



# **CONNECTION ASSESSMENT & APPROVAL PROCESS**

## ***PRELIMINARY ASSESSMENT REPORT***

***For the Proposed 680MVA Development at Keith TS  
by ATCO Canada Corp.***

***Final Version***

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

***Date: 26<sup>th</sup> September 2000***

## ***Preliminary Assessment Report***

*For the proposed 680MVA Development at Keith TS  
by ATCO Canada Corp.*

### Acknowledgement

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

### Disclaimers

#### ***IMO***

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#### ***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.

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.

## ***PRELIMINARY ASSESSMENT REPORT***

***For the Proposed 680MVA Development at Keith TS in Windsor  
by ATCO Canada Corp.***

### ***Executive Summary***

This Preliminary Assessment has examined the impact on the local system of the proposed **ATCO** development, in isolation of any other proposed developments.

#### ***Incorporation into Keith TS***

ATCO is proposing to construct a new 680MVA generating facility, approximately 1km from Keith TS. One of the gas-turbine units in the new development is to be incorporated into the 115kV busbar at Keith TS via a new 115kV line terminated into an existing position on one of the 115kV diameters. The remaining gas-turbine unit, together with the single steam turbine unit, are to be incorporated into the 230kV busbar, which is to be converted to a 'ring' configuration to accommodate the termination of the new 230kV line.

The proposed termination arrangement is not expected to result in any overall degradation in the supply reliability of the area.

With this 'split' incorporation arrangement, the output from the 115kV-connected gas-turbine unit would be used directly to supply the 115kV load in the Windsor area, thereby reducing the transfers through the two auto-transformers at Keith TS.

Under normal system conditions, the 'split' incorporation arrangement is expected to have a beneficial impact on the transfers through the two auto-transformers at Keith TS. However, under contingency conditions, that result in one of the auto-transformers being removed from service, there could be occasions when the remaining auto-transformer will be overloaded. To address these situations the scope of the existing Windsor Area Overload Protection Scheme would need to be expanded.

#### ***Impact on Fault Levels***

The studies have indicated that the increased fault levels resulting from the incorporation of the ATCO Project will remain within the fault interrupting capability of the existing breakers. Consequently no remedial action will be necessary to accommodate the additional generating capacity.

#### ***Impact on the Transfer Capability of the Ontario-Michigan Interface***

The ATCO Project has been determined to have the following impact on the maximum transfers that can be maintained across the Ontario-Michigan Interconnections:

- Under IMPORT conditions, the transfer capability would be reduced by approximately 420MW to 1085MW
- Under EXPORT conditions, the transfer capability would be reduced by approximately 10MW to 2400MW

While the Report identifies measures that (theoretically) would need to be undertaken to restore the transfer capability of the Interface to its present levels, no attempt has been made to assess the feasibility or practicality of these measures.

## ***ATCO Development Proposal for Incorporation into Keith TS, at Windsor***

### ***1. Introduction***

ATCO Canada Corp. is proposing to construct a 680MVA generating facility approximately 1km south of Keith TS. Because of concerns regarding possible overloading of the two 115MVA, 230/15kV auto-transformers at Keith TS they have elected to split their proposed development in two, with part of the development being incorporated at 230kV and the remainder at 115kV.

The proposed in-service date for the new facility is mid-2003

Diagram 1 shows the proposed incorporation arrangement, with a single gas turbine unit connected to the 115kV busbar at Keith TS, and the other gas turbine unit, together with the steam turbine unit, incorporated into the 230kV busbar.

### ***2. Comments on the Proposed Incorporation Arrangement***

The existing 230kV switching arrangement at Keith TS is slightly unusual in that it 'lacks symmetry', with an in-line breaker, C21J, installed in circuit C21J, but with no similar breaker installed in circuit C22J. The presence of the in-line breaker means that contingencies involving circuit C21J do not result in the simultaneous removal of the 'associated' auto-transformer, T11, from service. However, without a similar in-line breaker in the companion circuit, C22J, contingencies involving this circuit result in the automatic removal from service of the auto-transformer T12.

#### ***2.1 230kV connection***

The arrangement that ATCO is proposing for the termination of the circuit from the 230kV portion of their new generating station, will result in a 'ring' bus being formed at Keith TS. This switching arrangement, which involves the installation of two new breakers in a tie-bus, will ensure that contingencies involving the 230kV incorporation circuit or either of the 230kV step-up transformers at the ATCO facility, that are 'cleared normally', do not impact on any of the existing facilities at Keith TS.

However, the introduction of the two new breakers would mean that a breaker-failure condition involving either of them would result in the loss of either C21J; or C22J and the auto-transformer T12 at Keith TS; thereby potentially increasing the outage rate for these facilities. However, since the incidence rate for breaker failure conditions is low, the impact is not likely to be serious. Furthermore any adverse impact would be more than offset by the benefit of creating a ring busbar at Keith TS. With the ring busbar in place, contingencies involving the auto-transformer T11 would no longer result in the simultaneous loss of circuit C21J.

