IMO_REP_0222

CONNECTION ASSESSMENT & APPROVAL PROCESS

SYSTEM IMPACT ASSESSMENT REPORT

For the Proposed GTAA Project

by Enersource Hydro Mississauga

CAA ID No. 2003-107

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

FINAL Version

Date: 23rd November 2004

Station A Box 4474 Toronto ON M5W 4E5 Canada **tel** 905.855.6219 **fax** 905.855.6372 **www.theIMO.com**

System Impact Assessment Report

For the Proposed GTAA Project by Enersource Hydro Mississauga

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 with 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.

Approval of the proposed connection is based on information provided to the IMO by the connection applicant and the transmitter(s) at the time the assessment was carried out. The IMO assumes no responsibility for the accuracy or completeness of such information, including the results of studies carried out by the transmitter(s) at the request of the IMO. Furthermore, the connection approval is subject to further consideration due to changes to this information, or to additional information that may become available after the approval has been granted. Approval of the proposed connection means that there are no significant reliability issues or concerns that would prevent connection of the proposed facility to the IMO-controlled grid. However, connection approval does not ensure that a project will meet all connection requirements. In addition, further issues or concerns may be identified by the transmitter(s) during the detailed design phase that may require changes to equipment characteristics and/or configuration to ensure compliance with physical or equipment limitations, or with the Transmission System Code, before connection can be made.

This report has not been prepared for any other purpose and should not be used or relied upon by any person for another purpose. 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, which 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. In the event that the IMO provides a draft of this report to the connection applicant, you must be aware that the IMO may revise drafts of this report at any time in its sole discretion without notice to you. Although the IMO will use its best efforts to advise you 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 study are based on the information available to Hydro One, at the time of the study, suitable for a system impact assessment of a new generation or load connection proposal.

The short circuit 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.

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.

ENERSOURCE HYDRO MISSISSAUGA: GTAA GENERATING FACILITY

SYSTEM IMPACT ASSESSMENT

1. Introduction

The Greater Toronto Airports Authority (the GTAA), with the support of Enersource Hydro Mississauga (EHM), is proposing to develop a 181.9MVA combined-cycle generating facility at Toronto Pearson International Airport.

The new generating facility is to be incorporated at 44kV via the two existing feeder circuits, M45 & M46, connected to the EZ-busbar at Bramalea TS and via the single feeder circuit, M12, connected to the EQ-busbar at Woodbridge TS. Each feeder circuits from Bramalea TS is to be used for the incorporation of one of the 71.1MVA gas-turbine units, while the feeder circuit from Woodbridge TS is to be used for the incorporation of the 39.7MVA steam-turbine unit.

The scheduled in-service date for the new generating facility is the fall-2005; with commissioning scheduled to commence in June 2005.

2. Connection Arrangement

Diagrams 1 & 2 show the proposed connection arrangements for the two gas-turbine units at Bramalea TS and the single steam-turbine unit at Woodbridge TS, respectively.

At Bramalea TS

The existing M45 & M46 feeders, originating from the 44kV EZ DESN, are to be extended by the amounts indicated below to the new generating facility where each gas-turbine unit is to be connected to a separate feeder.

• Feeder M45	Present length:	10.1km	(equipped with 566kcmil conductors)
	Proposed extension:	4.1km	(to be equipped with 795kcmil conductors)
• Feeder M46	Present length:	8.9km	(equipped with 566kcmil conductors)
	Proposed extension:	3.7km	(to be equipped with 795kcmil conductors)

At Woodbridge TS

Similarly the existing M12 feeder, originating from the 44kV EQ DESN, is to be extended as indicated below to the new generating facility where the steam-turbine generating unit is to be connected to it.

• Feeder M12	Present length:	13.3km	(equipped with 566kcmil conductors)
	Proposed extension:	0.87km	(to be equipped with 795kcmil conductors)

At the New Generating Facility

Diagram 3 shows the proposed connection arrangement of the three generating units on to the local 44kV busbar, with the two bus-section breakers operated normally-open.

Three 44/27.6kV step-down transformers are to be installed to interconnect each section of the new 44kV busbar with the sections of the existing 27.6kV busbar. This busbar is presently connected to, and supplied from, Richview TS via three 27.6kV feeders that have not been shown in this Diagram. The existing feeder breakers on these 27.6kV circuits are to be operated normally-open, as are the two 27.6kV bus-section breakers.

