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CONNECTION ASSESSMENT & APPROVAL PROCESS

PRELIMINARY ASSESSMENT REPORT

For the Proposed 180MW Portlands Project

by Toronto Hydro Energy Services Inc. & Boralex Inc.

CAA ID No. 2002-053

Consistent Information Set Department, and
Long Term Forecasts & Assessments Department

FINAL Version

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Preliminary Assessment Report

For the Proposed Portlands Project by Toronto Hydro Energy Services Inc.and Boralex Inc.

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 whether the connection applicant's proposed connection to the IMO-controlled grid would have an adverse impact on the reliability of the integrated power system and whether the IMO should issue a notice of approval or disapproval of the proposed connection 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. In particular, this report does not address any other Market-related or any commercial aspects of the connection proposal. This report has been prepared solely for use by the connection applicant 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 that 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. The IMO reserves the right to revise any drafts of this report that it provides to the connection applicant, at any time, at its sole discretion, without notice to the connection applicant. Although the IMO will use its best efforts to advise the connection applicant of any such changes, it is the responsibility of the connection applicant to ensure that the most recent version of this report is being used.

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 the 115kV cables and the skywires of the 115kV overhead lines in the Leaside sector. It does not include other Hydro One facilities; in particular the existing station buswork. The short circuit results are only for the purpose of assessing the capabilities of existing Hydro One breakers, cables and overhead line skywires, 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 under the current IMO Connection Assessment and Approval process. Additional facility studies may be necessary to confirm constructability and the time required for construction. Further studies at more advanced stages in the development of the project may identify additional facilities that need to be provided or that require upgrading.

PRELIMINARY ASSESSMENT REPORT

For the Portlands Project: A Joint Development between Toronto Hydro Energy Services Inc. and Boralex Inc.

EXECUTIVE SUMMARY

Introduction

Toronto Hydro Energy Services Inc. and Boralex Inc. are proposing to install a 180MW (220MVA) combined-cycle generating facility at the Paperboard Industries Corporation site on Commissioners Road in the Portlands area of downtown Toronto. The facility is to consist of three identical gas-turbine units and a single steam-turbine unit. Each unit is to be rated at 55.3MVA.

The scheduled in-service date for the new facilities is Q3-2004.

Incorporation Arrangement for the new generating facilities

It is proposed to connect the new generating facilities on to the existing 115kV tapped circuits, H1L & H3L, between Basin Junction and Basin TS. The bus-section switches at the new facility are to be operated normally-open so that half the new development will be associated with each connection.

An alternative connection arrangement for the Portlands Project has been proposed by the IMO to allow both it, and the Portlands Energy Centre Project, to be developed.

Thermal Limitations of the Existing 115kV System

With the 115kV busbar at Hearn TS operated normally-open at breaker positions 5A6 & 7P8 (a diagonal split) the transfer capabilities from each half of the Hearn 115kV busbar are limited to approximately 340MVA. This would not be sufficient to accommodate the output of both the Portlands Energy Centre (formerly the Hearn New Generation) Project and the Portlands Project. Since the transfer capabilities are limited by the continuous thermal ratings of the sections of circuits H6LC & H8LC, between Hearn TS and Gerrard Junction, uprating these circuits would achieve an increase in these transfer capabilities. With an increased continuous rating of approximately 227MVA (1100 amp) for the overhead line section of these circuits, the transfer capabilities from the two halves of the Hearn 115kV busbar would increase to approximately 410MVA. This would be sufficient to accommodate the full output from both Projects.

However, this would require the connections for the Portlands Project to be distributed on to the two halves of the Hearn 115kV busbar. Half of the facility would remain connected to either circuit H1L or H3L. The other half would need to be connected via a new 115kV connection directly on to the Outer Busbar at Hearn TS. This would require the installation of a new 115kV in-line breaker at Hearn TS to provide a termination for the new 115kV single-circuit connection from the generating plant.

Generation Rejection

If both Projects were to be developed, the generation rejection scheme required for the incorporation of the Portlands Energy Centre Project would need to be enhanced. A functional specification for the enhanced scheme has been included in the Report.

Fault Level Analysis

The fault level analysis showed that the incorporation of the Portlands Project, either in isolation, or together with the Portlands Energy Centre Project would result in the fault interrupting capability of some of the existing breakers being exceeded. This would therefore require the numbers of breakers shown in the following Table to be replaced at Leaside TS and Hearn TS.

System Conditions *Leaside 115kV Busbar 'OPEN' & Terauley TS Quartered & Operated 'OPEN'*	***No. of Breakers to be Replaced***				
	At Leaside TS		***At Hearn TS***		***Total No.***
*Hearn 115kV Busbar '**CLOSED**':*	*3-phase*	*L-G*	*3-phase*	*L-G*	
Portlands Project in isolation: *Incorporated via circuits H1L & H3L at Basin TS*	*8*	***26***	*12*	***12***	***38***
*Hearn 115kV Busbar '**OPEN**' at breakers 5A6 & 7P8:*	*3-phase*	*L-G*	*3-phase*	*L-G*	
Portlands Project in isolation: *Incorporated via circuits H1L & H3L at Basin TS*	*8*	***26***	***1***	***1***	***27***
Portlands Project distributed across both halves of the Hearn 115kV busbar					
*Hearn 115kV Busbar '**OPEN**' at breakers 5A6 & 7P8:*	*3-phase*	*L-G*	*3-phase*	*L-G*	
Portlands Project in isolation	*11*	***26***	*0*	*0*	***26***
Portlands Energy Centre Project in isolation	*25*	***26***	*3*	***6***	***32***
Portlands Energy Centre & Portlands Projects	***26***	***26***	*5*	***8***	***34***

Note: The shaded cells correspond to the situation with only the Portlands Energy Centre Project in-service, which was addressed in the Preliminary Assessment Report for the Hearn New Generation Project.

Impact of Increased Fault Levels on Other Transmission Facilities in the Leaside Sector

The short-circuit capabilities of the following facilities are also expected to be inadequate for the increased fault levels arising from the incorporation of the new generating facilities. Further analysis will be required to confirm the extent of any replacement program that may be necessary.

With both the Portlands Energy Centre Project & the Portlands Project in-service		
115kV Underground Cables whose short-circuit capability may be inadequate		
Circuits	*Sections*	*Approximate Length*
H7L & H11L	Leaside TS to Todmorden Junction	0.80km
H7L & H11L	Lumsden Junction to Main TS	1.53km
H7L & H11L	Hearn TS to Main TS	0.92km
H1L & H3L	Basin Junction to Mill Street Junction	1.53km
H1L & H3L	Mill Street Junction to Gerrard TS	1.37km
H3L	Bloor Street Junction to Gerrard TS	1.80km
Skywires on 115kV circuits whose short-circuit capability may be inadequate		
Circuits	*Sections*	*Approximate Length*
H6LC & H8LC	Bloor Street Junction to Don Fleet Junction	2.93km
H5E & H7E	Hearn TS to Esplanade TS	3.15km
H2JK	Hearn TS to Don Fleet Junction	0.35km

Transient Stability Studies

Where machine data were missing, appropriate values were assumed. In addition, since no models were provided for the exciter, the power system stabiliser or the governor, suitable models were assumed.

Using these models and assumed data, the transient responses for all the fault conditions that were examined were stable and well damped.

IMO Requirements for the Incorporation of the 180MW Portlands Project

From its assessment of the proposed connection, the IMO has identified the following requirements for the incorporation of the Portlands Project:

If the Portlands Project were to be developed in isolation (i.e. without the Portlands Energy Centre Project.)

1. Connect the new generating facility to circuits H1L & H3L at Basin TS.
   (the bus-section breakers at the new facility are to be operated normally-open).

   Operate with the 115kV busbar at Hearn TS open at breaker positions 5A6 & 7P8 (a diagonal split).
2. Replace 26 - 115kV breakers at Leaside TS

If the Portlands Energy Centre Project and the Portlands Project are both developed

1. Connect half the new Portlands Project to circuit H1L or H3L at Basin TS, and connect the remaining half via a new 115kV circuit to the Outer Busbar at Hearn TS. A new 115kV in-line breaker will need to be installed at Hearn TS.

   Operate with the 115kV busbar at Hearn TS open at breaker positions 5A6 & 7P8 (a diagonal split).
2. Replace 26 - 115kV breakers at Leaside TS with units rated at 63kA symmetrical.
   Replace 8 - 115kV breakers at Hearn TS.
3. Uprate the 115kV circuits H6LC & H8LC between Hearn TS and Gerrard Junction to a continuous rating (for a maximum conductor temperature of 93^{o}C at an ambient temperature of 30^{o}C) of approximately 1100 amp.
4. Enhance the Generation Rejection Scheme that is to be installed for the Portlands Energy Centre Project.

Note: *While it would be possible to incorporate the Portlands Project, in isolation, via only the Inner Busbar at Hearn TS it is recommended that if this arrangement is adopted that provision be included in the design to allow half of the Portlands Project to be reterminated on to the Outer Busbar should the Portlands Energy Centre Project be developed at a later date.*

Since the fault levels at Leaside TS, with both Projects in-service, would exceed the 50kA rating specified in the Transmission System Code for the 115kV system, it is recommended that breakers with a higher fault interrupting capability than 50kA be used to replace all of the existing breakers whose ratings would be exceeded.

AND

Perform detailed studies to confirm the extent of the work required to replace those skywires and 115kV cables whose short-circuit capabilities are inadequate for the higher fault levels, and proceed with the replacement of these skywires and cables.

AND

Where data have had to be assumed, the Proponents will be responsible for ensuring that the equipment that is eventually installed meets or exceeds the values that are shown in the Diagrams (so as to result in an equal or superior performance to that shown in the stability plots). In addition, the input to the power system stabiliser will need to produce a unit damping torque that is in-phase with any changes in the speed of the generator.