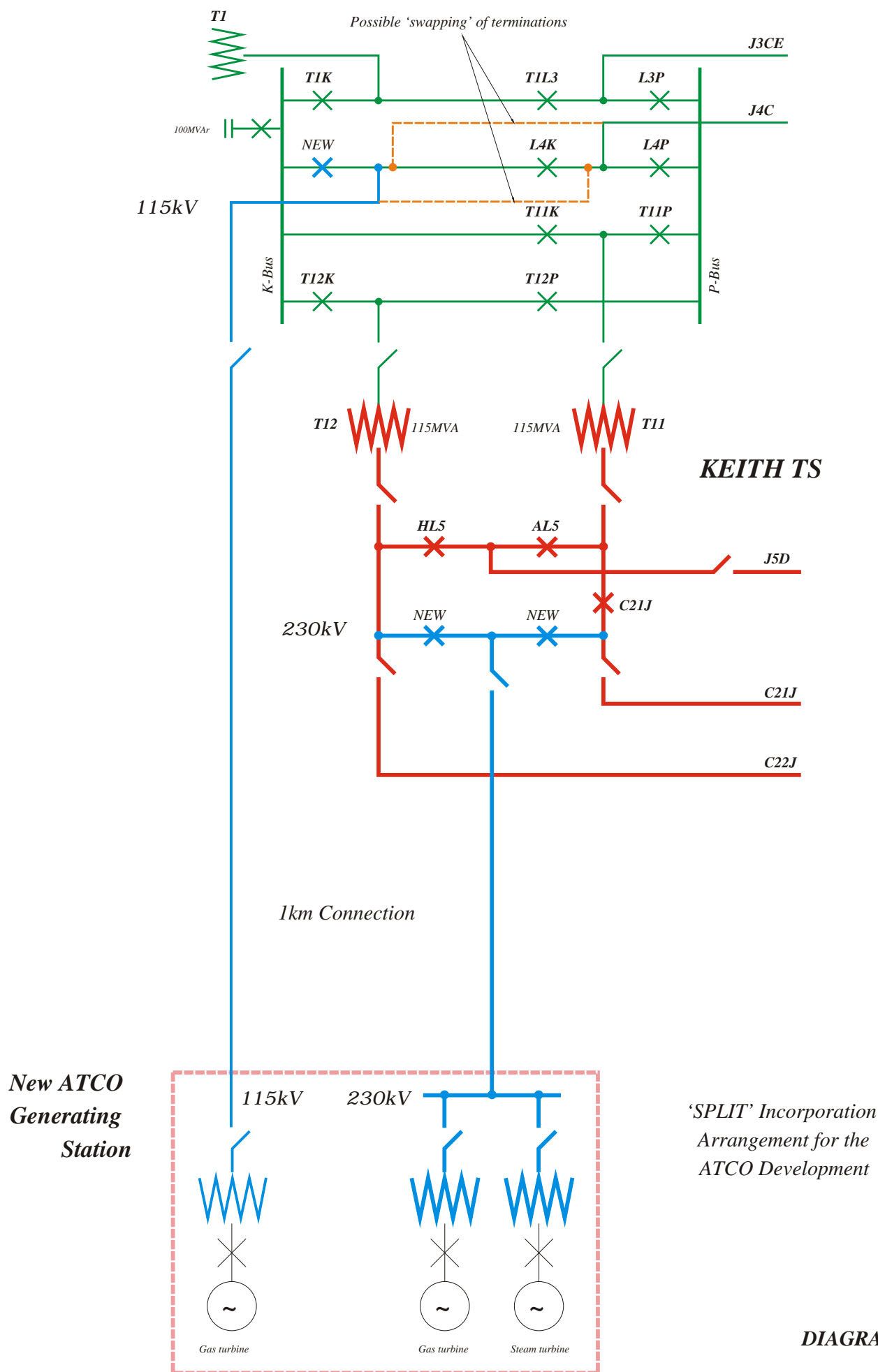
#### ***2.2 115kV connection***

For the incorporation of the 115kV portion of their new generating facility, ATCO is proposing to install a new 115kV breaker in the existing '4' diameter at Keith TS.

With this arrangement, contingencies involving the 115kV incorporation circuit or the 115kV step-up transformer at the ATCO generating station would be 'normally-cleared' by the new breaker and the existing L4K breaker. A breaker failure condition involving the new breaker would result in clearance of the 'K' busbar. Loss of this busbar would also result in the loss of the 100MVA capacitor bank that is directly connected to it.

While a breaker failure condition is not common, the simultaneous loss of a capacitor bank with generating capacity, as a result of this condition, is not desirable. Consequently, it is recommended that consideration should be given during the implementation phase, to the possible swapping of the existing termination for circuit J4C with the proposed termination point for new ATCO 115kV connection.

A breaker failure condition involving the existing L4K breaker would result in the loss of 115kV circuit J4C. However, since this is the current situation, there would be no increased, adverse impact.



### 2.3 Support for adopting a 'Split' Incorporation Arrangement

Diagram 7 shows the incremental flows that would be expected to result from the incorporation of the ATCO Project, *if it were to be connected entirely at 230kV*.

This shows an incremental change of 90MW in the flow through each of the 230/115kV auto-transformers at Keith TS. Since these transformers are only rated at 115MVA, then if the entire ATCO facility were to be incorporated at 230kV, it would increase the probability that these auto-transformers could be overloaded.

Diagram 6 shows the incremental flows that are expected to occur for the proposed 'split' incorporation arrangement, with a portion of the ATCO Project connected to the 230kV busbar at Keith TS, and the remainder connected to the 115kV busbar. With this arrangement the incremental flows through each auto-transformer drop to just 20MW.

The flows shown in these Diagrams indicate that 140MW (78%) of the additional 180MW of generating capacity that would be connected to the 230kV busbar at Keith TS if the entire plant were to be incorporated at 230kV, would flow through the two auto-transformers: 70MW (39%) through *each* auto-transformer.

## 3. Fault Level Analysis

Fault level studies were performed to determine the impact of the ATCO development (in isolation) on the existing transmission facilities.

The following system conditions were assumed when conducting the studies:

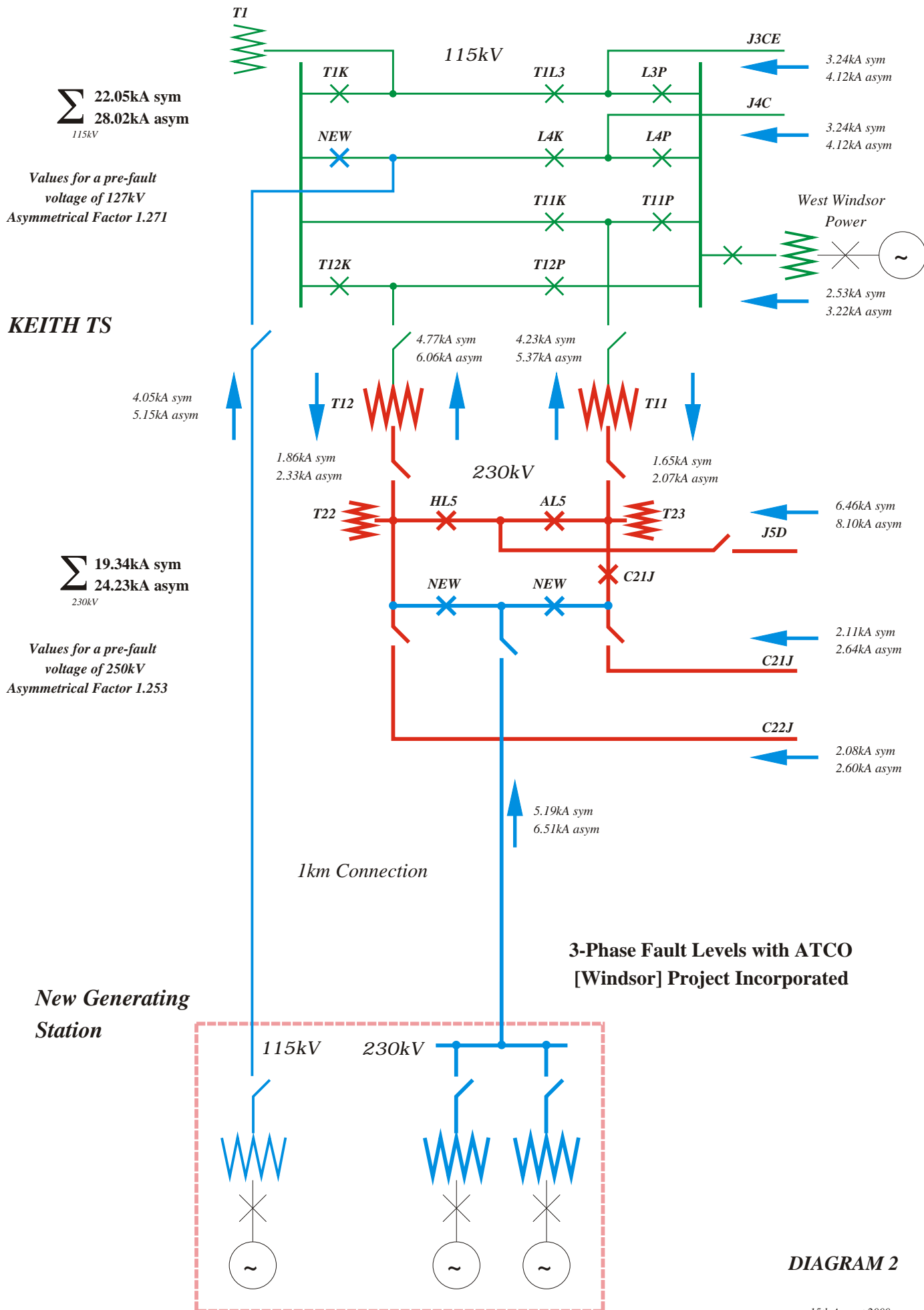
- All existing transmission facilities, together with those facilities that have been 'committed' are assumed to be in-service.
- The three interconnections with Michigan reflect their final arrangement following the installation of the new phase-shifters.
- The generators at the Bruce 'A' and Pickering 'A' stations are out-of-service
- The two 500/230kV auto-transformers at Lennox TS, together with units G1 to G4 at Lennox GS are in-service.
- The 230kV busbars at Richview TS are operated 'split', while Cherrywood TS is operated with a separate North & South switchyard.
- The 260MVA steam turbine generator, together with one of the 210MVA gas turbine units, is connected into the 230kV busbar at Keith TS, via a single, 230kV circuit. The remaining 210MVA gas turbine unit is connected into the 115kV busbar at Keith TS via a single, 115kV circuit. Both circuits are assumed to be 1km in length.