With this arrangement, each generating unit will therefore be dedicated to a single 44kV feeder, together with a discrete portion of the GTAA load, via its associated 44/27.6kV step-down transformer.

3. *Projects Included in this Assessment*

The following projects were included in the analysis that was performed for the GTAA Project:

Sithe-Southdown & Sithe-Goreway Projects

Sithe Energies Canadian Development Ltd. has received approval for the connection of their two combined-cycle generating facilities to the following 230kV circuits in the western GTA:

- the Sithe-Goreway Project: to the 230kV circuits V72R & V73R from Claireville TS, and
- the Sithe-Southdown Project: to the 230kV circuits B15C & B16C from Cooksville TS.

The capacity of each facility is to be approximately 1100MVA.

Each facility is to have a common 230kV busbar, arranged so that it can be operated split should this mode of operation become necessary in order to limit fault levels.

Boralex-Mississauga Project

This Project is to consist of three generating units, each rated at 71.2MVA, that are to be connected through a single step-up transformer on to the 230kV circuit V72R.

Portlands Energy Centre

This Project is to consist of two 234MVA gas-turbine units and a single 265MVA steam-turbine unit, providing a combined capacity of 733MVA.

In order to limit fault levels, the 115kV busbars at both Hearn TS & Leaside TS, together with the 230kV busbars at Leaside TS, are to be operated split. In addition, to compensate for the loading imbalanced introduced by the splitting of the busbars in the Leaside Sector, the two gas-turbine units are to be connected to the more-heavily loaded western half of the Hearn busbar.

Parkway TS & Cooksville TS

Since these two Projects have been fully committed and are scheduled to be completed by the spring-2006, they have also been included in the system model.

Parkway TS

The development of Parkway TS involves establishing a new 230kV busbar and connecting it via new 500/230kV auto-transformers to the existing 500kV circuits C550V & C551V, between Claireville TS and Cherrywood TS. The existing 230kV circuits, C11R & C12R between Cherrywood TS and Richview TS are each to be sectionalised and terminated as three discrete sections on to the new 230kV busbar.

In addition, the radial 230kV circuits V71R & V75R from Claireville TS are to be extended through to Parkway TS and terminated on to the new 230kV busbar. However, in order to limit the contribution that these two circuits would make to the fault levels at Claireville TS, normally-open points are to be introduced at their approximate mid-points.

Cooksville TS

With Lakeview GS scheduled to cease operations on 30th April 2005, the 230kV circuits between Applewood Junction and Lakeview SS will become redundant. However, the existing 230kV busbar at Lakeview SS provides a common point of interconnection between the four 230kV circuits, and since this busbar is critical to the continued supply reliability of the substantial loads at Manby TS, it cannot be removed from service unless an alternative point of interconnection is provided.

Hydro One is therefore planning to establish a new 230kV busbar at Cooksville TS to replace the one at Lakeview SS and to reconfigure the existing circuits between Cooksville TS and Applewood Junction. This will then allow the circuits between Applewood Junction and Lakeview SS to be isolated and left idle.

Lakeview GS

Since Lakeview GS is required to cease burning coal for electricity production on 30th April 2005, OPG has notified the IMO that it will not be converted to an alternative fuel and will therefore shutdown on that date.

This generating facility has therefore been excluded from all the analysis.

4. Local Loads & Existing Generation Facilities

Loads Supplied from Circuits V72R & V73R

The forecast peak load, for the summer-2006, that was assumed at Bramalea TS was 380MVA (343MW at 0.9 pf).

Existing Generating Facilities Incorporated into Bramalea TS

The existing generating facilities that are incorporated at 44kV into Bramalea TS are as follows:

- TransAlta McDonnell-Douglas — a 42MW gas-turbine unit into the JQ DESN
a 42MW gas-turbine unit into the ZE DESN, and
a 30MW steam-turbine unit into the ZE DESN
- KMS Peel Inc. — a 9.5MW gas-turbine unit into the JQ DESN, and
a 5.3MW steam-turbine unit into the JQ DESN

The maximum combined output from these facilities after allowing for losses was assumed to be 125MW.

With the local generating facilities operating at full output, the net load at Bramalea TS, assuming a power factor of 0.9, would therefore be approximately 240MVA (217MW).