It is also *recommended* that should it be necessary to replace a substantial number of the existing circuit breakers and/or an extensive amount of the existing buswork at Hearn TS, that serious consideration be given to revising the existing arrangement so that the upgraded facilities conform to a breaker-and-a-half or a breaker-and-a-third design.

Approximate Cost Estimates

Approximate cost estimates have been provided for all the work that has been identified.

Identification of 'Sole Beneficiary'

Those facilities that are triggered by, and deemed to be for the sole benefit of this Project, have been identified.

Need for a System Impact Assessment

The scope of this assessment was expanded to include the transient stability analysis, and a separate System Impact Assessment is therefore not required.

Impact of New Generating Capacity at Hearn TGS on NPCC

The IMO has concluded that the Portlands Project will not be declared an NPCC critical facility following the incorporation of the new generating capacity, together with its fully duplicated generation rejection scheme.

Customer Impact Assessment

The Customer Impact Assessment has been deferred until the Connection Assessment for an alternative connection arrangement for the Portlands Project can be completed.

If the arrangement that has been considered in this Assessment is the one that is subsequently selected for a Customer Impact Assessment, then any adverse impacts that may be identified in the CIA will be addressed through an Addendum to this Preliminary Assessment Report.

Scheduled In-service Date

The IMO considers that the scheduled in-service date may not be achievable due to the extensive breaker-replacement work that needs to be completed, particularly at Leaside TS. The Proponents are therefore encouraged to consult with Hydro One and revise their in-service date accordingly.

Notification of Approval of the Connection Proposal

Subject to satisfying all of the IMO's requirements that have been identified in this Report for the incorporation of the Portlands Project, it is recommended that a Notification of Approval for Connection be issued.

However, the IMO reserves the right to impose further requirements to mitigate any adverse impacts that may be identified in a subsequent Customer Impact Assessment for this Project.

PRELIMINARY ASSESSMENT REPORT

for the

Proposal by Toronto Hydro Energy Services Inc.

and

Boralex Inc.

To Connect the 180MW Portlands Project

Preliminary Assessment Report for the Portlands Project:
A Joint Development between Toronto Hydro Energy Services Inc. and Boralex Inc.

1. Introduction

The Portlands Project involves the installation of a four-unit 180MW generating facility at the Paperboard Industries Corporation site on Commissioners Road, in the Portlands area of downtown Toronto. The facility is to consist of three identical gas-turbine units, each rated at 55.3MVA, and a single steam-turbine unit, also rated at 55.3MVA.

The proposed in-service date for the new facility (corresponding to the start of full commercial operation) is Q3-2004.

2. Connection Arrangement

Diagram 1 shows the proposed connection arrangement for the new generating facilities that it is proposed to install at the Paperboard Industries site.

All four generating units are to be connected to a common 13.8kV busbar through individual 13.8kV synchronising breakers. The 13.8kV busbar is to be operated normally-open with two generating units connected to each half of the split busbar.

Two 115/13.8kV step-up transformers, each rated at 166.6MVA, are to connect the two halves of the 13.8kV busbar to the 115kV tapped connections, between Basin Junction and Basin TS, to circuits H1L and H3L.

Each connection on to circuits H1L & H3L is to be equipped with a 115kV breaker. A further 115kV bus-tie breaker, which is to be maintained 'normally-open', has been included in the arrangement proposed by the Applicants.

Since the tapped connections between Basin Junction and Basin TS are equipped with 795kcmil conductors, with a continuous summertime rating of approximately 177MVA, each connection would be adequate to accommodate half of the full output of the Portlands Project, even if there were no load at Basin TS.

Coupled Offers

It should also be noted that the tools that the IMO presently has available for determining the dispatch of generation facilities requires separate offers to be submitted for each injection point. Since the incorporation arrangement proposed for the connection of the new generating facilities to the IMO-controlled grid will mean that two distinct injection points would be used for this Project, then separate offers would be required for each of them.

It is recognised that to fully exploit the inherent efficiencies of combined-cycle generating facilities, the offers for each injection point on the IMO-controlled grid would need to be inter-dependent. However, the existing IMO tools for dispatching generation capacity are presently unable to accommodate such coupled offers.

Hearn Switching Station

On 1st July 2002, Hydro One and Ontario Power Generation officially separated their respective facilities at the Hearn TGS site. All of the 115kV switching facilities at the site have now been segregated from those facilities associated with the Powerhouse.

Accordingly, all references in this Report to those facilities within the switchyard at the Hearn site will use the designation 'Hearn TS'.

3. Thermal Limitations of the Existing 115kV System

Terauley TS

Hydro One is currently in the process of installing two new 115kV circuit switchers at Terauley TS to allow the existing facilities to be quartered and operated normally-open. With new normally-open points established at Terauley TS, the two in-line breakers at Esplanade TS, which are presently operated normally-open, will then be operated closed.

Diagram 2 shows the arrangement of the Leaside sector once Terauley TS has been quartered and is being operated split.

With Terauley TS operated split, the 115kV busbar at Hearn TS can only be operated closed, or split ***diagonally*** *at breaker positions 5A6 and 7P8. Operating with a vertical split of the Hearn 115kV busbar, with breakers 6P7 and A1P8 both open, would not be acceptable since a double-circuit contingency involving circuits H6LC & H8LC would result in the isolation of the entire load at Esplanade TS.*

Fault Level Considerations

Although the results of the fault level analysis are dealt with later in this Report, the analysis that was performed for the Portlands Energy Centre (formerly the Hearn New Generation Project) showed that it would be necessary to operate with the Hearn 115kV busbar split to restrict the fault levels, and hence limit the number of breakers that would need to be replaced at that location.

Diagonal split of the Hearn 115kV busbar

Since the earlier study had concluded that a diagonal split of the Hearn 115kV busbar would provide the required transfer capability to accommodate the proposed Portlands Energy Centre, the scope of this study with both Projects in-service, was therefore confined to this operating arrangement.

Diagram 3 therefore shows the configuration of the Leaside sector that was used as the basis for the analysis.

3.1 Linear Load Flow Analysis

Table 1 shows the results of the Linear Load Flow Analysis for the peak load condition for the summer-2004, with the 115kV busbar at Leaside TS open and with a diagonal split of the Hearn 115kV busbar.

[The loads used correspond to those that were supplied by Toronto Hydro in their Load Forecast, dated summer-2001]

Limiting Contingencies

For the purpose of this analysis, double-circuit contingencies, or stuck-breaker conditions that result in the loss of two circuits by configuration, are not considered to be limiting. It is proposed that facilities would be installed to initiate generation rejection and thereby address the resulting overloads arising from these particular conditions.

Transfer Capabilities

As shown in Table 1, the first limiting condition for the 115kV **Inner** Busbar at Hearn TS would be a single-circuit contingency involving circuit H6LC (Item 2 in the Table). A contingency involving this circuit would restrict the maximum transfer that could be made away from this section of the Hearn 115kV busbar to approximately 348MVA.

Similarly, the first limiting condition for the 115kV **Outer** Busbar at Hearn TS would be a single-circuit contingency involving the companion circuit H8LC (Item 4 of the lower portion of the Table). This contingency would restrict the maximum transfers that could be made away from this section of the Hearn 115kV busbar to approximately 341MVA.

Diagram 4 shows the limiting transfers from the two halves of the Hearn 115kV busbar.

Ability to accommodate the output from the Portlands Projects

The maximum continuous summer rating of each of the generating units has been quoted at 44.7MW, which would give a total output of approximately 179MW, ignoring any station load. If it is assumed that under peak load conditions that the generating units could be required to operate at a power factor of up to 0.9, then a transfer capability of approximately 200MVA would be required.

With the Portlands Project developed in isolation (i.e. without the Portlands Energy Centre Project), the analysis shows that the transfer capability of 348MVA from the Inner Busbar would be sufficient to accommodate the entire output of the Portlands Project with it connected to circuits H1L & H3L, close to Basin Junction.

However, with the 550MW Portlands Energy Centre connected to both the 115kV Inner and Outer Busbars at Hearn SS, approximately 275MVA of the transfer capability from each half of the Hearn 115kV busbar would already have been committed.

There would therefore be only enough transfer capacity available to accommodate approximately 140MVA (2 x 70MVA) from the Portlands Project. In addition, it would necessitate connecting half of the proposed new facilities to the Outer portion of the 115kV busbar.

Diagram 5 shows an alternative connection arrangement for the Portlands Project that would allow a combined capacity of 140MVA to be connected to the IMO-controlled grid.

System Upgrades required to allow additional generating capacity to be incorporated

An examination of Table 1 shows that the transfer capability for single-circuit contingencies is restricted by the continuous rating of the following circuits:

- For the Inner Busbar -
    - Circuit H8LC between Hearn TS & Gerrard Junction (Item 2)

and

- For the Outer Busbar -
    - Circuit H6LC between Hearn TS & Gerrard Junction (Items 4 & 5)

Furthermore, if these two circuits were uprated/reconductored over the critical section between Hearn TS and Gerrard Junction so that their continuous rating would be higher than the next limiting element (circuit H1L - Item 5 for the Inner busbar and Item 8 for the Outer busbar), then the transfer limit from either half of the Hearn busbar would increase to 409MVA.

Since a transfer limit of 409MVA would be sufficient to accommodate the full output of both the Portlands Energy Centre and the Portlands Project, it would therefore not be necessary to consider uprating/reconductoring any additional circuits to increase the transfer limits from the respective halves of the Hearn 115kV busbar.

Table 2 shows the effect of reconductoring circuits H6LC & H8LC over the section of the double-circuit line between Hearn TS and Gerrard Junction with 1192kcmil conductors to replace the existing 795kcmil conductors. This change in the conductor size would increase the continuous rating from 177MVA to 227MVA, at an assumed ambient temperature of 30^{o}C and a wind speed of 4km/hour.