*The full, quoted fault interrupting capability of the circuit breakers on the 230kV and 115kV systems was used when assessing the adequacy of the equipment for the projected fault interrupting duty that is likely to be imposed on it. The 5% margin that has traditionally been applied to the ratings of the 230kV (and 500kV) breakers has been eliminated.*

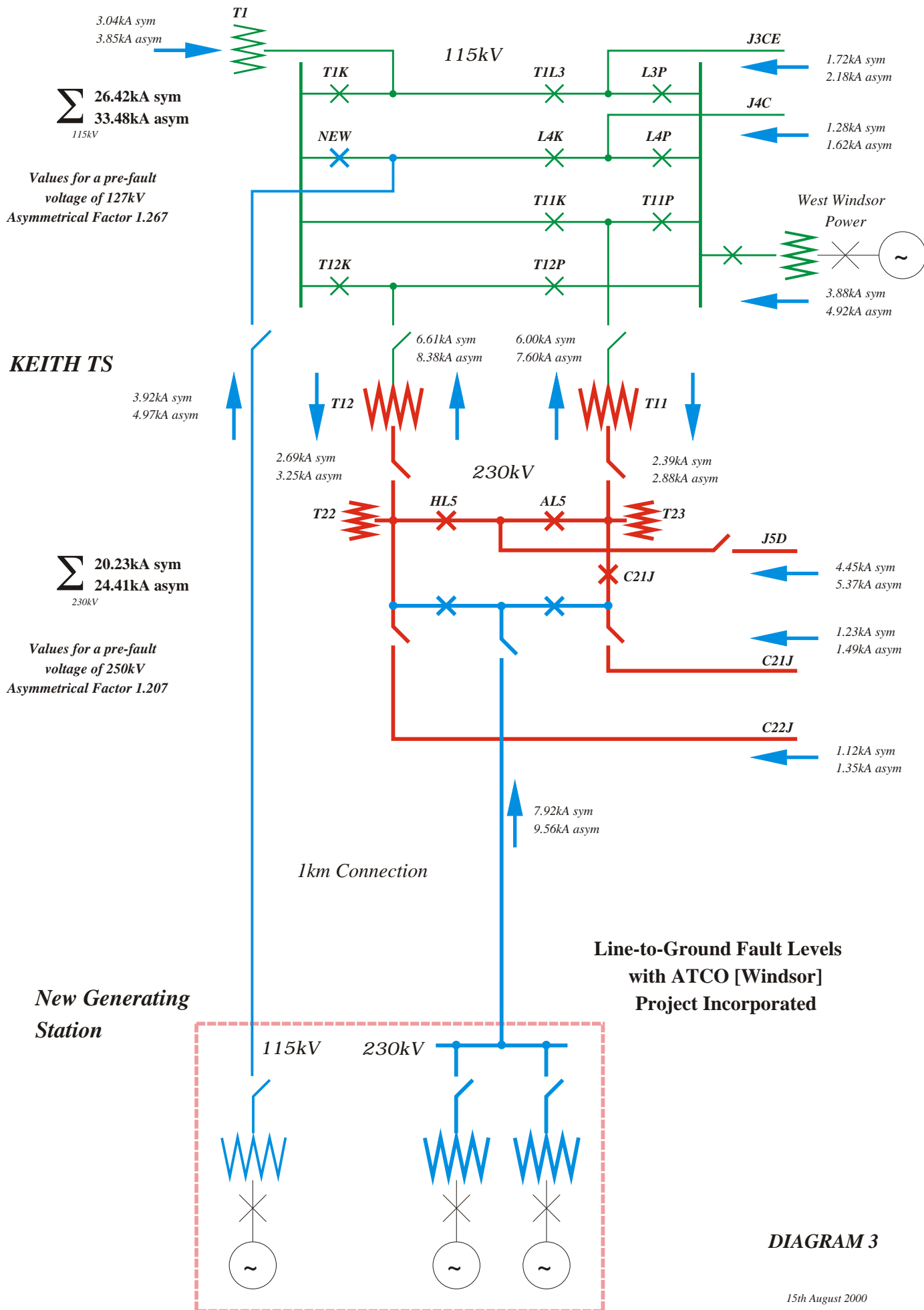
### 3.1 Fault Level Results

The results have been summarised on the following Diagrams for the two most-critical locations:

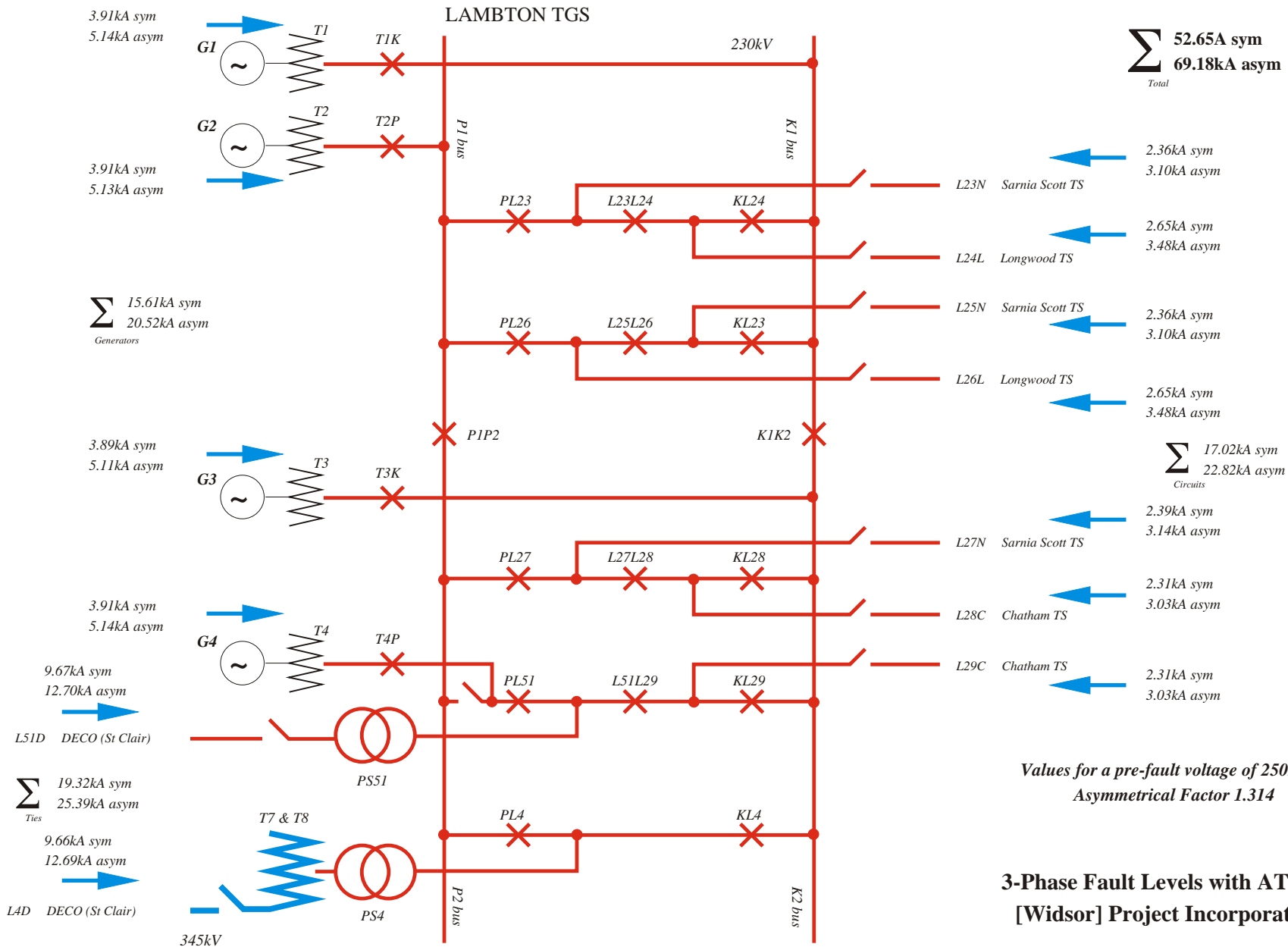
- Diagram 2 For 3-phase Faults on the 230kV & 115kV busbars at Keith TS
- Diagram 3 For Line-to-Ground Faults on the 230kV & 115kV busbars at Keith TS
- Diagram 4 For a 3-phase Fault on the 230kV busbar at Lambton TGS
- Diagram 5 For a Line-to-Ground Fault on the 230kV busbar at Lambton TGS