Existing GTAA Load

The existing peak load at the Airport that is presently supplied from the 27.6kV feeders from Richview TS is approximately 32MW. This is distributed as follows:

- On the two 44kV feeders from Bramalea TS: approximately 20MW
- On the single 44kV feeder from Woodbridge TS: approximately 12MW

The peak load at the Airport is projected to grow to approximately 44MW during the initial years of operation of the new generating facility.

5. Thermal Ratings of the 230kV Circuits between Claireville TS & Bramalea TS

230kV Circuits V72R & V73R

The thermal ratings for the radial sections of circuits V72R & V73R between Claireville TS and Bramalea TS are shown in the following Table:

Thermal Ratings for 230kV Circuits V72R & V73R *(MVA Ratings for a voltage of 240kV)*						
Section: 230kV cabled ingress to Claireville TS						
Conductors	*Continuous*		*15-min LTR*			
2750mcm cable (companion O/S)	***1540A***	***640MVA***	***2860A***	***1189MVA***		
Section: 230kV Overhead Line between Bramalea TS & the termination of the 230kV cable into Claireville TS						
Conductors	*Continuous*		*Emergency*		*15-min LTR 1180A (445MVA) pre-load*	
1924kcmil ACSR (69/19)	***1370A***	***569MVA***	***1690A***	***702MVA***	***2210A***	***918MVA***
	At 93^{o}C: 35^{o}C ambient temp.: 4km/hr wind		At 116^{o}C (sag temp): 35^{o}C ambient: 4km/hr wind:			

[The pre-load current was based on a maximum output from the Sithe-Goreway and Boralex-Mississauga facilities of approximately 970MVA and 150MVA, respectively (at unity power factor). With a net load at Bramalea TS of approximately 240MVA, and an output of 94MVA from the two gas-turbine units of the GTAA Project, this would equate to a pre-contingency flow on each circuit, after allowing for losses, of approximately 490MVA (1180A). This assumes equal flow distribution on each circuit.]

6. Load Flow Analysis

For the Peak Load Condition

Diagram 4 shows the results with the Sithe-Goreway, Boralex-Mississauga & the GTAA Projects, together with all the existing generating facilities at Bramalea TS, in-service and operating at their full output. For the case shown, the peak load at Bramalea TS was assumed to be 380MVA (343MW at a power factor of 0.9). In addition, since the existing 20MW load at the Airport, which is currently being supplied from Richview TS, is to be supplied from the new GTAA facilities, the load at Bramalea TS has been further increased by this amount.

The maximum flows recorded on circuits V72R & V73R were 503.1MVA and 465.4MVA, respectively. Since these would be well within the continuous rating of 569MVA for each of these circuits, there would be no problem in accommodating the full output of the three new Projects during peak load periods.

For the Off-Peak Load Condition

During periods of reduced demand, with the load at Bramalea TS at a nominal value of 266MVA (equivalent to 70% of the peak values), and with a further 14MW of load at the Airport, the flows on circuits V72R & V73R increase to 557.5MVA and 520.1MVA, respectively; as shown in Diagram 5. These flows would represent a net increase of approximately 55MVA per circuit.

While the increased flows at the lower level of demand would still remain within the continuous rating of 569MVA for these circuits, the margin on circuit V72R would only be 12MVA. Consequently, if all the generating facilities were to be operating during periods when the loads are less than the 70% of peak that has been assumed, overloading could occur. However, during periods of reduced demand, the ambient temperatures are normally lower than the 35^{o}C that was assumed when determining the thermal ratings.

At an ambient temperature of 25^{o}C (for example), the continuous thermal rating for circuits V72R & V73R would increase to 1500A, or 623MVA at a voltage of 240kV. Since this would be less than the 640MVA continuous rating of the cabled connections into Claireville TS, the overhead lines would continue to be the limiting section of these circuits. Furthermore, the higher continuous rating would increase the margin available to accommodate lower demand at Bramalea TS from 12MVA per circuit to 66MVA.

Contingency Conditions

Under contingency conditions involving either of the 230kV circuits, V72R & V73R, overloading of the companion 230kV circuit is expected to occur with both the Sithe-Goreway & the Boralex-Mississauga Projects in-service. In order to be able to respond to this condition, the Sithe-Goreway & the Boralex-Mississauga Projects are therefore required to install and participate in a Generation Rejection/Run-back Scheme.