Analysis has also confirmed that the transfers through the two step-down transformers at Basin TS remain balanced even with half of the Portlands Project connected to only one of the taps to Basin TS. This is due to the close proximity of the Hearn 115kV busbar and the relatively high impedance of each of the step-down transformers.

4. Generation Rejection

With the Portlands Project developed in isolation

Since a double-circuit contingency involving circuits H1L & H3L would result in the automatic rejection of all of the generating capacity at the Portlands Project, the most restrictive operating condition would be the loss of circuit H8LC while circuit H1L or H3L is out-of-service. For this condition, after allowing for the local load at Basin TS and the portion of the loads at Esplanade TS and Terauley TS that is normally supplied via circuit H5E, the transfer on the remaining 115kV circuit would be well within its continuous rating.

Even if a vertical split of the Hearn 115kV busbar were to be used (although this would require Terauley TS and Esplanade TS to be operated closed), the most restrictive operating condition would be a double-circuit contingency involving circuits H7L & H11L, while either circuit H1L or H3L is out-of-service. After allowing for the local load at Basin TS, the transfer on the remaining 115kV circuit would be within its continuous rating.

Generation Rejection facilities would therefore not be required.

With both the Portlands Energy Centre and the Portlands Project developed

With both Projects developed and with all elements in-service pre-contingency, the transfer capabilities from both the Inner and Outer Busbars at Hearn TS would be insufficient to accommodate the full output of the two Projects under double-circuit contingency conditions or for a stuck-breaker condition following a single-circuit contingency.

Similarly under outage conditions, the transfer capability from the respective halves of the Hearn 115kV busbar would not be sufficient to accommodate the full output of both generating Projects following selected single- or double-circuit contingencies.

With both Projects developed, a generation rejection scheme would therefore be required at Hearn TS to initiate rejection of appropriate amounts of generating capacity at the Portlands Energy Centre and the Portlands Project in response to the following contingency conditions:

i. H1L single-circuit contingency
ii. H3L single-circuit contingency
iii. H1L & H3L double-circuit contingency
iv. H1L & H3L (by configuration)
v. H7L single-circuit contingency
vi. H11L single-circuit contingency
vii. H7L & H11L double-circuit contingency
viii. H7L & H11L (by configuration)
ix. H2JK single-circuit contingency
x. H5E single-circuit contingency
xi. H7E single-circuit contingency
xii. H5E & H7E double-circuit contingency
xiii. H6LC single-circuit contingency
xiv. H8LC single-circuit contingency
xv. H6LC & H8LC double-circuit contingency
xvi. H5E & H8LC (by configuration)
xvii. L4L8 stuck breaker condition at Leaside TS
xviii. L8L12 stuck breaker condition at Cecil TS

Standard Requirements for Special Protection Systems

Any new Special Protection System (G/R, L/R and/or Cross-Tripping Scheme) or enhancements to existing SPSs must comply with the following criteria:

- All facilities are to be fully duplicated.
- The logic used for detecting a contingency condition is to be connectivity based (i.e. rejection is to be initiated by the status of the switching devices), and
- The SPSs are to be capable of being pre-armed with the appropriate selections to ensure an immediate response to each contingency condition that is addressed by the Scheme.

Diagram 6 shows the functional specification for the proposed generation rejection facilities for the incorporation of both the Portlands Energy Centre and the Portlands Project.

5. Impact on Reliability

With the Portlands Project developed in isolation

If only the Portlands Project were to be developed, it would be connected to circuits H1L & H3L (as shown in Diagram 1) and this would mean that a double-circuit contingency involving these two circuits would result in the entire generating facility being tripped. However, since this contingency condition would also result in the loss of approximately an equivalent amount of load at Carlaw TS, Gerrard TS and Basin TS, the net result on the Leaside sector would be minimal.

For this arrangement the intent would be to operate with both the HV and LV bus-section breakers open. This would result in the automatic rejection of half the new generating facility in the event of a contingency involving either of the 115kV circuits H1L and H3L. However, depending on the local load at the Portlands site and also at Basin TS there could be periods when it would be possible to operate with the bus-section breakers closed. This would avoid the loss of generation capacity in response to a single-circuit contingency involving either of the main 115kV circuits or either of the step-up transformers. Should it be decided to take advantage of the opportunity to operate with either or both of the LV and HV busbars closed, then this would need to be considered further in the detailed design phase for the new facilities to ensure that equipment ratings are adequate.

Similarly under outage conditions there could be situations when system conditions would allow the entire Portlands facility to be connected to just a single 115kV circuit. For this operating condition, a contingency involving the 115kV circuit to which the Portlands Project is connected would result in the loss of the 115kV circuit together with the entire Portlands facility. While this would represent an extreme contingency condition, analysis has shown that the resulting voltage decline would be less than 2kV, or approximately 1.5%. This would be well within the IMO's criterion 10%.

With both the Portlands Energy Centre Project & the Portlands Project developed

If both Projects were to be developed, then the Portlands Project would need to be distributed between the Inner and Outer 115kV Busbars at Hearn TS (as shown in Diagram 5). With this arrangement a double-circuit contingency involving circuits H1L & H3L would result in the loss of only half of the Portlands Project. Since the transfer capability for the Inner Busbar at Hearn TS for this particular contingency condition, once circuits H6LC & H8LC have been upgraded, would be approximately 338MVA (as shown in Table 2) then there should be no need to reject further generating capacity to respect thermal ratings.

With the Portlands Project distributed between the Inner and Outer 115kV Busbar at Hearn TS, operating with the LV and/or the HV bus-section breakers closed would not be permitted since this would effectively interconnect the two halves of the 115kV busbar at Hearn TS. However, under outage conditions, depending on the thermal ratings of the remaining circuits and the local load at the Portlands development, there could be opportunities to operate with the entire Portlands Project connected via a single circuit. Again, consideration would need to be given to the implications of this mode of operation on the protective relaying; the thermal ratings; and the fault interrupting capability of the equipment in the detailed design phase for the Project.

General

Since synchronising and rejection of the individual generating units is to be achieved via operation of the LV breaker associated with each individual unit, neither of these operations will impact the integrity of the 115kV transmission system or the connections of the remaining generating units.

Furthermore, the incorporation of the new generating facilities, regardless of which incorporation arrangement is adopted, will not introduce any new contingency conditions. It has therefore been concluded that the proposed connection arrangement for the Portlands Project will have no negative impact on the IMO-controlled grid.

6. Fault Level Analysis

Fault level studies were performed to determine the impact of the proposed new generating facilities at the Portlands Project 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' were assumed to be in-service.
- The three Interconnections with Michigan reflect their final arrangement following the installation of the new phase-shifters.
- All four generating units at Bruce 'B' together with units 3 & 4 at Bruce 'A' were assumed to be in-service.
- All four generating units at Pickering 'A' and at Pickering 'B' were assumed to be in-service.
- All four units at Lakeview GS were assumed to be in-service with the 230kV busbar split.
- The two 500/230kV auto-transformers at Lennox TS, together with units G1 to G4 at Lennox GS were assumed to be in-service.
- The 230kV busbars at Richview TS were assumed to be split, while Cherrywood TS was assumed to have both the North & South switchyards split.
- The 230kV busbar at Claireville TS was assumed to be closed.
- The 115kV busbar at Leaside TS was assumed to be split.
- All of the generation Projects in the Sarnia-Windsor area that have been the subject of a connection assessment were assumed to be in-service.
- The Sithe-Goreway and Sithe-Southdown Projects were assumed to be in-service
- The proposed 1050MW Project that is expected to be constructed in the St Clair area of the Detroit Edison System was assumed in-service
- *The original (1995) representation for the Detroit Edison Company in the year-2000 was used to model that system*.

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.

*Note: The facilities that are detailed above are considered to represent the **'existing'** system in all of the subsequent analysis and in the discussion of the results.*

6.1 System Conditions Examined

Status of the 115kV Busbars at Leaside TS and Hearn TS

In the studies that were performed for the Portlands Energy Centre Project it was determined that to minimise the number of breakers whose fault interrupting capability would be exceeded, while maximising the transfer capability away from the Hearn 115kV busbar, the following operating arrangement for the 115kV busbars at Leaside TS and Hearn TS represented the 'optimum':

- Leaside 115kV busbar open at breaker positions EK & JP
- Hearn 115kV busbar open at breaker positions 5A6 & 7P8: a diagonal split

In all of the fault level studies performed with the Portlands Energy Centre Project in-service, either in isolation or together with the Portlands Project, only this operating arrangement was therefore considered.

For the situation with only the Portlands Project in-service, fault level studies were performed with the 115kV busbar at Hearn TS operated closed, as well as split diagonally.

Operating Arrangements that were Studied

The following Table details the various operating conditions that were examined and includes the reference number of the respective Diagrams and Tables in which the fault level results have been summarised.

System Condition		***Fault Condition***	***Station***	***Table***	***Diagram***
With the Leaside 115kV Busbar Open at breakers EK & JP *With Terauley TS Quartered and Open*					
Portlands Project in isolation *Incorporated via circuits H1L & H3L at Basin TS*	Hearn Closed	3 -Phase Fault	Leaside TS	3A	7
		Single Line-to-Ground Fault			8
		3 -Phase Fault	Hearn TS	3B	9
		Single Line-to-Ground Fault			10
	Hearn Open at breaker positions 5A6 & 7P8: Diagonal Split	3 -Phase Fault	Leaside TS	4A	11
		Single Line-to-Ground Fault			12
		3 -Phase Fault	Hearn TS	4B	13
		Single Line-to-Ground Fault			14
Portlands Project in isolation *Distributed over two halves of Hearn busbar*		3 -Phase Fault	Leaside TS	5A	15
		Single Line-to-Ground Fault			16
		3 -Phase Fault	Hearn TS	5B	17
		Single Line-to-Ground Fault			18
Portlands Energy Centre Project in isolation		3 -Phase Fault	Leaside TS	5A	19
		Single Line-to-Ground Fault			20
		3 -Phase Fault	Hearn TS	5B	21
		Single Line-to-Ground Fault			22
Portlands Energy Centre Project & Portlands Project		3 -Phase Fault	Leaside TS	5A	23
		Single Line-to-Ground Fault			24
		3 -Phase Fault	Hearn TS	5B	25
		Single Line-to-Ground Fault			26

The convention that has been employed in the summary tables to distinguish between the various fault level results is to shade those cells that contain the symmetrical fault level values and ratings, and to leave those cells that contain the asymmetrical values unshaded.