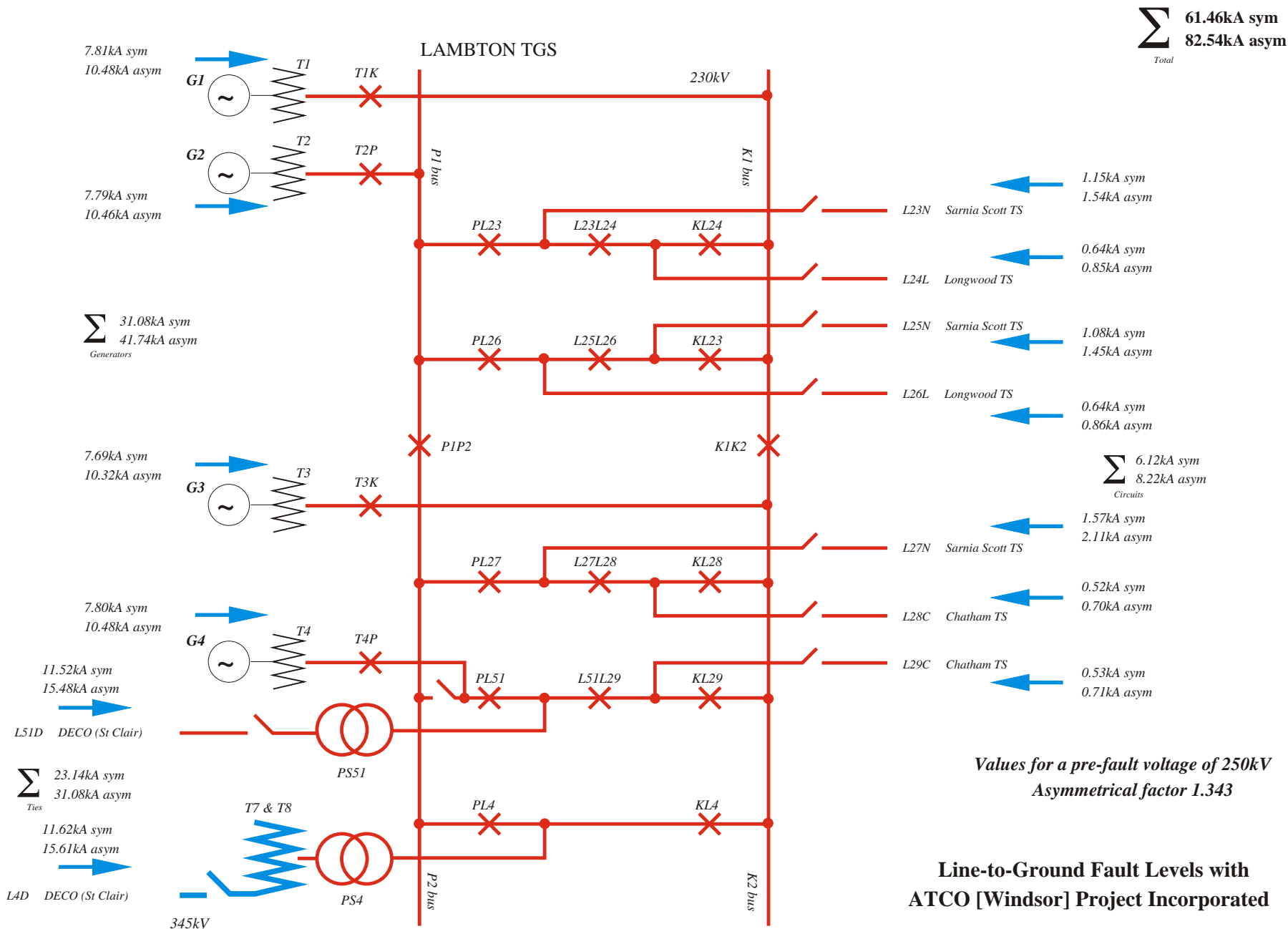
**DIAGRAM 2**



**DIAGRAM 3**



**DIAGRAM 4**



**DIAGRAM 5**

### 3.1.1 Fault Levels at Keith TS

In addition to information presented in Diagrams 2 & 3, showing the individual contributions to the fault levels on the 230kV & 115kV busbars, the maximum fault levels have also been summarised in the Table below: (with no reduction, where appropriate, for specific infeeds to reflect the duties that would be imposed on individual breakers):

<i>Fault levels on the 230kV busbar at Keith TS for a Pre-fault Voltage of 250kV</i>						
	Symmetrical Fault		Asymmetrical Fault		Breaker Capability	
	3-phase	L-G	3-phase	L-G	Symmetrical	Asymmetrical
Existing	13.3kA	13.2kA	16.2kA	15.7kA	43.3kA	48.6kA
With the ATCO Project	19.34kA	20.23kA	24.23kA	24.41kA		
<i>Fault levels on the 115kV busbar at Keith TS for a Pre-fault Voltage of 127kV</i>						
	Symmetrical Fault		Asymmetrical Fault		Breaker Capability	
	3-phase	L-G	3-phase	L-G	Symmetrical	Asymmetrical
Existing	16.4kA	19.8kA	20.6kA	24.9kA	Various: From 39.3kA To 42.0kA	Various: 45.5kA
With the ATCO Project	22.05kA	26.42kA	28.02kA	33.48kA		

From the information presented above, it is apparent that the fault levels, for both the 230kV & 115kV busbars at Keith TS, are all within the rating of the existing facilities, even before making allowance for specific fault infeeds that the breakers are not required to interrupt.

### 3.1.2 Fault Levels at Lambton TGS

The projected fault levels on the 230kV busbar at Lambton TGS are shown in Diagrams 4 & 5, and are also summarised in the following table.

<i>Fault levels on the 230kV busbar at Lambton TGS for a Pre-fault Voltage of 250kV</i>								
	Symmetrical Fault		Asymmetrical Fault		Breaker Capability			
	3-phase	L-G	3-phase	L-G	Symmetrical		Asymmetrical	
<i>Existing</i>	52.1kA	60.9kA	68.5kA	<b>82.48kA</b>	A	65.0kA	A	<b>78.0kA</b>
					B	70.0kA	B	92.0kA
<i>With the ATCO Project Incorporated</i>								
	52.65kA	61.46kA	69.18kA	<b>82.54kA</b>	A	65.0kA	A	<b>78.0kA</b>
					B	70.0kA	B	92.0A

*Note: The 'A' ratings are for breakers PL4 & KL4, while the 'B' ratings are for the remaining breakers at Lambton TGS*

From the table above, it is apparent that it is only the **total** fault level for an asymmetrical fault condition that exceeds the rating of the two, lower-rated breakers at Lambton TGS. The ratings for all the other breakers are adequate for the **total** fault levels, even before making allowance for specific fault infeeds in order to reflect the actual interrupting duty imposed on individual breakers.