7. Cross-Tripping Scheme

For the loss of both 230kV circuits, V72R & V73R, either as a result of a double-circuit contingency, or because of a single-circuit contingency when the companion circuit is already out-of-service, the Sithe-Goreway and the Boralex-Mississauga Project would be automatically removed from service. This would leave the 44kV-connected loads at Bramalea TS in separate islands with the existing embedded generating capacity.

The GTAA has indicated that for the loss of the system connection, they require to form a separate island with the airport load supplied directly from their own generation capacity. In order to achieve this automatic separation upon loss of the entire connection into Claireville TS, a Cross-Tripping Scheme will need to be installed.

Diagram 6 shows the functional specification for the isolated Cross-Tripping Scheme, while Diagram 7 shows the functional specification for the integrated Cross-Tripping and Generation Rejection/Run-back Scheme, that would be required should the Sithe-Goreway and the Boralex-Mississauga Projects, as well as the GTAA Project, were to be developed.

In order to comply with the IMO's criteria, these Schemes will need to be fully duplicated and capable of meeting the 'Special Protection System Criteria', as detailed in the NPCC Document A-11.

If, following the successful islanding of the GTAA facility and the subsequent restoration of the 230kV connection to the IMO-controlled grid, it is then proposed to reconnect the GTAA facility to its respective 44kV feeders without shutting down the individual generating units, then suitable synchronising facilities will need to be installed at each point of connection. In addition, the 44kV breakers in each 44kV feeder would have to be capable of withstanding a sustained 2 pu voltage across their open terminals.

8. Voltage Decline Studies for the GTAA Project

The GTAA has confirmed that since a 'once-through heat recovery steam-generator' (OTSG) design, with a capability for dry operation, has been used for the new facility, a trip involving the steam-turbine unit would not affect the operation of the gas-turbine units. The gas-turbine units would therefore be able to continue normal operation. The new facility has also been designed so that, except under the following exceptional circumstances, there will be no common-mode of failure that would result in an interruption of the entire generating facility:

- interruption of the natural gas supply to the facility
- loss of the water supply to the facility

Consequently, it is expected that the maximum voltage declines that would occur would be in response to a generator trip when only a single gas-turbine unit is in operation. For this condition there would be no other units available to provide post-contingency voltage support.

A voltage decline study was therefore performed to determine the impact on the voltages at the LV busbars of the DESN stations at Bramalea TS of the loss of a single gas-turbine unit, with no other generating facilities in-service at Bramalea TS. For this study the gas-turbine unit was assumed to be supplying all of its local reactive power losses and delivering zero MVArs to the 44kV system.

The results are summarised in the following Table for the condition with the gas-turbine unit supplying only its own local reactive power losses, and therefore delivering zero MVAr to the 44kV system:

Voltage Declines at Bramalea TS in response to the loss of a single gas-turbine unit				
		Pre-tripping	*Post-tripping: taps locked*	*Decline*
V72R	230kV	240.31kV	239.81kV	0.21%
V73R	230kV	240.02kV	239.51kV	0.21%
B	27.6kV	29.37kV	29.30kV	0.24%
Y	27.6kV	29.37kV	29.31kV	0.20%
EZ	44.0kV	46.42kV	46.03kV	0.84%
JQ	44.0kV	46.11kV	46.01kV	0.22%

These results show that, even with a constant-MVA model for the local loads, the voltage decline at the EZ busbar would only be 0.84%, which would be well within the IMO's criterion of 5% for the loss of a generating unit.

If the gas-turbine unit were to be operating at a power factor of 0.9, then after allowing for the local reactive power losses, the maximum reactive power that would be expected to be delivered to the 44kV system would be approximately 15MVAr. The study was therefore repeated for this operating scenario, and the results are summarised in the following Table:
:

Voltage Declines at Bramalea TS in response to the loss of a single gas-turbine unit				
		Pre-tripping	*Post-tripping: taps locked*	*Decline*
V72R	230kV	240.65kV	239.79kV	0.36%
V73R	230kV	240.37kV	239.50kV	0.36%
B	27.6kV	29.42kV	29.30kV	0.40%
Y	27.6kV	29.37kV	29.30kV	0.24%
EZ	44.0kV	46.42kV	45.43kV	2.13%
JQ	44.0kV	46.19kV	46.00kV	0.41%

Although the voltage declines are higher, they are still well within the IMO's criterion of 5% for the loss of a generating unit.