Where the projected fault levels at the main busbars exceed the fault interrupting capability of the existing breakers, the relevant figures in the summary tables have been shown in ***bold-italic.***

The Diagrams also provide details of the fault interrupting capability of the existing circuit breakers. In addition, those breakers whose rating would be exceeded for the particular system configuration under consideration and with the new generation capacity at the Portlands Energy Centre Project and the Portlands Project in-service have been individually identified.

6.2 'Existing' System Conditions

Included in each of the Tables are the fault levels for the ***'existing'*** system once the four units at Pickering 'A' and the two units at Bruce 'A' have been returned to service, and the proposed Sithe-Goreway and Sithe-Southdown generating facilities have been placed in-service.

These fault levels show that with the return to service of the generating units at Pickering 'A' and Bruce 'A' and following the completion of the two new Sithe plants, the fault interrupting capability of the existing breakers at Leaside TS and Hearn TS are expected to be exceeded.

This situation was previously identified in the Preliminary Assessment Report for the Quartering of Terauley TS, and the solution that was proposed was for the IMO the 'manage' the situation until a permanent solution could be developed.

One possible interim measure could involve imposing a restriction of the maximum voltage at which the 115kV busbars at Leaside TS and Hearn TS could be operated when all the critical generating facilities are in-service. [See Section 7.4 of that Report.]

6.3 Fault Level Results

The Table below shows the incremental increases in the fault levels at Leaside TS and Hearn TS that would be expected to result from the incorporation of the two Projects.

- The results for Cases 1 & 2 in the upper half of the Table are for the Portlands Project, in isolation, connected via circuits H1L & H3L at Basin TS.

  While the results for each Case show similar increases in the fault levels at Hearn TS (for the Inner Busbar to which the Project would be connected) and at Leaside TS they cannot be compared directly because the initial, reference fault levels are entirely different for the two operating conditions considered for the 115kV busbar at Hearn TS (i.e. ***closed*** and ***split diagonally***).

- Since the results for Cases 2 to 5 inclusive correspond to the same system configuration (with the 115kV busbar at Hearn split diagonally), they can be compared directly.

  Comparing the results for Cases 2 & 3 shows that incorporating the Portlands Project either to circuits H1L & H3L at Basin TS, or distributing it evenly between the Inner and Outer Busbars at Hearn TS will have essentially the same impact on the fault levels at Leaside TS.

  However, as shown in Case 2, connecting all of the Portlands Project to the Inner Busbar at Hearn TS would result in a marked increase in the fault levels for that busbar compared to the values for the Outer Busbar. With the new generating units distributed between the two halves of the Hearn busbar, the resulting increases in the fault levels would be more similar, as shown in Case 3.

- Cases 3 & 4 show the respective increases in the fault levels at Leaside TS and Hearn TS resulting from the incorporation of only the Portlands Project and the Portlands Energy Centre Project, respectively.

  The higher values for Case 4 (for just the Portlands Energy Centre Project) reflect the greater capacity of this Project (550MW) compared to the Portlands Project (180MW).

- Case 5 shows the increases in fault levels that would be expected to occur should both Projects be developed.

  These expected increases would be substantial and would be approximately double the 'existing' fault levels at Hearn TS (with the busbar split diagonally), while increasing the already high fault levels at Leaside TS by approximately a third.

  Particular attention is drawn to the fault levels in Table 5A corresponding to this condition with both Projects incorporated. This shows projected fault levels of 50.06kA symmetrical and 61.98kA asymmetrical at Leaside TS.

  These would therefore exceed the 50kA symmetrical rating specified for 115kV breakers in the Transmission System Code.

  If a suitable margin is to be provided for future increases in fault level as a result of new transmission facilities or the incorporation of further generating capacity in the GTA region, then breakers with a higher rating than 50kA would need to be installed.

System Conditions *Leaside 115kV Busbar 'OPEN' & Terauley TS Quartered & Operated 'OPEN'*	***Incremental Increases in Fault Levels***			
	At Leaside TS		***At Hearn TS***	
*Hearn 115kV Busbar '**CLOSED**':*	*West*	*East*		
1 Portlands Project in isolation: *Incorporated via circuits H1L & H3L at Basin TS*	*3.90kA sym* *4.96kA asym*	*5.36kA sym* *6.32kA asym*	*7.35kAsym* *9.40kA asym*	
*Hearn 115kV Busbar '**OPEN**':* *at breakers 5A6 & 7P8*	*West*	*East*	*Inner*	*Outer*
2 Portlands Project in isolation: *Incorporated via circuits H1L & H3L at Basin TS*	*3.72kA sym* *4.96kA asym*	*5.35kA sym* *6.31kA asym*	*7.72kA sym* *8.70kA asym*	*2.75kA sym* *2.43kA asym*
Portlands Project distributed across both halves of the Hearn 115kV busbar				
*Hearn 115kV Busbar '**OPEN**':* *at breakers 5A6 & 7P8*	*West*	*East*	*Inner*	*Outer*
3 Portlands Project in isolation	*3.92kA sym* *5.27kA asym*	*5.27kA sym* *6.21kA asym*	*5.41kA sym* *6.29kA asym*	*5.32kA sym* *7.93kA asym*
4 Portlands Energy Centre Project in isolation	*7.06kA sym* *9.12kA asym*	*9.68kA sym* *11.14kA asym*	*12.44kA sym* *18.85kA asym*	*11.59kA sym* *17.29kA asym*
5 Portlands Energy Centre & Portlands Projects	*10.16kA sym* *12.83kA asym*	*13.54kA sym* *15.37kA asym*	*17.17kA sym* *23.79kA asym*	*15.26kA sym* *24.22kA asym*

The Table below provides a summary of the numbers of breakers, as shown in the individual fault level diagrams, that would need to be replaced at Leaside TS and Hearn TS, for either three-phase or line-to-ground faults, for each of the operating scenarios that were considered.

System Conditions *Leaside 115kV Busbar 'OPEN' & Terauley TS Quartered & Operated 'OPEN'*	***No. of Breakers to be Replaced***				
	At Leaside TS		***At Hearn TS***		***Total No.***
*Hearn 115kV Busbar '**CLOSED**':*	*3-phase*	*L-G*	*3-phase*	*L-G*	
Portlands Project in isolation: *Incorporated via circuits H1L & H3L at Basin TS*	*8*	***26***	*12*	***12***	***38***
*Hearn 115kV Busbar '**OPEN**' at breakers 5A6 & 7P8:*	*3-phase*	*L-G*	*3-phase*	*L-G*	
Portlands Project in isolation: *Incorporated via circuits H1L & H3L at Basin TS*	*8*	***26***	***1***	***1***	***27***
Portlands Project distributed across both halves of the Hearn 115kV busbar					
*Hearn 115kV Busbar '**OPEN**' at breakers 5A6 & 7P8:*	*3-phase*	*L-G*	*3-phase*	*L-G*	
Portlands Project in isolation	*11*	***26***	*0*	*0*	***26***
Portlands Energy Centre Project in isolation	*25*	***26***	*3*	***6***	***32***
Portlands Energy Centre & Portlands Projects	***26***	***26***	*5*	***8***	***34***

Note: The shaded cells correspond to the situation with only the Portlands Energy Centre Project in-service, which was addressed in the Preliminary Assessment Report for the Hearn New Generation Project.

6.4 Discussion of the Results

From the results presented in the Table above, the following conclusions can be drawn:

- If the Portlands Project were to be developed in isolation, incorporating it via circuits H1L & H3L at Basin TS, with the Hearn 115kV busbar operated closed, would require a total of 38 - 115kV breakers to be replaced.
- This number could be reduced to 27 by operating with the Hearn 115kV busbar split diagonally (with breakers 5A6 & 7P8 open). With this arrangement, the transfer capability from the Inner Busbar would be sufficient to accommodate all of the output from the Portlands Project.
- If the Portlands Project were to be distributed across the two halves of the Hearn busbar when it is split diagonally, the number of breakers needing to be replaced could be reduced further to 26. However, as shown in Diagram 5, connecting half the Portlands Project to the Outer Busbar at Hearn TS would not only require a new 115kV breaker to be installed at Hearn TS (restoring the total number to 27), but it would involve the construction of a new 115kV line between the Portlands Project and Hearn TS.

  Consequently, if the Portlands Project were to be developed in isolation, connecting the entire facility to the Inner Busbar at Hearn TS by incorporating it via circuits H1L & H3L would appear to represent the least-cost alternative.

- As discussed in the Preliminary Assessment Report for the Portlands Energy Centre Project (formerly the Hearn New Generation Project) the preferred incorporation arrangement was with a diagonal split of the Hearn 115kV busbar and with the new generation capacity evenly distributed across the two halves of the split busbar. This would have required a total of 32 - 115kV breakers to be replaced.
- If both the Portlands Energy Centre Project and the Portlands Project were to be developed, then in order to achieve the required transfer capability away from the Hearn 115kV busbar it would need to be split diagonally and circuits H6LC & H8LC would also need to be uprated between Hearn TS and Gerrard Junction. In addition all of the new generation capacity would need to be distributed evenly across the two halves of the split busbar. This would also require a total of 34 breakers to be replaced: an increase of two over the number required for the incorporation of the Portlands Energy Centre Project, in isolation. In addition it would require a further 115kV breaker to be installed at Hearn TS for the termination of the new 115kV incorporation circuit from the Portlands Project.