The table below shows the situation once allowance has been made for the respective fault infeeds that breakers KL4 and PL4 are not required to interrupt.

<i>Asymmetrical fault duties imposed on breakers KL4 &amp; PL4 for a line-to-ground fault</i>			
	<i>Critical breaker</i>	<i>Asymmetrical Fault Line-to-Ground</i>	<i>Breaker Capability Asymmetrical</i>
<b>Existing System</b>	KL4 (less the G3 contribution)	71.96kA	78.0kA
	PL4 (less the G4 contribution)	71.80kA	
<b>With the ATCO Development Incorporated</b>	KL4 (less the G3 contribution)	72.22kA	78.0kA
	PL4 (less the G4 contribution)	72.06kA	

### *Existing Facilities*

For the existing system configuration, after making allowance for specific infeeds in order to reflect the actual interrupting duty imposed on individual breakers, the projected fault levels are within the rating of the existing equipment.

### *With the ATCO Project Incorporated*

Similarly, with the ATCO Project incorporated, after allowing for the non-contributing fault infeeds, the actual fault interrupting duty imposed on each critical breaker would remain within its rating.

Since the fault levels at Lambton TGS are within the rating of the two most-critical breakers, none of the breakers at this station would need to be replaced to cater for the enhanced fault level on the 230kV busbar resulting from the incorporation of the ATCO project.

### *3.1.3 Fault Levels at the 230kV & 115kV Busbars of those TSs that are in close electrical proximity to Keith TS*

<i>Fault levels on the 230kV busbar at Chatham TS for a Pre-fault Voltage of 250kV</i>						
	<i>Symmetrical Fault</i>		<i>Asymmetrical Fault</i>		<i>Breaker Capability</i>	
	<i>3-phase</i>	<i>L-G</i>	<i>3-phase</i>	<i>L-G</i>	<i>Symmetrical</i>	<i>Asymmetrical</i>
<b>Existing</b>	18.7kA	11.7kA	20.5kA	11.7kA	32.8kA	36.4kA
<b>With the ATCO Project</b>	20.28kA	12.09kA	22.25kA	12.17kA	43.3kA	48.6kA

<i>Fault levels on the 115kV busbar at Essex TS for a Pre-fault Voltage of 127kV</i>						
	<i>Symmetrical Fault</i>		<i>Asymmetrical Fault</i>		<i>Breaker Capability</i>	
	<i>3-phase</i>	<i>L-G</i>	<i>3-phase</i>	<i>L-G</i>	<i>Symmetrical</i>	<i>Asymmetrical</i>
<b>Existing</b>	15.8kA	17.8kA	18.3kA	17.8kA	39.3kA	45.5kA
<b>With the ATCO Project</b>	18.63kA	20.09kA	21.14kA	22.80kA		

These tables shows that even at the enhanced fault levels that result from the incorporation of the ATCO Project, there is still a substantial margin between the rating of the existing facilities at both Chatham TS and Essex TS, and the projected maximum fault levels.

### *3.2 230kV Generator Breakers at Lambton TGS*

Discussions are currently underway with Ontario Power Generation regarding the fault interrupting capability of their 230kV breakers T1K, T2P, T3K & T4P at Lambton TGS. In the absence of any LV breakers, these HV breakers are used for both fault isolation duty and for synchronising of the individual generators to the system.

We have been informed that breakers T2P & T3K have already been replaced with higher-rated units, while breakers T1K & T4P are scheduled for replacement.

From the information that is currently available, it appears that the rating of the remaining two original breakers is not adequate for the projected fault levels for the existing system configuration. However, we have been informed that in order to address this situation, modifications have been made to the relay protection to ensure that, in the event of a fault, operation of these breakers is delayed until after the main busbar has been isolated.

We propose to pursue this issue in more detail within the System Impact Assessment.

### 3.3 Summary of Fault Level Analysis

The fault level analysis that has been performed has shown that incorporating the proposed ATCO Project into the 230kV & 115kV busbars at Keith TS will not increase the fault levels in the Sarnia-Windsor-Chatham area sufficiently to require any of the existing breakers in this area to be replaced.

*It should also be stressed that no account has been taken in any of the analysis of possible plans by the Detroit Edison Company to incorporate additional generating capacity into their system. Depending on the proximity of these developments to the Interconnections, they could have a significant impact on the fault levels at Lambton TGS, Scott TS and Keith TS.*

## 4. Assessment of the Impact on Transfer Capabilities

Following the reinforcement of the Interconnections between Ontario and Michigan, the transfer capability of the Ontario-Michigan Interface has increased to approximately 1500MW and 2400 MW, for import and export conditions, respectively. These transfer limits are the direct result of thermal limitations on the interconnections under contingency conditions involving either the companion interconnections or facilities at the terminal stations.

Diagram 6 shows the incremental changes in the flow distribution in the Windsor-Chatham area that would be expected to result from the incorporation of the ATCO Project into Keith TS.

As shown in the Diagram, incorporating the ATCO project into Keith TS will result in an incremental change of approximately 220MW in the transfers through the 115kV system. While it is expected that the 115kV system will be able to accommodate this change in the transfers under normal-system conditions, contingency conditions are expected to require increased use of the Windsor Area Overload Protection Scheme (OLPS).

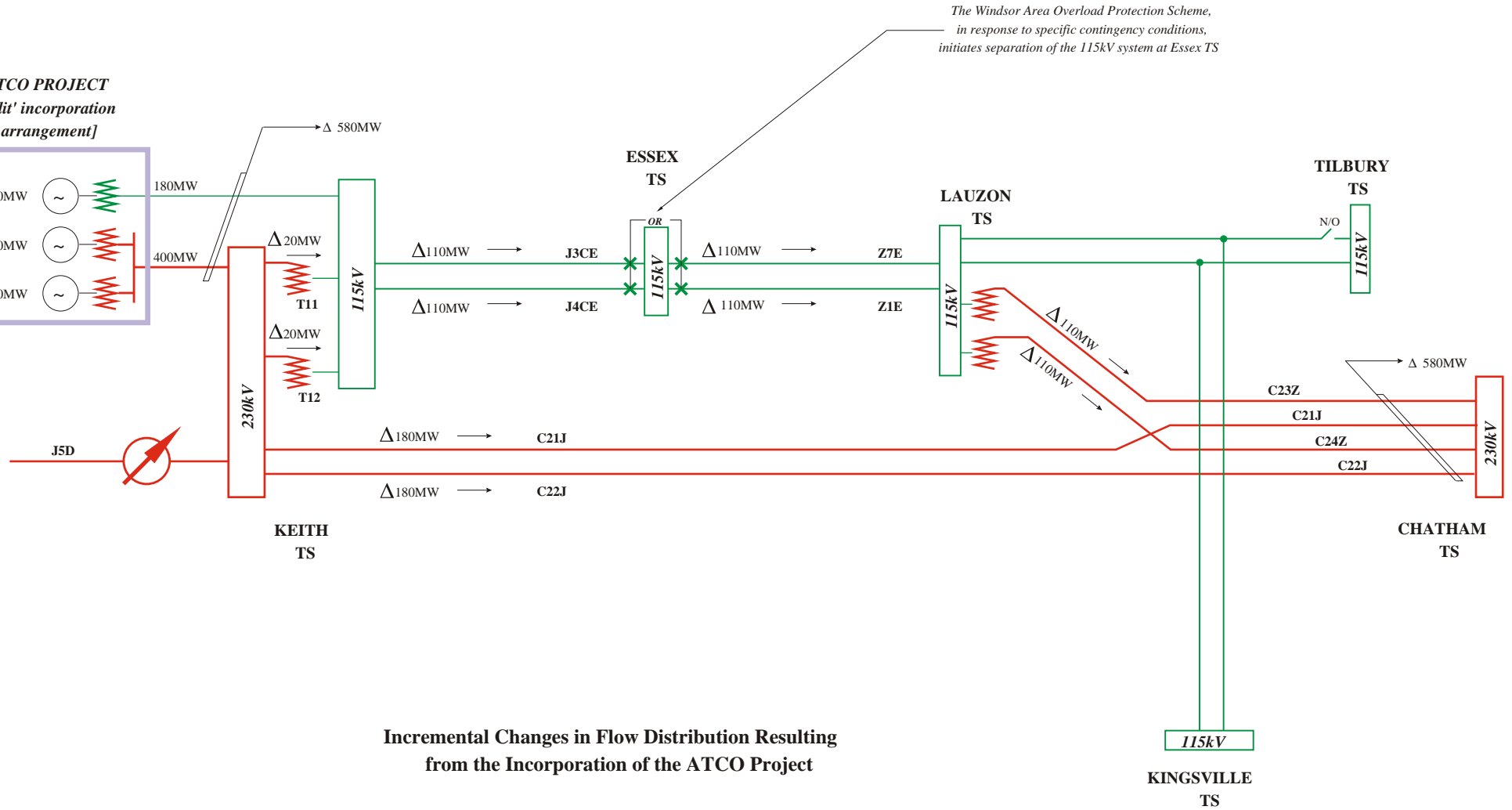
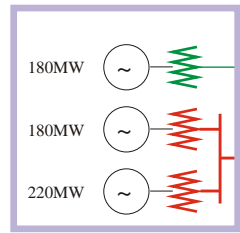
This Scheme was introduced to protect against voltage instability; excessive voltage declines; and thermal overloads. It is presently initiated by the detection of an overload condition on either of the auto-transformers at Keith TS, or on circuits Z1E or Z7E, measured at the Lauzon TS terminals. Should the Scheme detect an overload condition it is designed to respond by opening either circuits Z1E & Z7E, or circuits J3CE & J4CE, at Essex TS, so as to split the 115kV through-connection between Keith TS and Lauzon TS. This action is intended to ensure that the loads that are subsequently supplied from Keith TS and Lauzon TS remain within the ratings of the remaining equipment.

