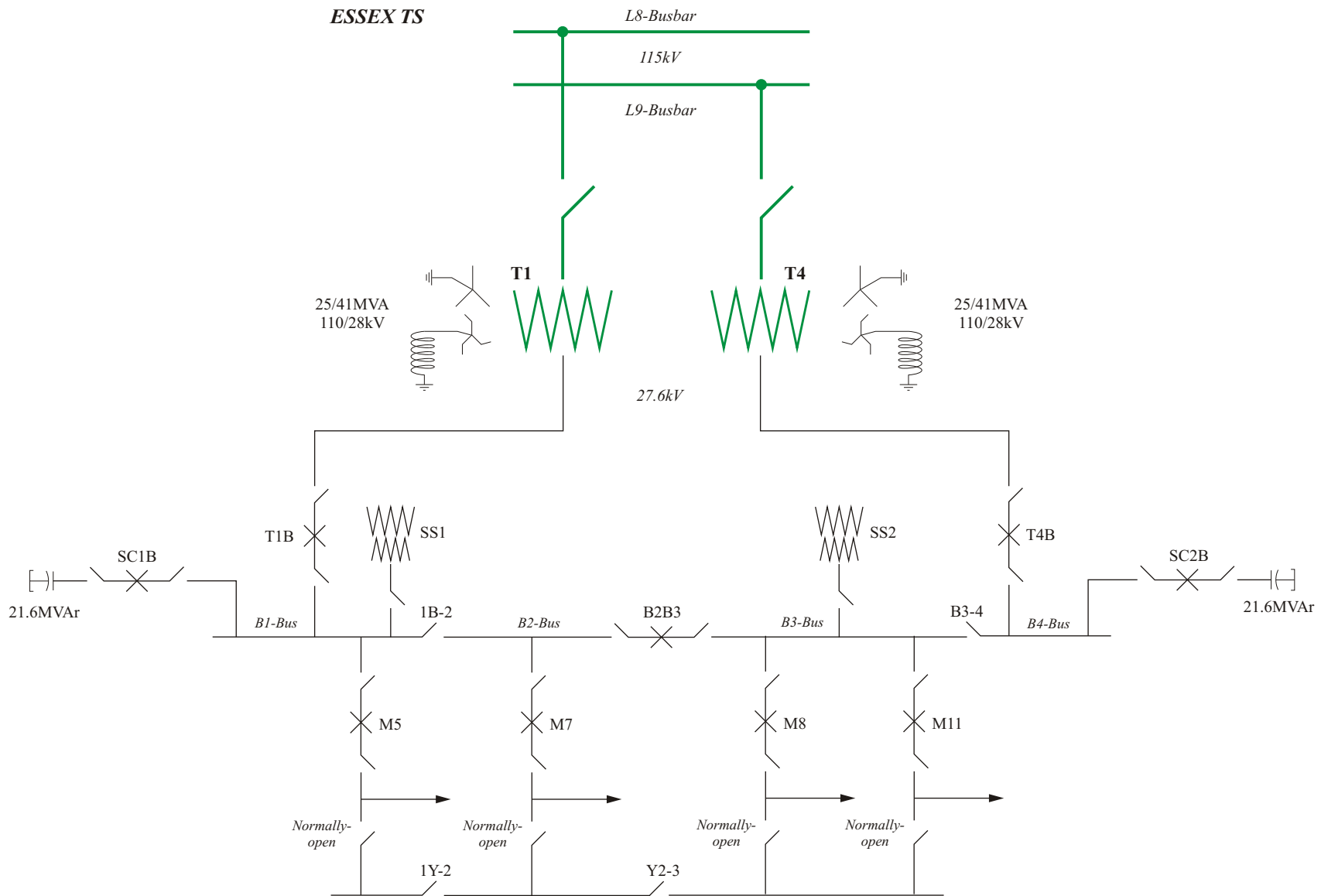
7. Customer Impact Assessment

Hydro One is to conduct a Customer Impact Assessment for all the work covered by this Assessment. Should any issues arise that require further assessment, then these will be addressed through an Addendum to this Assessment.

8. Notification of Approval

This Assessment has concluded that the proposed changes at Essex TS, together with the enhancement of the Windsor Area Special Protection System, will have no detrimental effect on the IESO-controlled grid.