6.5. Requirements for Incorporation

From the analysis of the transfer capabilities away from the Hearn 115kV busbar and of the increased fault levels resulting from the two new Projects, the requirements for incorporating the proposed Portlands Project can be summarised as follows:

i. To incorporate only the Portlands Project

- Replace a total of 26 - 115kV breakers (all located at Leaside TS) and operate with the Hearn 115kV busbar split diagonally.
- Connect either half of the Portlands Project to circuit H1L or circuit H3L, at Basin TS.

ii. To incorporate both the Portlands Project and the Portlands Energy Centre Project

- Replace a total of 34 - 115kV breakers (26 at Leaside TS and the remaining eight at Hearn TS) and operate with the Hearn 115kV busbar split diagonally.

  The 115kV breakers that would need to be installed at Leaside TS would have to have a fault interrupting capability higher than the 50kA rating specified in the Transmission System Code for the 115kV system.
- Connect one half of the Portlands Project to either circuit H1L or H3L at Basin TS, and connect the remaining half via a new 115kV connection to the Outer Busbar at Hearn TS. A new 115kV in-line breaker will need to be installed at Hearn TS.
- Uprate circuits H6LC & H8LC between Hearn TS and Gerrard Junction to a continuous rating (for a maximum conductor operating temperature of 93^{o}C, at an ambient temperature of 30^{o}C) of approximately 1100 amp.
- Enhance the G/R Scheme that is required for the incorporation of the Portlands Energy Centre Project.

In order to incorporate both the Portlands Energy Centre Project and the Portlands Project into the Leaside sector, it would be necessary for the Portlands Project to be connected to both halves of the Hearn 115kV busbar. If the Portlands Project were to be developed in isolation, then it would be possible to incorporate it on to just the Inner busbar, via circuits H1L & H3L, as was originally proposed. However, should the Portlands Energy Centre Project be deferred, and should it be decided to incorporate the entire Portlands Project via the Inner Busbar at Hearn TS, then it is recommended that provision be incorporated into its design to allow half of the Project to be reterminated on to the Outer Busbar at Hearn (as required in ii. above) should development of the Portlands Energy Centre Project proceed at a future date.

Furthermore, with both Projects in-service, the fault levels at Leaside TS would exceed the 50kA rating specified in the Transmission System Code for equipment installed on the 115kV system. It is therefore recommended that breakers with a higher fault interrupting capability than 50kA be used to replace all of the existing breakers whose ratings would be exceeded

6.6 Ability of the Existing Transmission Facilities in the Leaside Sector to Withstand the Increased Fault Levels.

Fault level studies were performed with both generation projects in-service to determine the fault levels at all the 115kV transformer stations in the Leaside sector. The results are summarised in Table 6.

These results indicate that the fault levels are expected to remain below the 40kA short-time (3 second) rating of the existing circuit switchers and disconnect switches.

However, the projected fault levels with both Projects in-service are expected to exceed the short-circuit capability of some of the existing 115kV cables and the skywires of some of the existing overhead lines.

The following is a preliminary list of the facilities that are expected to be effected. Further detailed assessment would be required to confirm the extent of any replacement program.

115kV Underground Cables whose short-circuit capability may be inadequate		
Circuits	*Sections*	*Approximate Length*
H7L H11L	Leaside TS to Todmorden Junction	0.80km
H7L H11L	Lumsden Junction to Main TS	1.53km
H7L H11L	Hearn TS to Main TS	0.92km
H1L H3L	Basin Junction to Mill Street Junction	1.53km
H1L H3L	Mill Street Junction to Gerrard TS	1.37km
H3L	Bloor Street Junction to Gerrard TS	1.80km
Skywires on 115kV circuits whose short-circuit capability may be inadequate		
Circuits	*Sections*	*Approximate Length*
H6LC H8LC	Bloor Street Junction to Don Fleet Junction	2.93km
H5E H7E	Hearn TS to Esplanade TS	3.15km
H2JK	Hearn TS to Don Fleet Junction	0.35km

The sections of those 115kV circuits identified in the above Table that could have skywires or underground cables with an inadequate short-circuit capability to withstand the increased fault levels resulting from the incorporation of the two new generation projects, are shown in Diagram 27.

7. Transient Stability Studies

Missing data

Where machine data were missing, appropriate values were assumed as shown in the Table below (the shaded cells indicate where data were assumed). All four units are identical.

Generator Parameters for Units G1, G2 & G3		*Gas-turbine Units:*	*55.3MVA*
Generator Parameters for Unit G4		*Steam-turbine Unit:*	*55.3MVA*
X_d	1.74	T'_{do}	5.00
X_q	1.60	T''_{do}	0.022
X'_d	0.144	T'_{qo}	0.20
X'_q	0.500	T''_{qo}	0.022
X''_d	0.094	S(1.0)	0.110
X_1	0.100	S(2.0)	0.410
X_2	Not available	H	4.0kW sec/kVA
X_0	Not available	D	0.0

Note: The shaded cells indicate the data that were assumed

No models were provided for the Excitation System, the Power System Stabiliser or the Governor and appropriate models were assumed as described below.

Excitation System

All excitation systems that are installed on generators rated at 10MVA or larger are required to have the following response capability:

Market Rules Requirement: Excitation System Performance

Reference 12 of Appendix 4.2 of the Market Rules states:

Each synchronous generating unit that is rated at 10MVA or larger shall be equipped with an excitation system with a voltage response time not longer than 50msec, and a ceiling voltage at least twice the rated field voltage.

Since no modelling information was provided for the exciters to be installed at the Portlands Project, a Simplified Excitation System (SEXS) model was therefore used, with the data values shown in Diagram 28.

Diagram 29 shows the results of an open-circuit test on this exciter in response to a step-change of 5% in the generator terminal voltage. The performance of this exciter, with a gain of 200, would meet the requirements of the Market Rules.

Power System Stabiliser

Diagram 30 shows the PSS2A model, together with the corresponding data that were assumed for the stabilisers to be installed on each of the generating units at the Portlands development.

Governors

Diagrams 31 & 32 show the GAST and IEEEG1 models that were assumed for the governors to be installed on the three gas-turbine units and the single steam-turbine unit, respectively, at the Portlands development. The typical data values that were assumed are also shown in these Diagrams.

Diagrams 33 and 34 show the corresponding performance of these governors in response to a 10% increase in load on the gas-turbine and steam-turbine units, respectively.

> Where data have had to be assumed, the Proponent will be responsible for ensuring that the equipment that is eventually installed meets or exceeds the values that are shown in the Tables above (so as to result in a better performance than that shown in the stability plots).

7.1 Transient Stability Results

Transient stability analysis was performed for the same fault conditions as were examined in the assessment for the Portlands Energy Centre Project, for the following development scenarios:

- with only the Portlands Project in-service, and
- with both the Portlands Energy Centre Project and the Portlands Project in-service.

Standard IMO fault clearance times were used throughout this analysis. Total fault-clearance times are included in the Table.

The studies were performed with no power system stabilisers on any of the four generating units at the Portlands Energy Centre Project to create a 'stressed' condition.

Fault Type	Location of Fault	Total Fault-Clearing Time	Diagram No.	
Three-Phase	500kV circuit M570V at Claireville TS	101 milliseconds	Portlands Only Both Projects	Diag. 35 Diag. 36
	230kV circuit C2L at Leaside TS	106 milliseconds	-	-
	230kV circuit C2L at Cherrywood TS		Portlands Only Both Projects	Diag. 37 Diag. 38
	115kV circuit H6LC at Hearn TS	113 milliseconds	Both Projects	Diag. 39
	115kV circuit H3L at Hearn TS		Both Projects	Diag. 40
Line-Line-Ground	230kV circuits C2L & C3L at Leaside TS	106 milliseconds	-	-
	230kV circuits C2L & C3L at Cherrywood TS		-	-
	115kV circuits H6LC & H8LC at Hearn TS	113 milliseconds	Both Projects	Diag. 41
	115kV circuits H6LC & H8LC at Leaside TS		-	-
	115kV circuits H1L & H3L at Hearn TS		-	-
	115kV circuits H1L & H3L at Leaside TS		-	-

All cases exhibited stable and well-damped responses.

In addition (apart from the initial oscillations experienced by the monitored units at the Portlands Energy Centre Project, due to the absence of power system stabilisers) there were no significant differences between the results for the cases with only the Portlands Project in-service and those with both developments in-service.

8. Equipment Nomenclature

It is recommended that the proponents consult with Hydro One regarding the nomenclature to be used for their equipment to ensure that suitable designations are employed.

An indication of the type of designations that are expected to be appropriate has been included on Diagrams 1 & 5, as a guide.

9. IMO Requirements for the Incorporation of the 180MW Portlands Development

To incorporate the proposed 180MW generating facility into the IMO-controlled grid, the IMO would require the following measures to be implemented:

If the Portlands Project were to be developed in isolation (i.e. without the Portlands Energy Centre Project.)

1. Connect the new generating facility to circuits H1L & H3L at Basin TS.
   (the bus-section breakers at the new facility are to be operated normally-open).

   Operate with the 115kV busbar at Hearn TS open at breaker positions 5A6 & 7P8 (a diagonal split).
2. Replace 26 - 115kV breakers at Leaside TS

If the Portlands Energy Centre Project and the Portlands Project are both developed

1. Connect half the new Portlands Project to circuit H1L or H3L at Basin TS, and connect the remaining half via a new 115kV circuit to the Outer Busbar at Hearn TS. A new 115kV in-line breaker will need to be installed at Hearn TS.

   Operate with the 115kV busbar at Hearn TS open at breaker positions 5A6 & 7P8 (a diagonal split).
2. Replace 26 - 115kV breakers at Leaside TS with units rated at 63kA symmetrical.
   Replace 8 - 115kV breakers at Hearn TS.
3. Uprate the 115kV circuits H6LC & H8LC between Hearn TS and Gerrard Junction to a continuous rating (for a maximum conductor temperature of 93^{o}C at an ambient temperature of 30^{o}C) of approximately 1100 amp.
4. Enhance the Generation Rejection Scheme that is to be installed for the Portlands Energy Centre Project.