Analysis has shown that the following contingency conditions could result in overloading of the remaining auto-transformer at Keith TS, and for which OLPS would need to be armed:

- Auto-transformer T11
- Auto-transformer T12 or circuit C22J (both are removed from service by configuration)
- Double-circuit contingency C21J + C22J
- Double-circuit contingency C22J + C24Z
- A breaker failure condition involving any of the following breakers at Keith TS:

- |      |               |      |     |                |      |
|------|---------------|------|-----|----------------|------|
| i.   | 230kV breaker | C21J | iv. | 115kV breaker  | T12P |
| ii.  | 115kV breaker | T11K | v.  | 27.6kV breaker | T22Y |
| iii. | 115kV breaker | T11P |     |                |      |

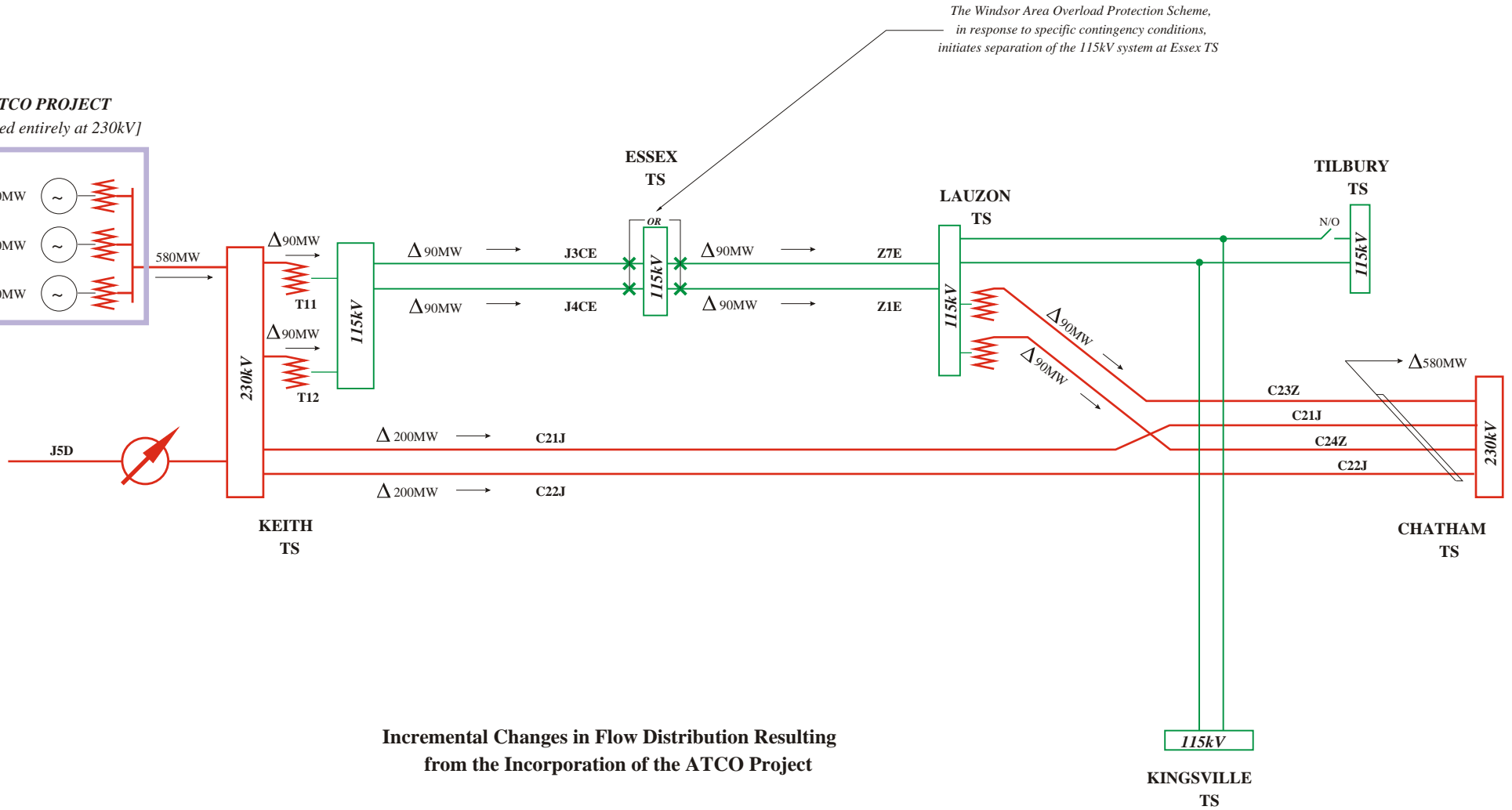
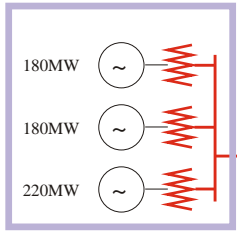
**ATCO PROJECT**  
 ['Split' incorporation arrangement]



**Incremental Changes in Flow Distribution Resulting from the Incorporation of the ATCO Project**  
 [for the proposed 'Split' incorporation arrangement]

**DIAGRAM 6**

**ATCO PROJECT**  
 [Connected entirely at 230kV]



**Incremental Changes in Flow Distribution Resulting from the Incorporation of the ATCO Project**  
 [Alternative arrangement with all facilities incorporated at 230kV]

**DIAGRAM 7**

In addition, with the ATCO Project in-service, analysis has shown that the following contingency conditions could also result in overloading of the 115kV circuits J3CE & J4CE that are not currently addressed by the Scheme:

Contingency Condition	Overloaded Circuit	Extent of Overloading (As a %age of the 15-minute limited-time-rating)
Circuit J4CE: Keith TS to Essex TS	J3CE	138%
<i>Breaker Failure conditions involving</i>		
115kV breaker L4K at Keith TS		138%
115kV breaker L4P at Keith TS		125%
115kV breaker L5L7 at Essex TS		135%
27.6kV breaker T3Y at Crawford TS		131%
Circuit J3CE: Keith TS to Essex TS		J4CE
<i>Breaker Failure conditions involving</i>		
115kV breaker L3P at Keith TS	125%	
115kV breaker T1L3 at Keith TS	140%	
27.6kV breaker T4E at Crawford TS	143%	

In order to address these particular contingency conditions, as well as those that were listed earlier, it is expected that the scope of the existing Schemes will need to be expanded so that they are able to provide appropriate responses for different contingency conditions. This may require detection of the specific contingency condition rather than an actual overload.