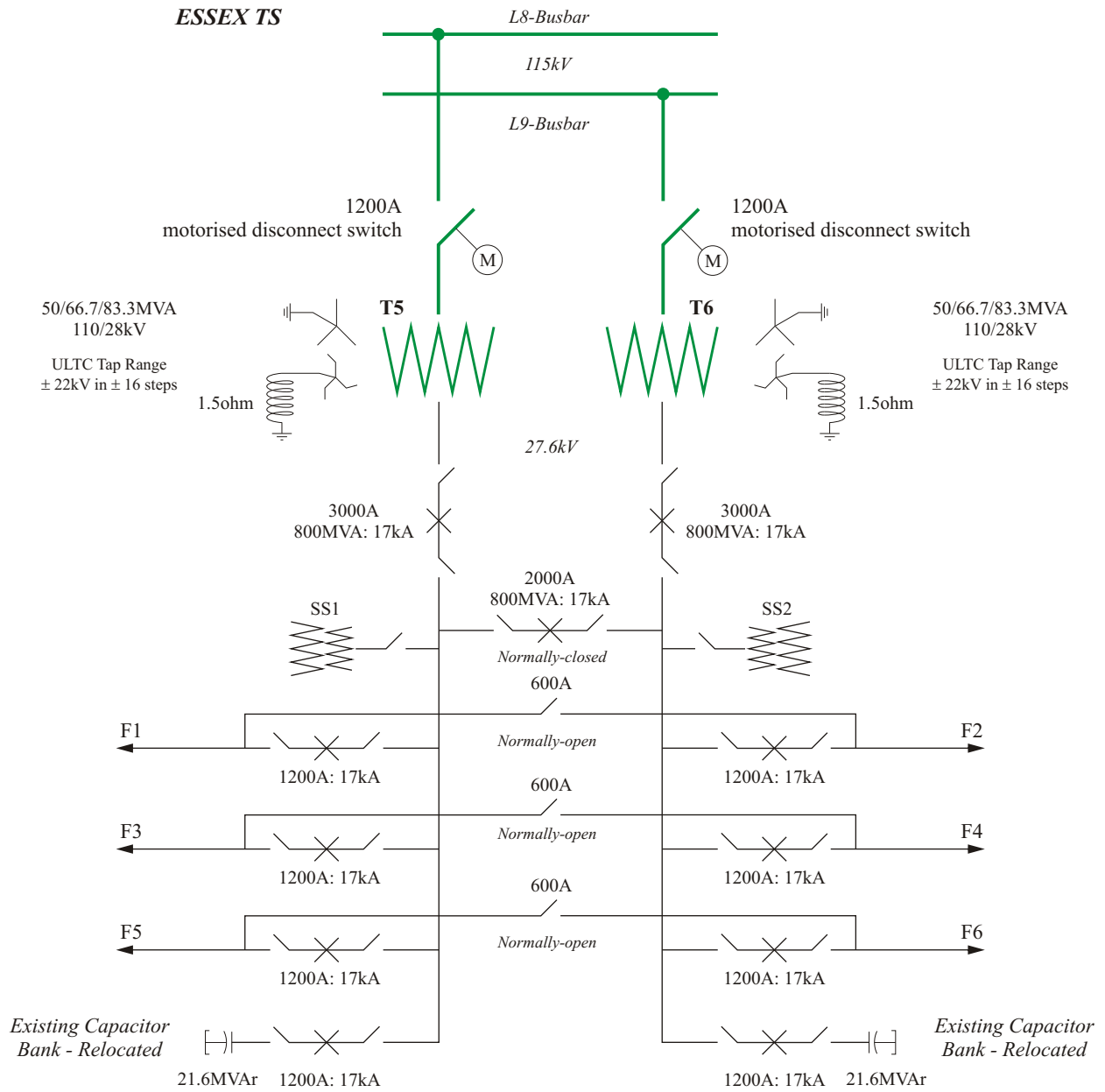
Furthermore, since no additional requirements related to the implementation of the proposed changes have been identified by the IESO, then subject to the satisfactory conclusion of the Customer Impact Assessment, it is therefore recommended that a Notification of Approval of the Connection Proposal be issued.



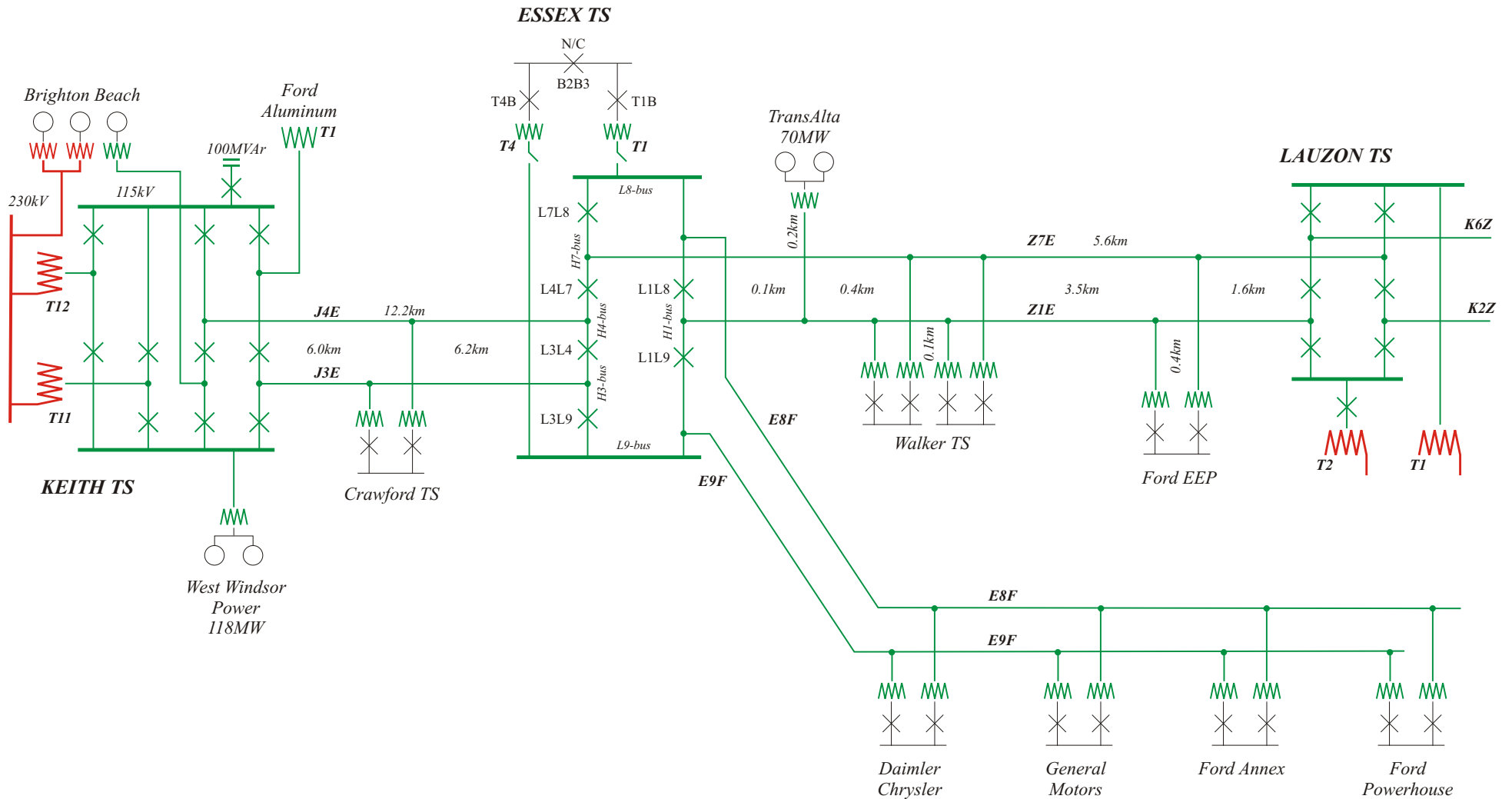
ESSEX TS: Arrangement of Existing DESN Station