9. Fault Level Analysis

Fault level studies were performed for the system configuration detailed below, with the following proposed generating facilities in-service:

- The Sithe-Goreway Project *[1100MVA]*
- The Sithe-Southdown Project *[1100MVA]*
- The Boralex-Mississauga Project *[210MVA]*
- The GTAA Project *[187MVA]*

The system model that was used for these studies included the following facilities:

- Parkway TS with four 500/230kV auto-transformers and with circuits V71R & V75R operated open.
- A new 230kV busbar at Cooksville TS, with series capacitors installed in circuit L24CR.
- Lakeview GS out-of-service and the 230kV circuits from Applewood Junction idle.
- All eight Pickering units in-service.
- All eight Bruce units in-service.

- Portlands Energy Centre in-service.
- Claireville TS: 230kV busbar closed.
- Richview TS: 230kV busbar open.
- Leaside TS: 230kV & 115kV busbars open.
- Hearn TS: 115kV busbar open vertically.

The results of these studies are summarised in Tables 1 to 7.

Table 1 summarises the changes in the fault levels at Claireville TS that are expected to occur as a result of planned changes to the system since the original SIA Report for the two Sithe Projects was issued on 5^{th} March 2001.

The values in the section of this Table represent the *reference* fault levels for this assessment.

Claireville TS

Table 2 shows the effect on the fault levels at Claireville TS of incorporating the new generating facilities.

With both Sithe Projects in-service, the fault levels for a single line-to-ground fault are shown to exceed the rating of the existing breakers at Claireville TS. However, since the three-phase fault levels, even with all four generating Projects in-service, are shown to remain within the rating of the existing breakers, the situation could be addressed by installing neutral reactors on the step-up transformers for the Sithe Projects.

The IMO has therefore made it a requirement for the incorporation of the two Sithe Projects that the step-up transformers be suitable for neutral reactors and that space be provided within the layout of the facility to accommodate these reactors.

Furthermore, since the Boralex-Mississauga Project is also shown to contribute to the excessive fault levels at Claireville TS, the same requirement for neutral reactors has been imposed on this Project by the IMO.

230kV Busbars at Richview TS & Bramalea TS

Tables 3, 4 & 5 show the effect of the new generating Projects on the fault levels on the 230kV busbars at Richview TS and Bramalea TS.

With the 230kV busbar at Richview TS operated split, the fault levels are shown to remain within the rating of all the existing breakers.

At Bramalea TS, the fault levels are well within the 63kA maximum for the 230kV system, as specified in the Transmission System Code, and furthermore, since there are no 230kV breakers at that location, they do not present a problem.

27.6kV & 44kV Busbars at Bramalea TS

The second half of Table 5 shows the effect on the new Projects on the fault levels on the 27.6kV and 44kV busbars at Bramalea TS.

Although the asymmetrical fault levels have been included in the Table, it is accepted that the fault currents would have decayed significantly by the time the LV breakers would have operated, and they have therefore not been taken into account in this assessment.

This Table shows that the fault levels on the LV busbars at Bramalea TS would all be within the limiting values specified in the Transmission System Code, except for those on the 44kV EZ busbar.

Examination of the individual fault infeeds shows that the GTAA Project would contribute 3.62kA to the fault levels on this busbar, causing it to exceed the 20kA limit for 44kV busbars by approximately 1.8kA.

It is also worth noting that since the 'reference' 3-phase fault level on the EZ busbar at Bramalea TS without the two Sithe Projects and the Boralex-Mississauga Project is 17.79kA, the GTAA project, in isolation, would be sufficient to cause the specified 20kA fault level limit for 44kV busbars to be exceeded. *[17.79kA + 3.62kA = 21.41kA]*

Since the high fault level on the 44kV EZ busbar at Bramalea TS is beyond the responsibility of the IMO, this aspect would need to be addressed by the transmitter and the distributor within the scope of the CIA for this Project.

Woodbridge TS

The first half of Table 6 summarises the fault levels on the 230kV busbars at Woodbridge TS.

While the fault levels are higher than those recorded at Bramalea TS, they remain within the 63kA maximum for the 230kV system, as specified in the Transmission System Code.

The second half of Table 6 summarises the fault levels on the 27.6kV and 44kV busbars of the local DESN stations.