#### 4.1 Linear (TLTG) Analysis

The PTI Linear Analysis Program, TLTG, was used to assess the potential impact of the ATCO Development on the existing transfer capability. This Program was used to rank the limiting conditions for both the reference condition, based on the existing system configuration, and for the situation with the ATCO Project incorporated. The respective results were then compared.

The following conditions were assumed as a basis for the analysis:

For Export Conditions:

- A maximum Lake Erie Circulation of 800MW counter-clockwise
- A maximum transfer of 350MW on the J5D Interconnection from Keith TS (Windsor) to the Waterman station in Detroit, Michigan

For Import Conditions:

- A maximum Lake Erie Circulation of 200MW counter-clockwise
- A maximum transfer of 220MW on the J5D Interconnection into Keith TS from the Waterman station in Detroit, Michigan.

For both Import & Export Conditions:

- The tap-changers on the phase-shifters on the L4D, L51D & B3N Interconnections were set on the neutral tap position.
- The phase shifter on the J5D Interconnection was set to regulate the maximum transfers on that Interconnection to the values detailed above.

- No attempt was made to optimise the relative tap positions in order to reduce any import or export restrictions.
- The ratings for the Ontario-Michigan Interconnections were based on an ambient temperature of 35°C and a wind speed of 4km/hr.
- The ratings for all other circuits were based on an ambient temperature of 30°C and a wind speed of 4km/hr.
- The 15-minute limited-time-ratings were based on a pre-loading of 75% of the continuous rating.
- Flows in Amps were converted to MVA at voltages of 235kV & 127kV.

In all of the analysis, Lambton TGS was assumed to be operating at full output, with all four 500 MW units in-service. In addition, the existing generating units at West Windsor Power, TransAlta, and the Dow Chemical Complex were assumed to be operating at their maximum contracted power output.

A select number of Load Flow Studies were performed to confirm the results from the Linear (TLTG) Analysis.

#### 4.2 Results of the Linear (TLTG) Analysis

Diagram 8 shows the principal interfaces that were used in this analysis, and Tables 1 & 2 summarise the results.

#### 4.3 Discussion of the Results.

The analysis only addressed limitations on the Interconnections between Michigan and Ontario, and on that portion of the system between the International Border and London, as shown in Diagram 10. It did not address limitations imposed on the level of imports and exports that could be maintained between Ontario and Michigan as a result of transfers on the other Interconnections with Ontario.

##### 4.3.1 For the IMPORT Condition

*Reference Condition I1, for the existing system configuration.*

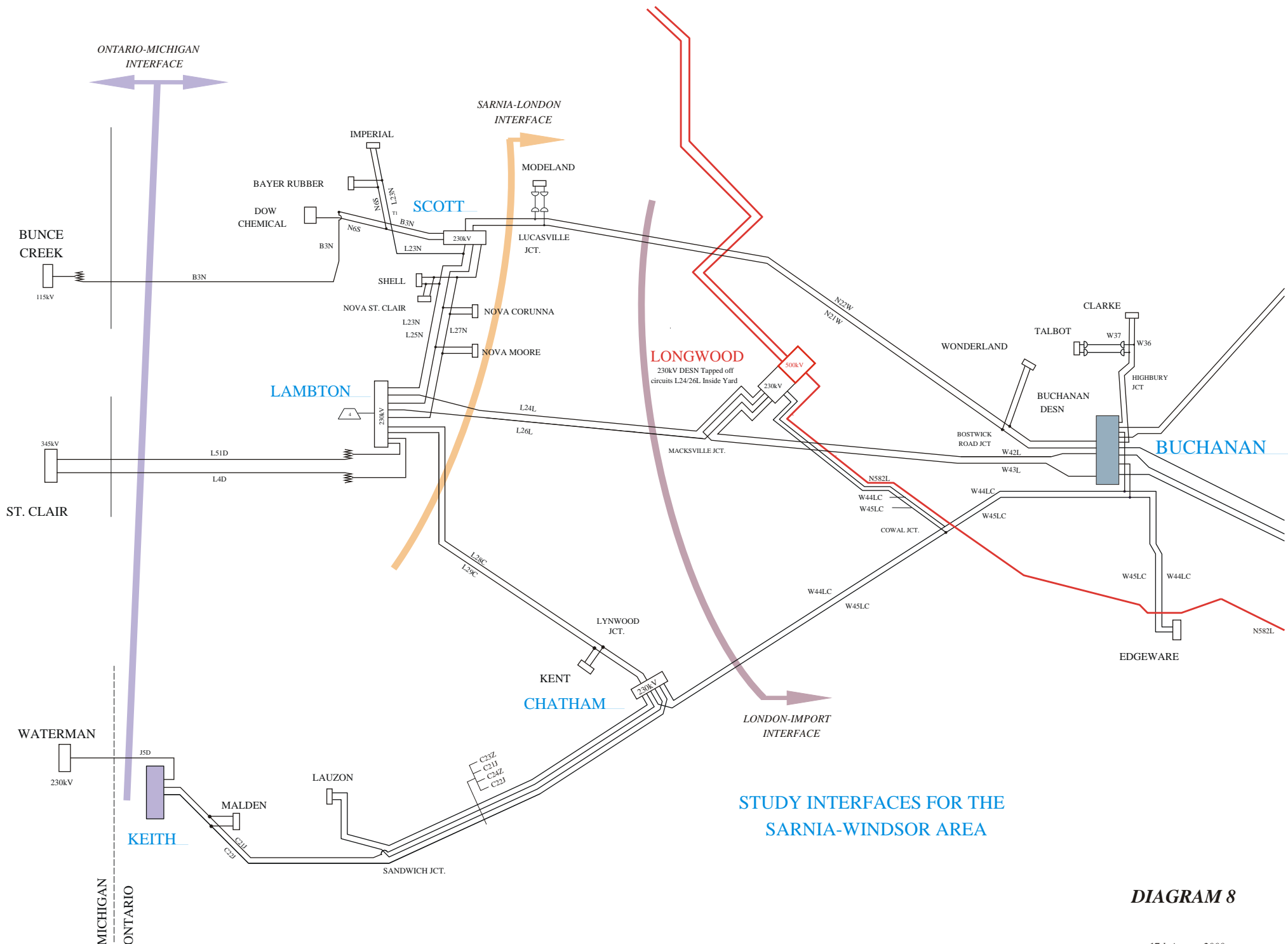
**The transfer capability of the Ontario-Michigan Interface is currently limited to approximately 1500 MW.**

Since a PL51 breaker-failure condition will result in the simultaneous loss of the L51D Interconnection and the G4 generating unit at Lambton TGS, it will result in an increased level of transfers on the remaining Interconnections. In order that the elevated, post-contingency flow appearing on the companion L4D Interconnection does not exceed its 15-minute limited-time-rating of 1170MW, transfers on the Ontario-Michigan Interface have to be restricted to approximately 1500MW.