DIAGRAM 1

28th March 2006

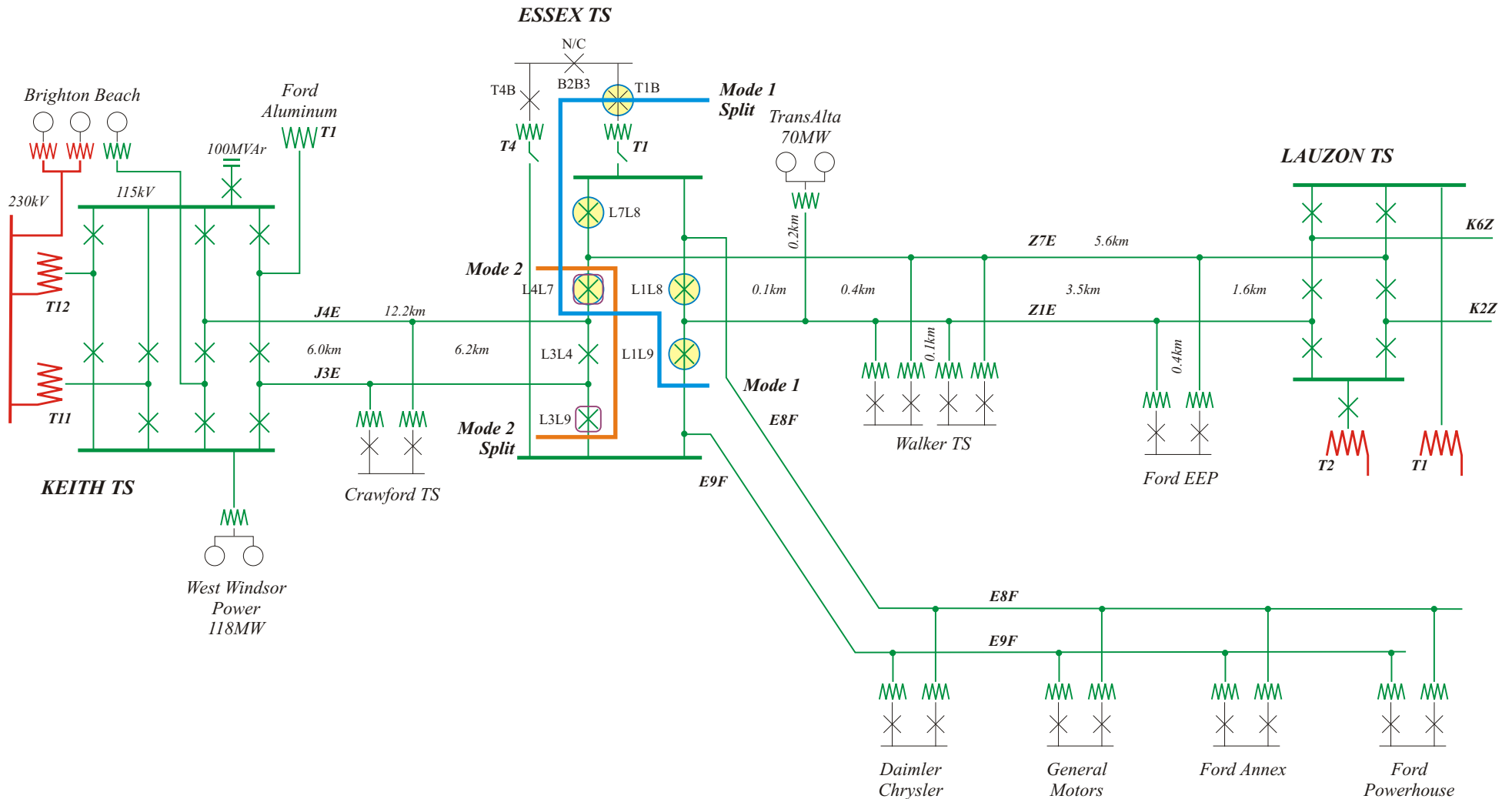




ESSEX TS: Proposed facilities at the Replacement DESN Station



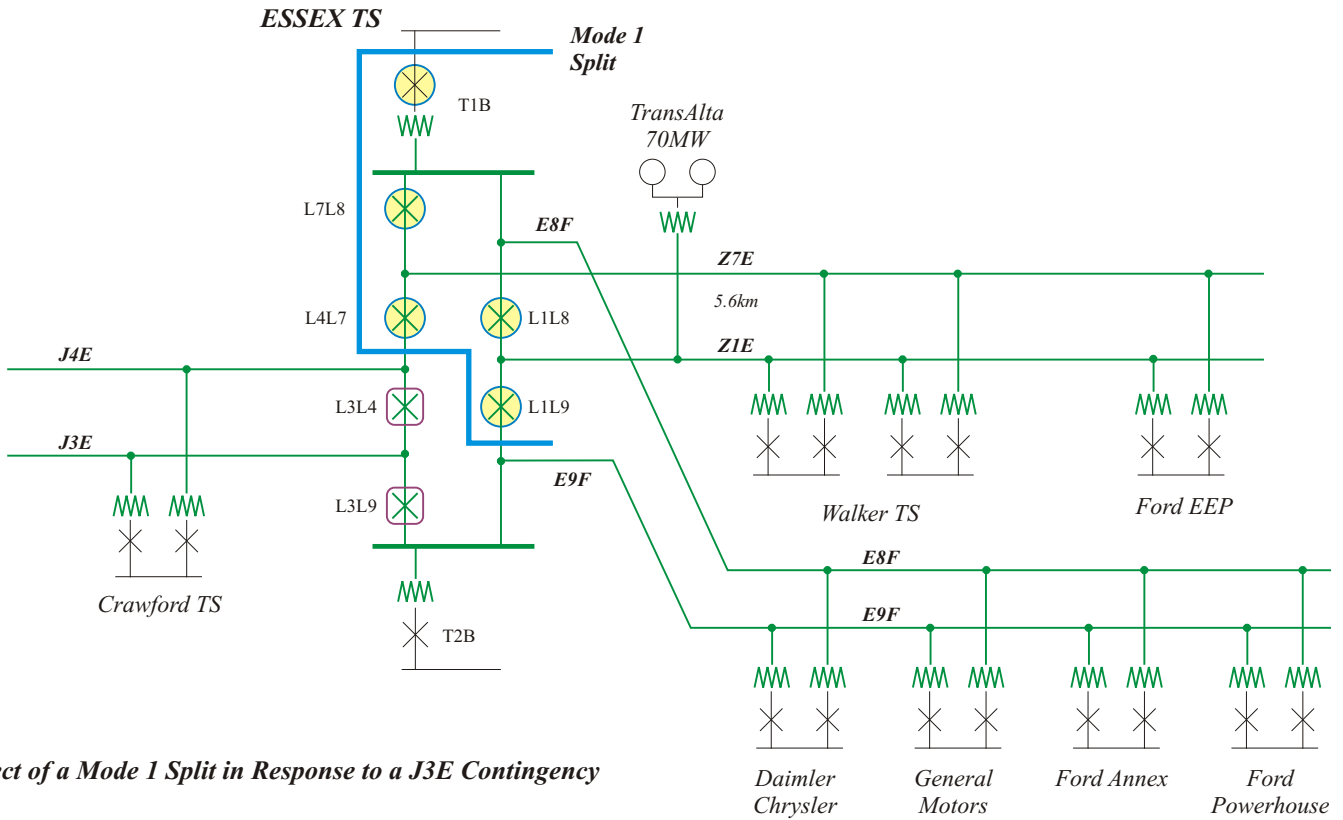
115kV Transmission Facilities in the Windsor Area