With the single steam-turbine unit connected to the 44kV system and contributing 1.65kA to the fault levels on the EQ busbar, the projected fault levels (at 16.23kA) would remain well within the 20kA limit specified in the Transmission System Code.

For the 27.6kV busbars of the BY DESN station, the fault levels are shown to be only marginally below the 17kA limit for a 3-phase fault (at 16.23kA) and the12kA limit for a single line-to-ground fault (at 11.65kA). However, since the contribution from the GTAA Project (together with the Boralex-Mississauga Project) for a 3-phase fault would be only 0.4kA (from 16.19kA to 16.23kA), the GTAA Project would have only a minimal effect on these fault levels.

Remaining Principal Busbars within the GTA

The fault levels on the other principal busbars within the GTA that are expected to be affected by the new generating facilities have been summarised in Table 7.

This indicates that all of the fault levels would be expected to remain well within the rating of the existing breakers at the various locations.

10. Exciter & Governor Responses

Studies were performed to examine the response of the equipment that it is proposed to install on the generators of the GTAA Project.

The initial results obtained using the settings provided by GTAA for the exciter on the steam-turbine unit were not acceptable. However, other steam-turbine units that have recently been incorporated into the system have been equipped with the same Unitrol excitation system that the GTAA is proposing to use and these are providing acceptable responses.

The studies were therefore repeated using similar settings to those used on the other steam-turbine installations, to demonstrate what would be achievable if more appropriate settings were employed.

Response Ratio Test

Diagram 8 shows the respective responses of the exciters for the gas-turbine & steam turbine units to a large increase in the reference setting of the voltage regulator, with each generating unit initialised to its rated output at rated power factor.

Diagram 9 shows the same information, but with an expanded time scale for the initial 1 second period. This clearly shows the very fast response of the static exciter for the steam-turbine unit, which is well within the 50 milliseconds specified in the Market Rules. However, the response of the brushless exciters on the gas-turbine units is shown to be significantly slower.

Both exciters are shown to be capable of meeting the Market Rules requirement of a ceiling voltage of at least twice the rated field voltage.

Open-Circuit Response Test

Diagram 10 shows the open-circuit responses of the exciters to a 5% increase in the terminal voltage of the steam-turbine and gas-turbine generating units.

This also clearly shows the superior performance of the static exciter on the steam-turbine unit, compared to that of the brushless exciter on the gas-turbine unit.

Excitation System Performance

While the voltage response time of the brushless exciters for the gas-turbine units would be longer than the 50msec specified in the current version of the Market Rules for a step-change in the terminal voltage of 5%, the Market Rules are being revised to allow generators with excitation systems that have a response ratio of at least 0.50 and a positive ceiling voltage of at least 150% of the rated field voltage to be incorporated, subject to confirmation by the IMO that they would not adversely impact the reliable operation of the IMO-controlled grid.

As shown in Diagram 9, the nominal response of the excitation system that is proposed to install on the gas-turbine units would be approximately 2.8. This would be significantly better than the 0.5 that it is proposed to allow under the revised Market Rules, and since the exciter is also able to produce a positive ceiling voltage of at least twice the rated field voltage while not adversely affecting the reliability of the IMO-controlled grid, the installation of these exciters would therefore be acceptable to the IMO.

Governor Response Test

Diagram 10 shows the response of the governors on the steam and gas-turbine units to a 10% increase in the electrical loading on the machines.

It should be noted that the units are required to produce a speed droop of at least 5%. While the gas-turbine units would normally have the capability to respond very quickly, the response of steam-turbine units is usually slower because their output is directly affected by the output of the gas-turbine units. To acknowledge this inherent relationship between the gas-turbine and steam-turbine units, the Market Rules are therefore being revised to require the specified droop setting to apply to the entire combined-cycle generation facility.

[Proposed MR Entry: The droop and dead band requirements shall apply to the entire combined-cycle generation facility.]

11. Constant Power Factor versus Constant Voltage Mode of Operation

The Market Rules are presently being revised to require all generating units be operated to control their respective terminal voltages to set values, and that these set-points be adjusted periodically, upon instructions from the IMO, to ensure that the prevailing reactive power requirements of the system are satisfied.

[Proposed MR Entry: Each synchronous generation unit shall regulate voltage except where permitted by the IMO.]