Note: *Since the Portlands Energy Centre Project precedes the Portlands Project in the Connection Assessments & Approvals Queue it is recommended that even if the Portlands Project were to be developed first, it be distributed between the two halves of the split busbar at Hearn TS.*

It is also strongly recommended that breakers with a higher fault interrupting capability than the value of 50kA specified for the 115kV system in the Transmission System Code be installed at Leaside TS to avoid having to replace them should the Portlands Energy Centre Project proceed at a later date.

AND

Perform detailed studies to confirm the extent of the work required to replace those skywires and 115kV cables whose short-circuit capabilities are inadequate for the higher fault levels, and proceed with the replacement of these skywires and cables.

AND

Where data have had to be assumed, the Proponents will be responsible for ensuring that the equipment that is eventually installed meets or exceeds the values that are shown in the Diagrams (so as to result in an equal or superior performance to that shown in the stability plots). In addition, the input to the power system stabiliser will need to produce a unit damping torque that is in-phase with any changes in the speed of the generator.

It is also *recommended* that should it be necessary to replace a substantial number of the existing circuit breakers and/or an extensive amount of the existing buswork at Hearn TS, that serious consideration be given to revising the existing arrangement so that the upgraded facilities conform to a breaker-and-a-half or a breaker-and-a-third design.

10. Approximate Cost Estimates

An attempt has been made to provide approximate cost estimates for the work that would need to be done to incorporate the Portlands Project into the IMO-controlled grid.

These costs are based on available unit costs and do not make any allowance for site conditions. Neither do they take account of outage or construction constraints; associated work that may be triggered by the work identified; or other unforeseen difficulties.

It should also be noted that, for those situations that involve the replacement of existing circuit breakers with higher-rated units, the extent of any associated upgrades to station buswork is unlikely to be known until a detailed review of the existing station facilities has been undertaken.

10.1 The replacement of 26 - 115kV breakers at Leaside TS (and the uprating of all the buswork to 63kA)

Estimated Cost ≈ $60 to $90 million

10.2 i. The replacement of 8 - 115kV breakers at Hearn TS

Estimated Cost ≈ $9 to $16 million

OR

ii. The replacement of a single 115kV breaker at Hearn TS

Estimated Cost ≈ $1 to $2 million

10.3 The installation of a new breaker position at Hearn TS (for connecting half of the Portlands Project)

Estimated Cost ≈ $2 to $4 million

10.4 The enhancement of the generation rejection/run-back scheme that is to be installed for the Portlands Energy Centre Project. The cost for the initial Scheme has been estimated at ≈ $1 to $2 million.

Estimated Cost ≈ $1 million

10.5 The reconductoring of circuits H6LC & H8LC between Hearn TS and Gerrard Junction

Estimated Cost ≈ $1 to $2 million

10.6 The replacement of up to 14 km of 115 kV cable circuits

Estimated Cost ≈ $42 to $70 million

10.7 The replacement of up to 6.5 km of skywire on existing 115 kV overhead lines

Estimated Cost ≈ $1 million

11. Identification of 'Sole Beneficiary'

Section 9.1.3 of the Transmission System Code states:

> *The cost of modifications and upgrades on specific network facilities that are triggered by and are for the sole benefit of the generator shall be borne by the generator.*

The IMO considers that the following system modifications would be for the 'sole benefit' of the Portlands Project:

i. The facilities at the points of connection for the Portlands Project

   The facilities required at the following points of connection to the IMO-controlled grid (protective relaying, monitoring of the status of equipment, SCADA information, communications, etc.) would be for the sole benefit of the Portlands Project:

   - On to 115kV circuit H1L and/or circuit H3L at Basin TS.
   - On to the 115kV Outer Busbar at Hearn TS.

The IMO also considers that in the event that both the Portlands Project and the Portlands Energy Centre Project should proceed, then the following system modification would be for the 'sole benefit' of the two Projects:

i. The installation/enhancement of a generation rejection/run-back scheme for the Portlands Energy Centre Project and the Portlands Project.

   The generation rejection/run-back scheme would be required to ensure that the thermal limits of the local 115kV system are not exceeded for double-circuit contingencies; for breaker-failure conditions; as well as for single-circuit contingencies under outage conditions. This scheme would minimise possible operational constraints on the two Projects.

While the Portlands Project and/or the Portlands Energy Centre Project would be responsible for triggering the replacement of the 115kV breakers at Leaside TS and at Hearn TS, this work would not be considered to be for the sole benefit of these particular Projects.

The installation of higher rated breakers at Leaside TS & Hearn TS would also provide significant operational benefits since many of the restrictions on how the busbars in the Leaside supply sector are to be operated would be removed.

12. Need for a System Impact Assessment

The scope of the original study was extended to include not only an assessment of the impact of the Portlands Project in isolation, but of the impact of this Project in conjunction with the Portlands Energy Centre Project that was previously proposed by Ontario Power Generation Inc. In addition the scope of this Assessment was extended to include the transient stability analysis that would normally have been addressed in a System Impact Assessment.

With the completion of these additional studies, the analysis performed for this Preliminary Assessment represents the same total content as would normally be performed in a separate Preliminary Assessment and System Impact Assessment. A further System Impact Assessment is therefore not considered to be required for this Project.

13. Impact of New Generating Capacity at the Portlands Development on NPCC

The IMO has concluded that the Portlands Project will not be declared an NPCC critical facility following the incorporation of the new generating capacity, together with its fully duplicated generation rejection scheme.

14. Customer Impact Assessment

The Proponents have indicated that since there is an alternative connection arrangement that is being considered for their Portlands Project that they intend to defer the Customer Impact Assessment until the Connect Assessment of this alternative arrangement has been completed. They will then select one of the arrangements for a Customer Impact Assessment.

Should the connection arrangement that has been considered in this Report be the one selected for a Customer Impact Assessment, then any adverse impacts that may be identified in the CIA will be addressed through an Addendum to this Preliminary Assessment Report.

15. Scheduled In-service Date

The scheduled in-service date that has been provided by the Applicants for this Project is Q3-2004.

The IMO has serious reservations that this date can be achieved in view of the extent of the breaker-replacement work that needs to be completed before this Project can be placed in-service.

The situation is expected to be particularly acute at Leaside TS. Since the facilities at that location are critical to the supply to downtown Toronto, the replacement schedule is expected to be confined to only a single breaker at a time, and it is also possible that during both the summer and winter peak load periods, the necessary outages to undertake the work may not be permitted.

Furthermore, since it has been recommended that the existing buswork be upgraded to a rating of 63kA to match the rating of the new circuit breakers, it is expected that temporary facilities will need to be constructed to maintain the critical connections at Leaside TS in-service while the work is undertaken.

Since the IMO considers that late-2006 may be a more realistic in-service date for this Project to allow all of the work required for its incorporation into the IMO-controlled grid to be completed, Toronto Hydro Energy Services Inc. and Boralex Inc. are therefore encouraged to consult with Hydro One to establish a revised in-service date for use in the IMO's assessments.

16. Notification of Approval of the Connection Proposal

By extending the scope of this Preliminary Assessment, the IMO has completed its review of the joint proposal by Toronto Hydro Energy Services Inc. and Boralex Inc. to install 220MVA of new generation capacity at the Paperboard Industries Corporation site on Commissioners Road. This Assessment has identified the IMO's requirements for connection of the new facilities to ensure that it will have no negative impact on the IMO-controlled grid.

Subject to the implementation of these requirements, it is recommended that a *Notification of Approval for Connection* be issued for the Project.

TABLES

TABLE 1 - Transfer Capability from the Hearn TS Interface: New Open Points established at Terauley TS

Hearn Busbar Open at 5A6 & 7P8, and breakers at Esplanade TS Closed		***Peak Loads***		*Diagram 4*
Limiting Contingency *i) Hearn: **Inner** Busbar*		*Limiting Circuit*	*Rating of Circuit*	*Interface Flow* *Hearn Inner: Net Output*
1	Double-circuit contingency H1L + H3L	H8LC Hearn x Gerrard	177MVA (Continuous 93°C)	*285MVA*
2	Single-circuit contingency H6LC	H8LC Hearn x Gerrard	177MVA (Continuous 93°C)	*348MVA*
3	Loss of H6LC & C5E due to an L5L6 stuck breaker at Cecil TS	H8LC Hearn x Gerrard	177MVA (Continuous 93°C)	*349MVA*
4	Double-circuit contingency H1L + H3L	H8LC Cecil x Gerrard	237MVA (Continuous 93°C)	*400MVA*
5	Single-circuit contingency H3L	H1L Hearn x Basin	177MVA (Continuous 93°C)	*409MVA*
6	Single-circuit contingency H5E	H8LC Hearn x Gerrard	177MVA (Continuous 93°C)	*425MVA*
Limiting Interface *ii) Hearn: **Outer** busbar*		*Limiting Circuit*	*Rating of Circuit*	*Interface Flow* *Hearn Outer: Net Output*
1	Loss of H8LC & L12C due to an L8L12 stuck breaker at Cecil TS	H6LC Hearn x Gerrard	177MVA (Continuous 93°C)	*331MVA*
2	Loss of H8LC & L4C due to an L4L8 stuck breaker at Leaside TS	H6LC Hearn x Gerrard	177MVA (Continuous 93°C)	*333MVA*
3	Double-circuit contingency H7L + H11L	H6LC Hearn x Gerrard	177MVA (Continuous 93°C)	*341MVA*
4	Single-circuit contingency H8LC	H6LC Hearn x Gerrard	177MVA (Continuous 93°C)	*341MVA*
5	Single-circuit contingency H7E	H6LC Hearn x Gerrard	177MVA (Continuous 93°C)	*377MVA*
6	Loss of H8LC & L12C due to an L8L12 stuck breaker at Cecil TS	H6LC Cecil x Gerrard	237MVA (Continuous 93°C)	*378MVA*
7	Loss of H8LC & L4C due to an L4L8 stuck breaker at Leaside TS	H6LC Cecil x Gerrard	237MVA (Continuous 93°C)	*381MVA*
8	Single-circuit contingency H3L	H1L Hearn x Basin	177MVA (Continuous 93°C)	*409MVA*
9	Single-circuit contingency H2JK	H6LC Hearn x Gerrard	177MVA (Continuous 93°C)	*419MVA*
10	Single-circuit contingency H11L	H6LC Hearn x Gerrard	177MVA (Continuous 93°C)	*421MVA*
11	Single-circuit contingency H7L	H6LC Hearn x Gerrard	177MVA (Continuous 93°C)	*421MVA*
12	Single-circuit contingency H8LC	H6LC Cecil x Gerrard	237MVA (Continuous 93°C)	*433MVA*