Showing the existing configuration of Essex TS

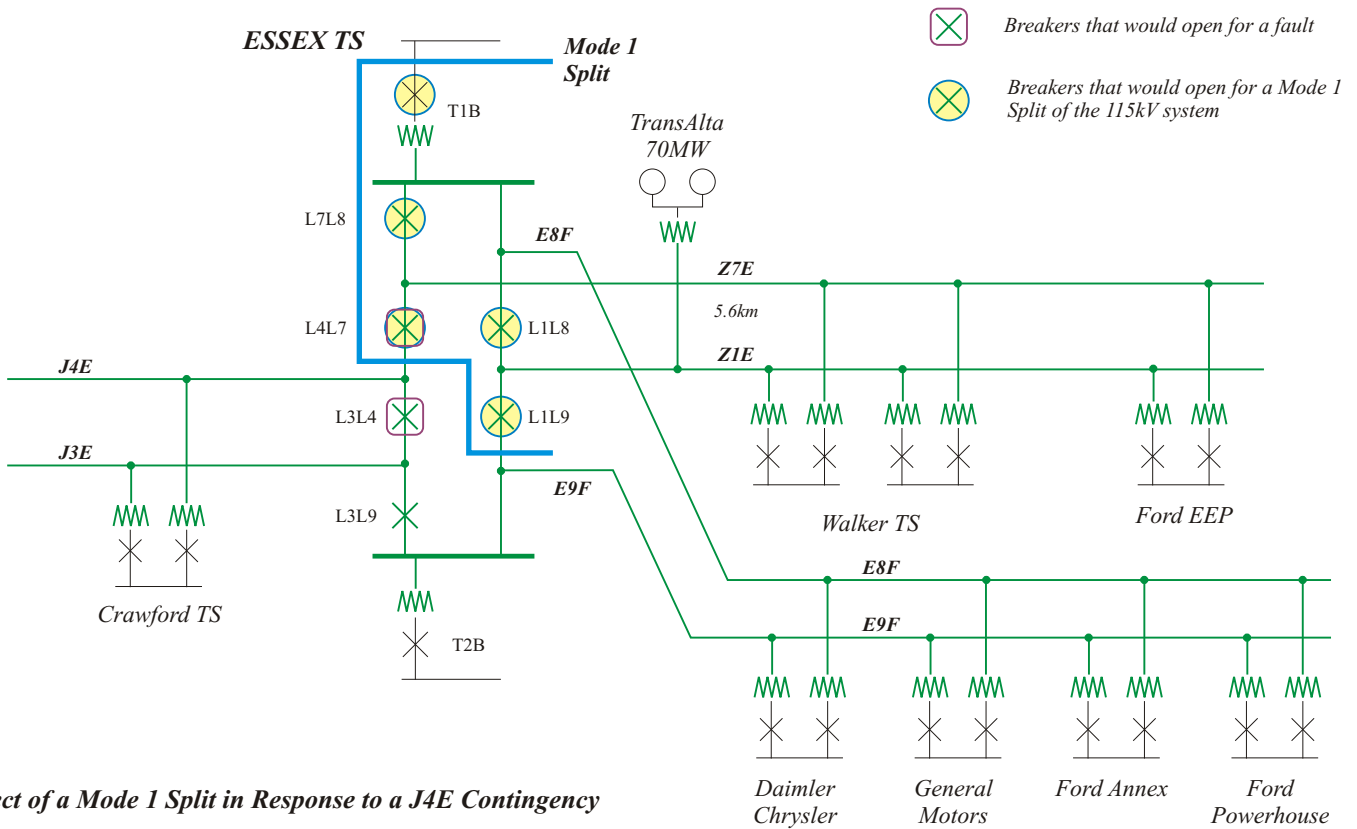


-  Breakers that would need to be opened for a Mode 1 Split of the 115kV system
-  Breakers that would open for a Mode 2 Split of the 115kV system

Windsor Area Overload Protection Scheme
Options Available for Splitting the Windsor Area 115kV System