##### *Condition I2*

If it were possible to increase the 15-minute limited-time-rating of the L4D Interconnection by at least 100MVA, then the next limiting condition would correspond to an Interface flow of approximately 1600MW. At transfers above this level, the post-contingency flow on circuit L28C, for a contingency involving the companion circuit L29C, would exceed its 15-minute limited-time-rating of 652MVA.

[It is worth noting that while circuits L28C & L29C are equipped with identical conductors, the maximum operating temperature for the conductors of circuit L28C is 119°C, while for L29C it is 135°C. Consequently a contingency involving circuit L29C is the more critical one.]



**STUDY INTERFACES FOR THE  
SARNIA-WINDSOR AREA**

**DIAGRAM 8**

17th August 2000

### *Conditions with the ATCO Development Incorporated*

#### *Condition I3*

With the ATCO development in-service, the limiting transfer level is 1505MW; which is the same as for the 'reference transfer level'. Furthermore this transfer limit is determined by the same contingency condition that involves a PL51 breaker-failure at Lambton TGS. Since the failure of this breaker results in the simultaneous loss of the L51D Interconnection and the G4 generating unit at Lambton TGS, transfers have to be limited to 1505MW to ensure that the post-contingency flow on the companion Interconnection, L4D, does not exceed its 15-minute limited-time-rating of 1170MVA.

#### *Condition I4*

Since the limiting transfer level for the previous contingency condition (with the ATCO facility in-service) is the same as the 'reference transfer level', the limiting transfer for this particular condition is provided simply for interest.

If it were possible to increase the 15-minute limited-time-rating of the L4D Interconnection beyond its present value of 1170MVA, then the next limiting transfer level would occur at a transfer of 1563MW. At this level, the pre-contingency flows on the section of circuits N21W & N22W, between Scott TS and Lucasville Junction would exceed their continuous rating of 464MVA.

#### *4.3.2 For the EXPORT Condition*

Under Export Conditions, a Special Protection System is currently available at Lambton TGS, to initiate rejection of a single generating unit at Lambton TGS in response to any of the following conditions:

- Opening of either of the Lambton TGS to St. Clair Interconnections (circuits L4D or L51D)
- Opening of any of the middle breakers in the 230kV switchyard at Lambton TGS (breakers L23L24, L25L26, L27L28 or L51L29)

This action is intended to reduce the post-contingency transfers on the remaining Interconnection.

It should be noted that it might be necessary to include the ATCO Project in the existing Lambton Generation Rejection Scheme.

#### *Reference Condition E1 for the existing system configuration*

**Transfers from Ontario across the Ontario-Michigan Interface are currently limited to approximately 2410MW.**

As a result of a breaker-failure condition involving breaker L51L29 at Lambton TGS, the L51D Interconnection will become open-ended, resulting in increased transfers on the remaining Interconnections. In order to ensure that the post-contingency flow on the B3N Interconnection, even after automatically rejecting one of the Lambton generating units, does not exceed its 15-minute limited-time-rating of 482MVA, the pre-contingency transfer on the Ontario-Michigan Interface will need to be restricted to 2410MW.

#### *Condition E2*

If the 15-minute limited-time-rating of the B3N Interconnection were to be increased, then the continuous rating of the L51D Interconnection would impose the next limiting condition, allowing a marginal improvement in the maximum transfer across the Interface to 2414 MW from 2409 MW.

### *Conditions with the ATCO Development Incorporated*

#### *Condition E3*

At transfer levels above 2400MW, the continuous rating of 845MVA for the L51D Interconnection would be exceeded. However, this value is very close to the 'reference' level of 2410MW, and represents a reduction in the transfer capability of only 10MW.

#### *Condition E4*

The next limiting transfer level of 2420MW corresponds to the same contingency condition that determined the 'reference condition' for maximum transfers for exports to Michigan (an L51L29 breaker-failure). Transfers above this level would result in the 15-minute limited-time-rating of 482MVA for the B3N Interconnection being exceeded.

However, since this transfer level exceeds the 'reference level' for the Interface, then this condition would not be limiting.

### *5.3 Conclusions*

The following conclusions can be drawn from the results of the TLTG Analysis:

#### *Under IMPORT Conditions*

- Incorporating the ATCO Project into the system would have no impact on the present transfer capability of 1505MW for the Ontario-Michigan Interface.

#### *Under EXPORT Conditions*

- Incorporating the ATCO Project into the system would reduce the maximum exports to Michigan by only 10MW (from 2410MW to 2400MW).
- In order to eliminate this reduction in the maximum transfer capability it would be necessary to upgrade the L51D Interconnection so that its continuous rating was no longer restrictive.

**Table 1**  
**Imports from Michigan**

<i>Limiting Transfers Across The Principal Interfaces</i>					
<i>ID</i>	<i>Continuous Rating of each Interface</i>	Ontario-Michigan Interface	Sarnia-London Interface	London Import Interface	Limiting Condition
			<i>2581MW</i>	<i>3263MW</i>	<i>3466MW</i>
I1	For the existing conditions	1505MW	2684MW	1875MW	<i>PL51 Breaker Failure at Lambton TGS.</i> Interface transfers are restricted by the 15-minute limited-time-rating of the L4D Interconnection (1170MVA)
I2		1593MW	2773MW	1964MW	<i>Contingency involving circuit L29C: Lambton to Chatham</i> Interface transfers are restricted by the 15-minute limited-time-rating of the companion circuit L28C (652MVA)
<i>With the ATCO Project Incorporated</i>					
I3	With the ATCO Project Incorporated	1505MW	2684MW	2388MW	<i>PL51 Breaker Failure at Lambton TGS.</i> Interface transfers are restricted by the 15-minute limited-time-rating of the L4D Interconnection (1170MVA)
I4		1563MW	2743MW	2388MW	<i>Base Case – Flows on circuits N21W &amp; N22W: Scott to Lucasville Junction</i> The Pre-contingency flow exceeds the continuous rating for the circuit (464MVA)

Note: Shaded area denotes that this limiting transfer, with the ATCO Project incorporated, would exceed the *existing* 'reference transfer capability' for this Interface.

**Table 2**  
**Exports to Michigan**

<i>Limiting Transfers Across The Principal Interfaces</i>					
<b>ID</b>		Ontario-Michigan Interface	Sarnia-London Interface	London Import Interface	Limiting Condition
	<i>Continuous Rating of each Interface</i>	2581MW	3263MW	3466MW	
E1	For the existing conditions	2409MW	-641MW	-2136MW	<i>L51L29 Breaker Failure at Lambton TGS (with rejection of one Lambton unit). Interface transfers are restricted by the 15-minute limited-time-rating of the B3N Interconnection (482MVA)</i>
E2		2414MW	-647MW	-2142MW	<i>Base Case – Flow on the L51D Interconnection</i> Interface transfers are restricted by the continuous rating of the L51D Interconnection (845MVA)
<i>With the ATCO Project Incorporated</i>					
E3	With the ATCO Project Incorporated	2402MW	-626MW	-1506MW	<i>Base Case – Flow on the L51D Interconnection</i> The Pre-contingency flow exceeds the continuous rating of the Interconnection (845MVA)
E4		2420MW	-697MW	-1577MW	<i>L51L29 Breaker Failure at Lambton TGS (with rejection of one Lambton unit)</i> Interface transfers are restricted by the 15-minute limited-time-rating of the B3N Interconnection (482MVA)

Note: Shaded area denotes that this limiting transfer, with the ATCO Project incorporated, would exceed the *existing* 'reference transfer capability' for this Interface.