TABLE 2 - Transfer Capability from the Hearn GS Interface: New Open Points established at Terauley TS
With circuits H6LC & H8LC, between Hearn & Gerrard Junction, assumed to be equipped with 1192kcmil conductors

Hearn Busbar Open at 5A6 & 7P8, and breakers at Esplanade TS Closed		***Peak Loads***	*Diagram 4*	
Limiting Contingency *i) Hearn: **Inner** Busbar*		*Limiting Circuit*	*Rating of Circuit*	*Interface Flow* *Hearn Inner: Net Output*
1 (1)	Double-circuit contingency H1L + H3L	H8LC Hearn x Gerrard	**227MVA** (Continuous 93°C)	**338MVA** *(285MVA)*
2 (4)	Double-circuit contingency H1L + H3L	H8LC Cecil x Gerrard	237MVA (Continuous 93°C)	400MVA *(no change)*
3 (5)	Single-circuit contingency H3L	H1L Hearn x Basin	177MVA (Continuous 93°C)	409MVA *(no change)*
4 (2)	Single-circuit contingency H6LC	H8LC Hearn x Gerrard	**227MVA** (Continuous 93°C)	**427MVA** *(348MVA)*
5 (3)	Loss of H6LC & C5E due to an L5L6 stuck breaker at Cecil TS	H8LC Hearn x Gerrard	**227MVA** (Continuous 93°C)	**427MVA** *(349MVA)*
6 (6)	Single-circuit contingency H5E	H8LC Hearn x Gerrard	**227MVA** (Continuous 93°C)	**557MVA** *(425MVA)*
Limiting Interface *ii) Hearn: **Outer** busbar*		*Limiting Circuit*	*Rating of Circuit*	*Interface Flow* *Hearn Outer: Net Output*
1 (6)	Loss of H8LC & L12C due to an L8L12 stuck breaker at Cecil TS	H6LC Cecil x Gerrard	237MVA (Continuous 93°C)	378MVA *(no change)*
2 (7)	Loss of H8LC & L4C due to an L4L8 stuck breaker at Leaside TS	H6LC Cecil x Gerrard	237MVA (Continuous 93°C)	381MVA *(no change)*
3 (3)	Double-circuit contingency H7L + H11L	H6LC Hearn x Gerrard	**227MVA** (Continuous 93°C)	**393MVA** *(341MVA)*
4 (2)	Loss of H8LC & L4C due to an L4L8 stuck breaker at Leaside TS	H6LC Hearn x Gerrard	**227MVA** (Continuous 93°C)	**407MVA** *(333MVA)*
5 (1)	Loss of H8LC & L12C due to an L8L12 stuck breaker at Cecil TS	H6LC Hearn x Gerrard	**227MVA** (Continuous 93°C)	**408MVA** *(331MVA)*
6 (8)	Single-circuit contingency H3L	H1L Hearn x Basin	177MVA (Continuous 93°C)	409MVA *(no change)*
7 (4)	Single-circuit contingency H8LC	H6LC Hearn x Gerrard	**227MVA** (Continuous 93°C)	**415MVA** *(341MVA)*
8 (12)	Single-circuit contingency H8LC	H6LC Cecil x Gerrard	237MVA (Continuous 93°C)	433MVA *(no change)*
9 (5)	Single-circuit contingency H7E	H6LC Hearn x Gerrard	**227MVA** (Continuous 93°C)	**477MVA** *(377MVA)*
10 (10)	Single-circuit contingency H11L	H6LC Hearn x Gerrard	**227MVA** (Continuous 93°C)	**501MVA** *(421MVA)*
11 (11)	Single-circuit contingency H7L	H6LC Hearn x Gerrard	**227MVA** (Continuous 93°C)	**501MVA** *(433MVA)*
12 (9)	Single-circuit contingency H2JK	H6LC Hearn x Gerrard	**227MVA** (Continuous 93°C)	**519MVA** *(419MVA)*

Note: The Case numbers shown in brackets refer to the position of the limiting condition in the previous Table.

Results of Fault Level Analysis with the 180MW Portlands Project incorporated at Basin TS

With the 115kV busbar at Hearn SS operated CLOSED

TABLE 3A - Fault Levels at Leaside TS

Fault levels on the 115kV busbar at LEASIDE TS			***for a Pre-fault Voltage of 127kV***					
Leaside 115kV Busbar 'Open' ; Hearn 115kV Busbar 'Closed'; & Terauley TS 'Open'								
			Symmetrical		***Asymmetrical***		***Breaker Ratings***	
			3-phase	***L-G***	***3-phase***	***L-G***	***Symmetrical***	***Asymmetrical***
No new Generation	*West*	*Existing*	32.25kA	36.53kA	41.76kA	***46.75kA***	***39.3kA***	***45.5kA***
	East		32.32kA	36.55kA	41.86kA	***46.78kA***		
With Portlands Project	*West*	*With New Gen*	36.15kA	***40.40kA***	***46.67kA***	***51.71kA***		
			+3.90kA	*+3.87kA*	*+4.91kA*	*+4.96kA*		
	East		37.17kA	***41.91kA***	***48.03kA***	***53.10kA***		
Diagrams 23 & 33			*+4.85kA*	*+5.36kA*	*+6.17kA*	*+6.32kA*		

Figures shown in ***bold-italic*** indicate situations where the total fault level exceeds the rating of the existing circuit breakers

TABLE 3B - Fault Levels at Hearn GS

Fault levels on the 115kV busbar at HEARN GS		***for a Pre-fault Voltage of 127kV***					
Leaside 115kV Busbar 'Open' ; Hearn 115kV Busbar 'Closed'; & Terauley TS 'Open'							
		Symmetrical		***Asymmetrical***		***Breaker Ratings***	
		3-phase	***L-G***	***3-phase***	***L-G***	***Symmetrical***	***Asymmetrical***
No new generation	*Existing*	29.96kA	29.12kA	***34.58kA***	29.91kA	***31.4kA***	***34.1kA***
With Portlands Project	*With New Generation*	***35.82kA***	***36.47kA***	***43.23kA***	***39.31kA***		
Diagrams 4 & 13		*+5.86kA*	*+7.35kA*	*+8.65kA*	*+9.40kA*		

Figures shown in ***bold-italic*** indicate situations where the total fault level exceeds the rating of the existing circuit breakers

Results of Fault Level Analysis with the 180MW Portlands Project incorporated at Basin TS

With 115kV breakers 5A6 & 7P8 Open at Hearn GS

TABLE 4A - Fault Levels at Leaside TS

Fault levels on the 115kV busbar at LEASIDE TS			***for a Pre-fault Voltage of 127kV***					
Leaside 115kV Busbar 'Open'; Hearn 115kV Busbar 'Open' at breakers 5A6 & 7P8; & Terauley TS 'Open'								
			Symmetrical		***Asymmetrical***		***Breaker Ratings***	
			3-phase	***L-G***	***3-phase***	***L-G***	***Symmetrical***	***Asymmetrical***
No new Generation	*West*	*Existing*	32.23kA	36.50kA	41.73kA	***46.71kA***	***39.3kA***	***45.5kA***
	East		32.30kA	36.52kA	41.80kA	***46.74kA***		
With Portlands Project	*West*	*With New Gen*	35.95kA	***40.11kA***	***46.69kA***	***51.34kA***		
			+3.72kA	*+3.61kA*	*+4.96kA*	*+4.63kA*		
	East		37.16kA	***41.87kA***	***48.05kA***	***53.05kA***		
Diagrams 24 & 34			*+4.86kA*	*+5.35kA*	*+6.25kA*	*+6.31kA*		

Figures shown in ***bold-italic*** indicate situations where the total fault level exceeds the rating of the existing circuit breakers

TABLE 4B - Fault Levels at Hearn GS

Fault levels on the 115kV busbar at HEARN GS			***for a Pre-fault Voltage of 127kV***					
Leaside 115kV Busbar 'Open'; Hearn 115kV Busbar 'Open' at breakers 5A6 & 7P8; & Terauley TS 'Open'								
			Symmetrical		***Asymmetrical***		***Breaker Ratings***	
			3-phase	***L-G***	***3-phase***	***L-G***	***Symmetrical***	***Asymmetrical***
No new generation	*Inner*	*Existing*	26.96kA	24.41kA	29.57kA	24.78kA	***31.4kA***	***34.1kA***
	Outer		25.02kA	23.27kA	26.97kA	23.43kA		
With Portlands Project	*Inner*	*With Portlands Project*	***32.75kA***	***32.13kA***	***36.55kA***	33.48kA		
			+5.79kA	*+7.72kA*	*+6.98kA*	*+8.70kA*		
	Outer		27.77kA	25.62kA	29.40kA	25.80kA		
Diagrams 5 & 14			*+2.75kA*	*+2.35kA*	*+2.43kA*	*+2.37kA*		

Figures shown in ***bold-italic*** indicate situations where the total fault level exceeds the rating of the existing circuit breakers