Effect of a Mode 1 Split in Response to a J3E Contingency

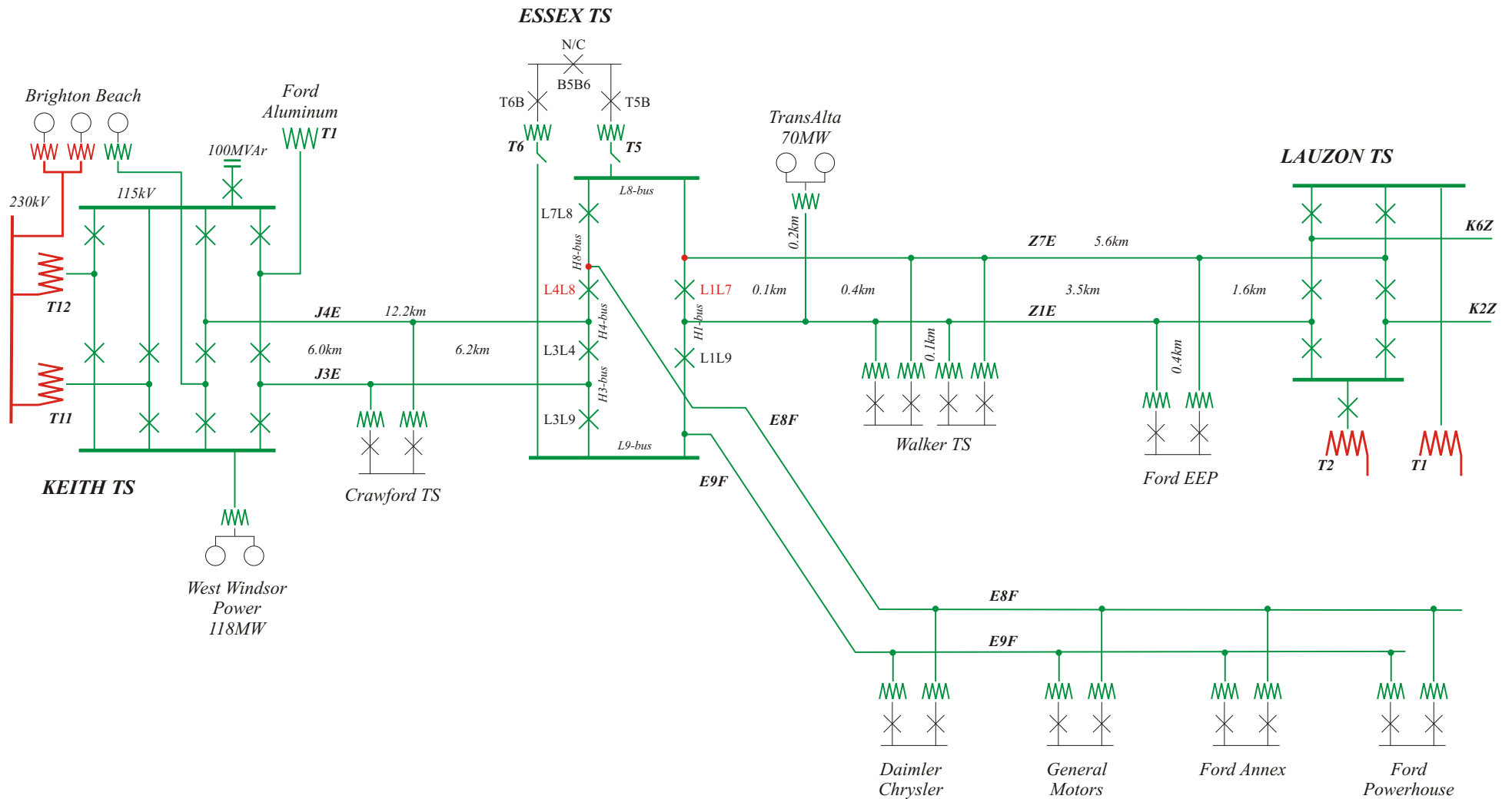


Effect of a Mode 1 Split in Response to a J4E Contingency

Effect of a Mode 1 Split with the Existing System Configuration

DIAGRAM 5

28th March 2006

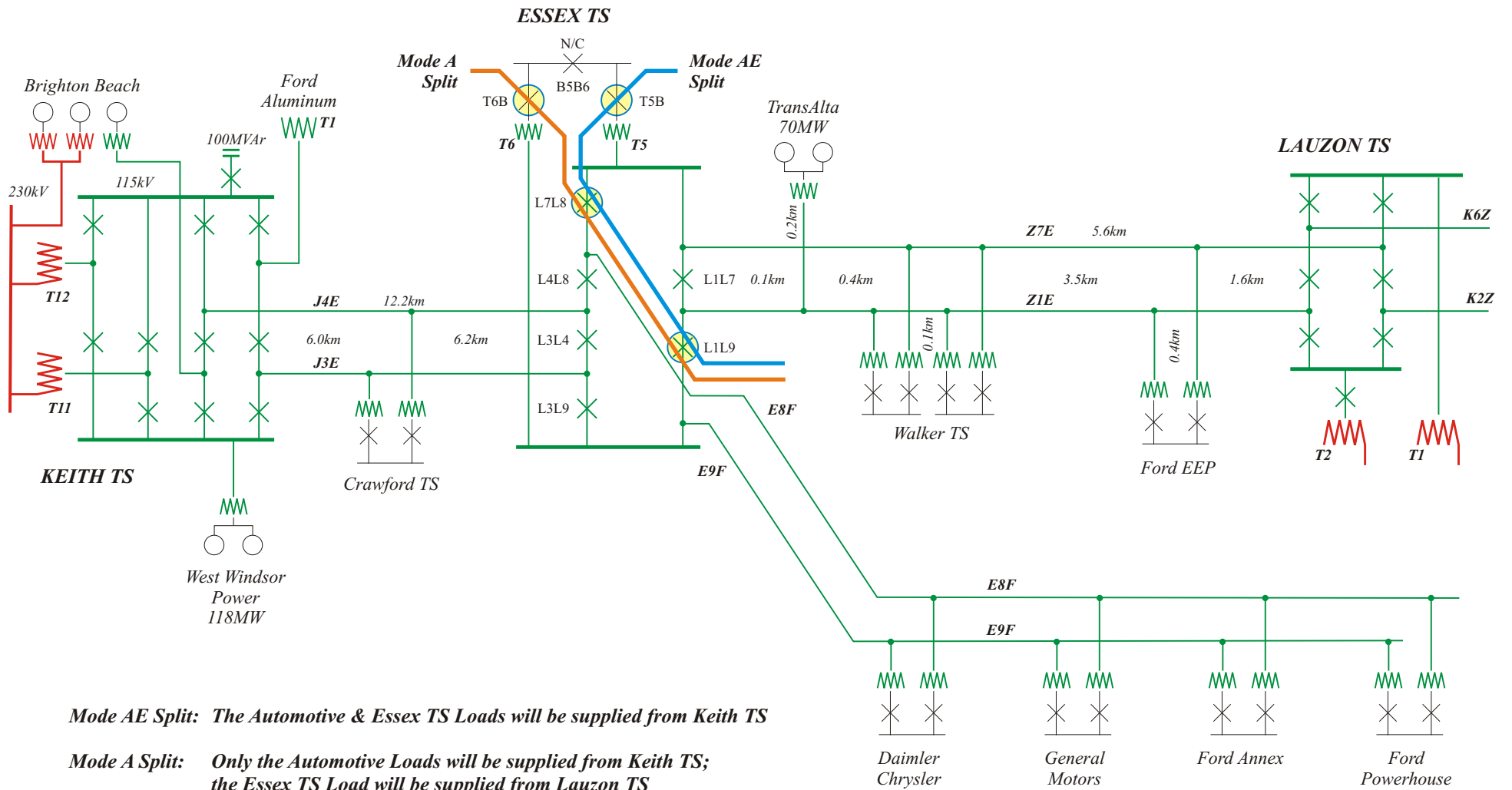



115kV Transmission Facilities in the Windsor Area

Following the Interchange of the Terminations for Circuit Z7E & E8F at Essex TS

DIAGRAM 6

6th April 2006



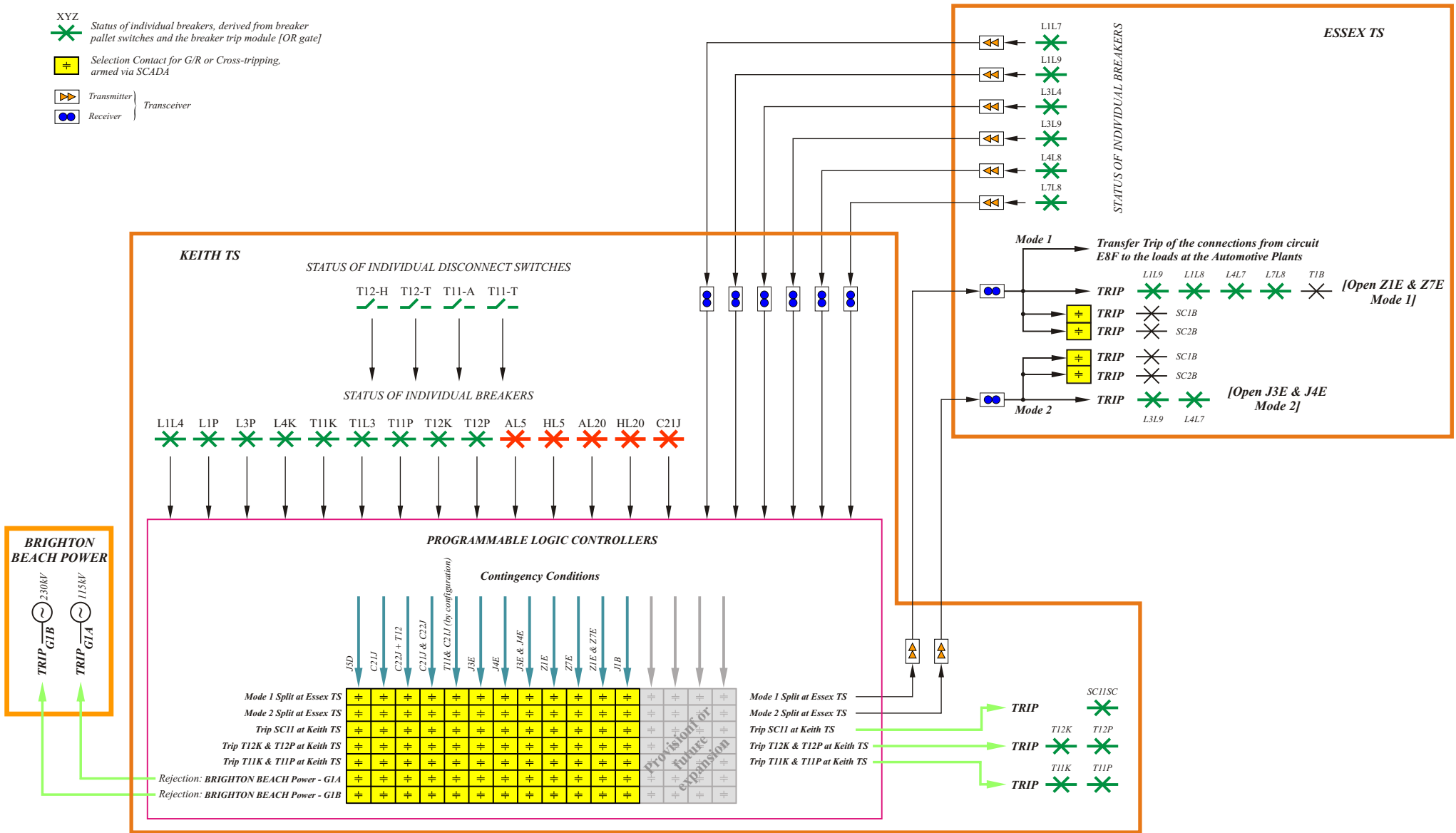
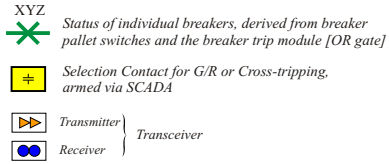
 Breakers that would need to be opened for either a Mode A or a Mode AE Split of the 115kV system

115kV Transmission Facilities in the Windsor Area

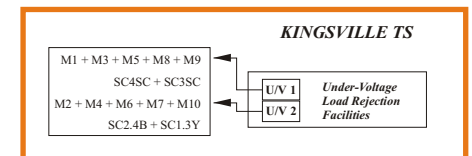
Revised Options for Splitting the 115kV Busbar at Essex TS