Results of Fault Level Analysis with half of the 180MW Portlands Project incorporated at Basin TS & the other half incorporated at Hearn SS

With 115kV breakers 5A6 & 7P8 Open at Hearn GS

TABLE 5A - Fault Levels at Leaside TS

Fault levels on the 115kV busbar at LEASIDE TS			***for a Pre-fault Voltage of 127kV***					
Leaside 115kV Busbar 'Open'; Hearn 115kV Busbar 'Open' at breakers 5A6 & 7P8; & Terauley TS 'Open'								
			Symmetrical		***Asymmetrical***		***Breaker Ratings***	
			3-phase	***L-G***	***3-phase***	***L-G***	***Symmetrical***	***Asymmetrical***
No new Generation	*West*	*Existing*	32.23kA	36.50kA	41.73kA	***46.71kA***	***39.3kA***	***45.5kA***
	East		32.30kA	36.52kA	41.80kA	***46.74kA***		
With Portlands Project	*West*	*With Portlands Project*	36.15kA	***40.39kA***	***47.00kA***	***51.70kA***		
			+3.92kA	*+3.89kA*	*+5.27kA*	*+4.99kA*		
	East		37.07kA	***41.79kA***	***47.89kA***	***52.95kA***		
Diagrams 20 & 30			*+4.77kA*	*+5.27kA*	*+6.09kA*	*+6.21kA*		
With Hearn Project	*West*	*With Hearn Project*	39.29kA	***43.51kA***	***50.85kA***	***55.13kA***		
			+7.06kA	*+7.01kA*	*+9.12kA*	*+8.42kA*		
	East		***40.92kA***	***46.20kA***	***52.29kA***	***57.88kA***		
Diagrams 22 & 32			*+8.62kA*	*+9.68kA*	*+10.49kA*	*+11.14kA*		
With Hearn & Portlands Projects	*West*	*With Hearn & Portlands Projects*	***42.39kA***	***46.21kA***	***54.56kA***	***57.90kA***		
			+10.16kA	*+9.71kA*	*+12.83kA*	*+11.19kA*		
	East		***44.98kA***	***50.06kA***	***57.17kA***	***61.98kA***		
Diagrams 21 & 31			*+12.68kA*	*+13.54kA*	*+15.37kA*	*+15.24kA*		

Figures shown in ***bold-italic*** indicate situations where the total fault level exceeds the rating of the existing circuit breakers

TABLE 5B - Fault Levels at Hearn GS

Fault levels on the 115kV busbar at HEARN GS for a Pre-fault Voltage of 127kV								
Leaside 115kV Busbar 'Open'; Hearn 115kV Busbar 'Open' at breakers 5A6 & 7P8; & Terauley TS 'Open'								
			Symmetrical		***Asymmetrical***		***Breaker Ratings***	
			3-phase	***L-G***	***3-phase***	***L-G***	***Symmetrical***	***Asymmetrical***
No new generation	*Inner*	*Existing*	26.96kA	24.41kA	29.57kA	24.78kA	***31.4kA***	***34.1kA***
	Outer		25.02kA	23.27kA	26.97kA	23.43kA		
With Portlands Project	*Inner*	*With Portlands Project*	***31.51kA***	29.82kA	***34.56kA***	31.07kA		
			+4.55kA	*+5.41kA*	*+4.99kA*	*+6.29kA*		
	Outer		29.43kA	28.59kA	33.32kA	31.36kA		
Diagrams 1 & 10			*+4.41kA*	*+5.32kA*	*+6.35kA*	*+7.93kA*		
With Hearn Project	*Inner*	*With Hearn Project*	***35.61kA***	***36.85kA***	***41.44kA***	***43.63kA***		
			+8.65kA	*+12.44kA*	*+11.87kA*	*+18.85kA*		
	Outer		***33.26kA***	***34.86kA***	***38.72kA***	***40.72kA***		
Diagrams 3 & 12			*+8.24kA*	*+11.59kA*	*+11.75kA*	*+17.29kA*		
With Hearn & Portlands Projects	*Inner*	*With Hearn & Portlands Projects*	***39.86kA***	***41.58kA***	***46.44kA***	***48.57kA***		
			+12.90kA	*+17.17kA*	*+16.87kA*	*+23.79kA*		
	Outer		***37.45kA***	***39.67kA***	***44.64kA***	***47.65kA***		
Diagrams 2 & 11			*+12.43kA*	*+15.26kA*	*+17.67kA*	*+24.22kA*		

Figures shown in ***bold-italic*** indicate situations where the total fault level exceeds the rating of the existing circuit breakers

TABLE 6 - Fault levels at the 115kV Transformer Stations in the Downtown Core supplied from Leaside TS

Location		*Existing*		*With Hearn*		*With Portlands*		*With Hearn & Portlands*	
		Symmetrical		*Symmetrical*		*Symmetrical*		*Symmetrical*	
		3-phase	*L-G*	*3-phase*	*L-G*	*3-phase*	*L-G*	*3-phase*	*L-G*
Leaside TS	West	32.23kA	36.50kA	39.29kA	43.51kA	36.16kA	40.39kA	42.39kA	46.21kA
	East	32.30kA	36.52kA	40.92kA	46.20kA	37.07kA	41.79kA	44.99kA	50.06kA
Hearn TS	Inner	26.96kA	24.41kA	35.61kA	36.85kA	31.51kA	29.82kA	39.86kA	41.58kA
	Outer	25.02kA	23.27kA	33.26kA	34.86kA	29.43kA	28.59kA	37.45kA	39.67kA
Esplanade TS	H2JK	21.30kA	18.63kA	27.00kA	25.45kA	24.42kA	21.93kA	29.69kA	27.93kA
	H5E	17.92kA	14.55kA	21.37kA	17.85kA	19.83kA	16.22kA	22.84kA	18.85kA
	H7E	17.02kA	14.06kA	20.45kA	17.28kA	18.94kA	15.72kA	21.95kA	18.32kA
Glengrove TS	L2	24.90kA	22.41kA	29.71kA	25.63kA	27.63kA	24.25kA	31.78kA	26.73kA
	D6	25.25kA	28.09kA	29.28kA	31.92kA	27.55kA	30.28kA	30.90kA	33.27kA
Duplex TS	K	27.10kA	30.34kA	32.79kA	36.52kA	30.32kA	33.81kA	35.28kA	38.78kA
	P	27.25kA	30.56kA	32.08kA	35.25kA	29.99kA	33.22kA	34.09kA	36.95kA
Charles TS	L9C	27.39kA	24.72kA	33.45kA	29.93kA	30.76kA	27.55kA	36.11kA	31.71kA
	L12C	28.15kA	25.76kA	34.68kA	31.62kA	31.76kA	28.92kA	37.58kA	33.66kA
	L4C	24.59kA	22.94kA	28.51kA	25.50kA	26.82kA	24.41kA	30.11kA	26.39kA
Gerrard TS	H1L	25.57kA	23.23kA	32.46kA	32.39kA	29.50kA	28.02kA	35.91kA	36.14kA
	H3L	25.73kA	23.45kA	32.67kA	32.63kA	29.49kA	27.99kA	35.92kA	36.09kA
Gerrard Junction	H6LC	28.00kA	26.13kA	35.08kA	33.09kA	31.89kA	29.80kA	38.32kA	35.59kA
	H8LC	28.37kA	26.14kA	35.46kA	33.10kA	32.25kA	28.80kA	38.67kA	35.57kA
Carlaw TS	H1L	24.01kA	21.20kA	29.99kA	28.58kA	27.45kA	25.12kA	32.91kA	31.45kA
	H3L	24.15kA	21.38kA	30.18kA	28.77kA	27.44kA	25.11kA	32.92kA	31.42kA
Main TS	H7L	22.52kA	20.70kA	27.93kA	28.20kA	25.53kA	24.38kA	30.39kA	30.76kA
	H11L	22.51kA	20.64kA	27.92kA	28.13kA	25.51kA	24.32kA	30.37kA	30.68kA
Basin TS	H1L					30.68kA	29.60kA	38.23kA	39.48kA
	H3L					26.10kA	23.79kA	33.92kA	34.25kA

TABLE 6 (Continued) - Fault levels at the 115kV Transformer Stations in the Downtown Core supplied from Leaside TS

Location		*Existing*		*With Hearn*		*With Portlands*		*With Hearn & Portlands*	
		Symmetrical		*Symmetrical*		*Symmetrical*		*Symmetrical*	
		3-phase	*L-G*	*3-phase*	*L-G*	*3-phase*	*L-G*	*3-phase*	*L-G*
Terauley TS	C5E(N)	27.32kA	24.47kA	33.55kA	29.90kA	30.77kA	27.40kA	36.31kA	31.76kA
	C7E(N)	27.29kA	24.46kA	33.51kA	29.89kA	30.73kA	27.39kA	36.26kA	31.75kA
	C5E(S)	17.68kA	15.99kA	21.03kA	20.08kA	19.54kA	18.05kA	22.44kA	21.33kA
	C7E(S)	16.83kA	15.34kA	20.18kA	19.36kA	18.71kA	17.40kA	21.64kA	20.66kA
Bridgman TS	L13	23.93kA	21.48kA	27.65kA	23.73kA	26.05kA	22.78kA	29.16kA	24.50kA
	L14	18.92kA	15.96kA	21.54kA	17.67kA	20.44kA	16.95kA	22.59kA	18.22kA
	L15	21.91kA	19.25kA	25.52kA	21.83kA	23.99kA	20.72kA	27.02kA	22.68kA
Dufferin TS	L13	16.61kA	12.49kA	18.34kA	13.22kA	17.62kA	12.92kA	18.99kA	13.45kA
	L15	16.00kA	11.92kA	17.83kA	12.86kA	17.07kA	12.47kA	18.54kA	13.15kA
Cecil TS		29.16kA	27.24kA	36.38kA	34.13kA	33.13kA	30.91kA	39.65kA	36.57kA