DIAGRAM 7

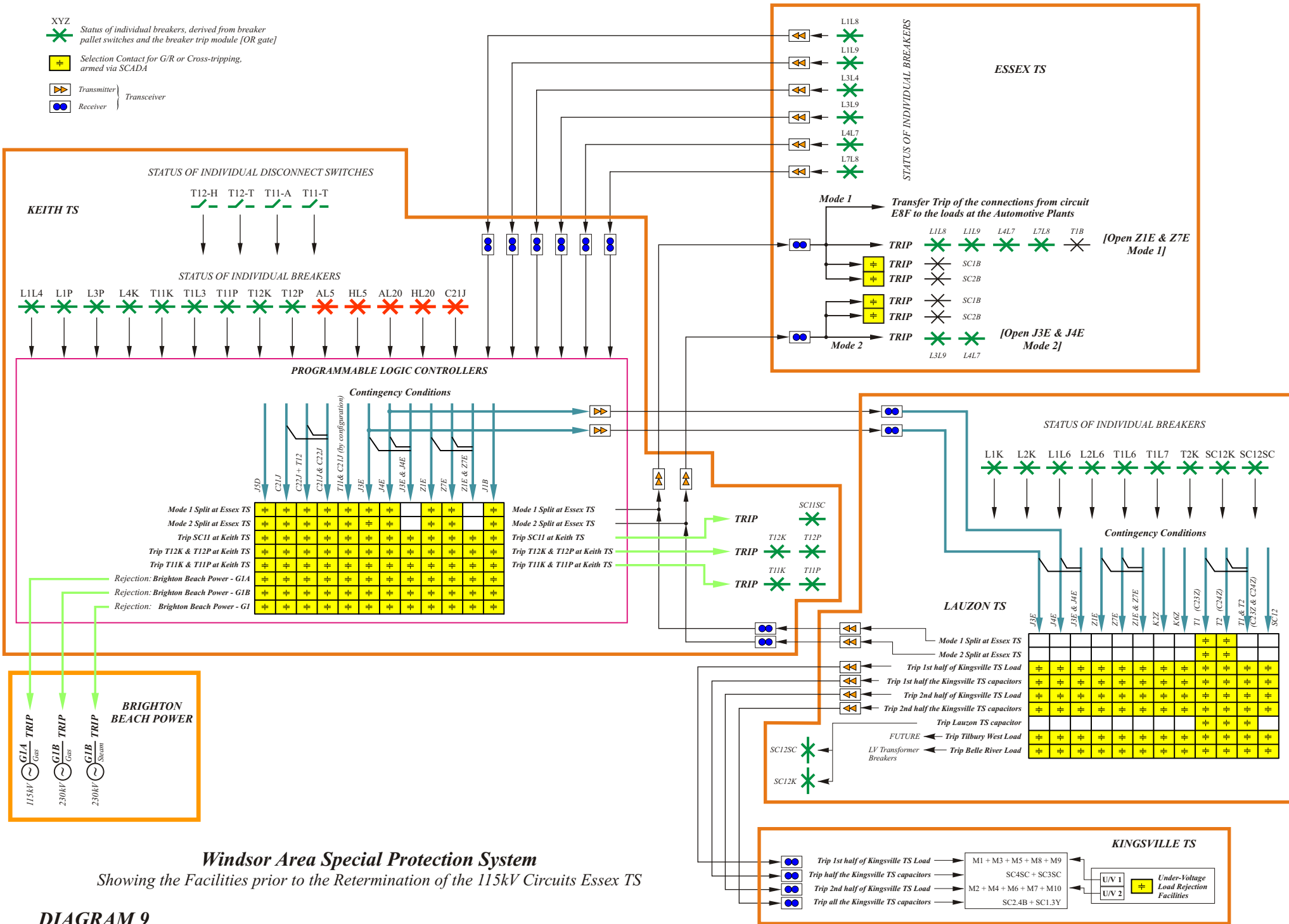
6th April 2006



Windsor Area Special Protection System
 Showing the Existing Facilities



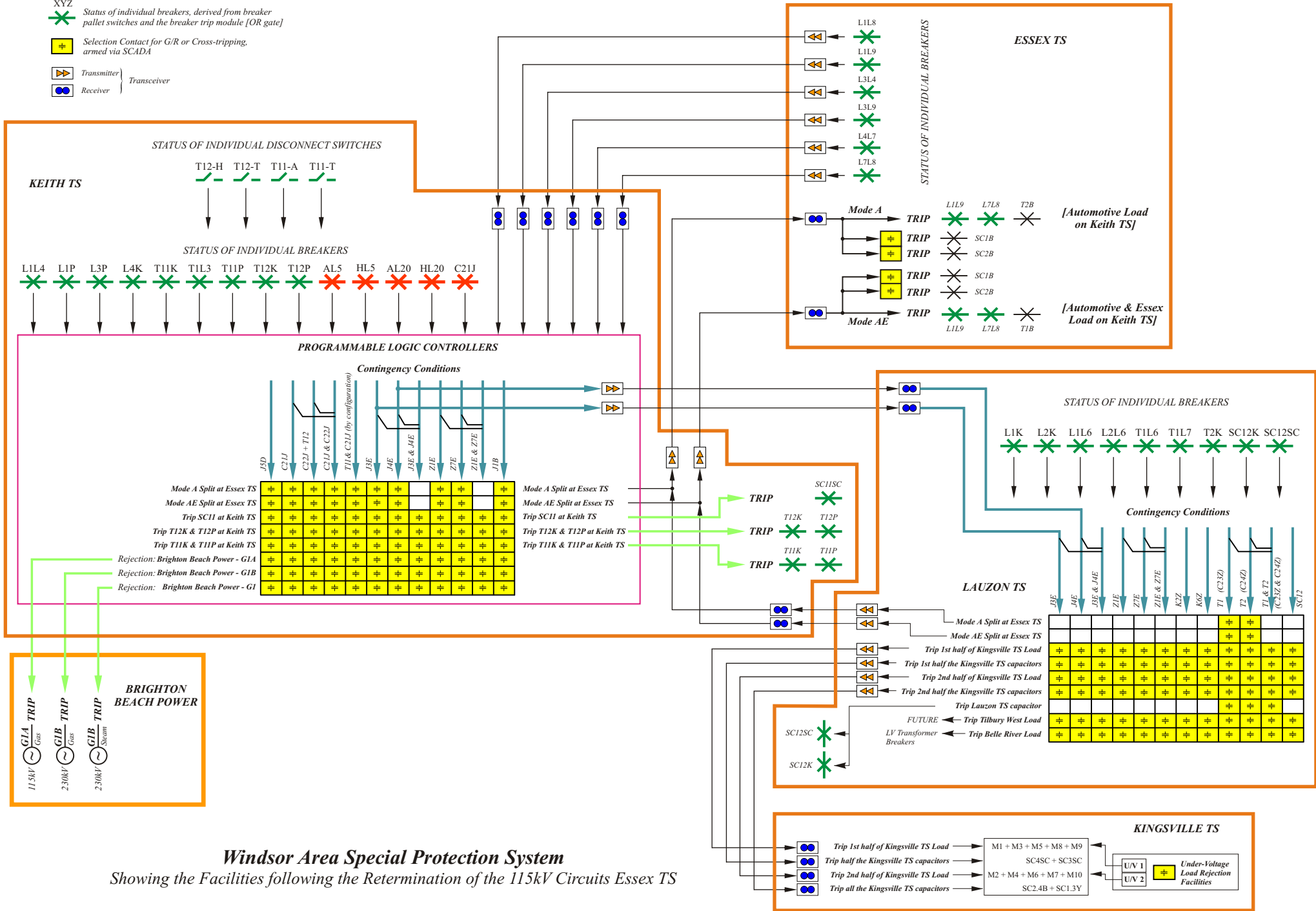
- XYZ
✳ Status of individual breakers, derived from breaker pallet switches and the breaker trip module [OR gate]
- ⊕ Selection Contact for G/R or Cross-tripping, armed via SCADA
- ▷ Transmitter } Transceiver
- ◁ Receiver }



Windsor Area Special Protection System

Showing the Facilities prior to the Retermination of the 115kV Circuits Essex TS

- XYZ
✳ Status of individual breakers, derived from breaker pallet switches and the breaker trip module [OR gate]
- ⊕ Selection Contact for G/R or Cross-tripping, armed via SCADA
- Transmitter } Transceiver
Receiver }



Windsor Area Special Protection System

Showing the Facilities following the Retermination of the 115kV Circuits Essex TS