12. IMO Requirements for the Modification of the Connection to the IMO-controlled Grid

The IMO's requirements for the modification of the existing connection of Bramalea TS to the IMO-controlled grid due to the incorporation of the GTAA Project are as follows:

IMO Requirements for Modifying the Connection of Bramalea TS to the IMO-controlled grid

- Provide evidence that the settings selected for the Unitrol exciter on the steam-turbine unit are able to produce a response similar to that shown in Diagrams 8 & 10.
- Provide evidence that the 'composite' droop setting for the entire GTAA facility is 5%.
- Provide evidence that the generating facility is operating under 'voltage control' rather than 'power factor' control.
- If the GTAA facility is to be re-synchronised to the system, then suitable synchronising facilities will be required in each connection. In addition, the 44kV breakers used for synchronisation will need to be capable of withstanding a sustained 2 pu voltage across their open terminals.

Cross-Tripping Scheme

Although it is not a requirement for the proposed modification of the Bramalea TS connection, the GTAA has requested that a Cross-Tripping Scheme be installed to initiate the automatic islanding of the GTAA complex should the main connection to the IMO-controlled grid be interrupted.

Furthermore, should the Sithe-Goreway and the Boralex-Mississauga Projects be developed, then since a Generation Rejection/Run-back Scheme would need to be installed for these Projects, it is proposed that the Cross-Tripping Scheme should be integrated into the G/R Scheme for these Projects.

Functional specifications for the isolated and the integrated Cross-Tripping Schemes have been provided. These Schemes would need to be fully duplicated to meet the IMO's criteria.

13. Customer Impact Assessment

The Customer Impact Assessment for this Project has been completed by Hydro One, and a Report was issued on 3rd May 2004.

This identified the high fault level on the 44kV EZ-busbar at Bramalea TS as the only customer-related issue and the solution that was proposed in this Report would involve installing a 5-ohm bus-tie reactor in series with the existing 44kV bus-tie breaker.

13.1 Subsequent Action Regarding the Fault Levels on the EZ Busbar at Bramalea TS

Instead of installing a bus-tie reactor on the 44kV EZ-busbar at Bramalea TS as proposed in the CIA report, Enersource Hydro Mississauga has requested Hydro One to undertake a review of the existing 44kV facilities and to upgrade any equipment that is identified as being inadequate to withstand a maximum three-phase symmetrical fault current of 22kA.

In addition, Enersource Hydro Mississauga has confirmed through a series of studies that a fault level of 22kA at the EZ-busbar at Bramalea TS would not adversely affect any of their customers.

Appropriate data are to be provided to Brampton Hydro One so that they can conduct similar studies for their customers who are supplied from the EZ-busbar.

14. Notification of Approval

Subject to the satisfactory resolution of the impact of the high fault levels on the 44kV EZ-busbar at Bramalea TS on the Brampton Hydro customers who are supplied from this DESN station, as well as the satisfactory implementation of the IMO's requirements as detailed in Section 12, it is proposed to issue a Notification of Approval for this Project.

FAULT LEVELS FOR THE INCORPORATION OF THE SITHE-GOREWAY, SITHE-SOUTHDOWN, BORALEX-MISSISSAUGA & GTAA PROJECTS

With the Portlands Energy Centre (3-unit configuration) In-service

TABLE 1 - Reference Fault Levels at CLAIREVILLE TS

Fault Levels on the 230kV busbar at CLAIREVILLE TS for a Pre-fault Voltage of 250kV						
	Symmetrical		***Asymmetrical***		***Breaker Ratings***	
	3-phase	***L-G***	***3-phase***	***L-G***	***Symmetrical***	***Asymmetrical***
From the Sithe SIA Report: 5th March 2001 *With Lakeview GS in-service* *Without Parkway TS* *Without Cooksville TS*	65.06kA	68.40kA	83.21kA	81.40kA	***80.0kA***	***96.0kA***
Original 'Margin' between fault levels & breaker ratings for incorporating new generation capacity	*14.94kA*	*11.60kA*	*12.79kA*	*14.60kA*		
Fault Levels with both Sithe Projects incorporated	74.82kA	76.05kA	***96.15kA***	90.50kA		
+ Both Sithe Projects: Difference	*+9.76kA*	*+7.65kA*	*+12.94kA*	*+9.10kA*		
From the Parkway TS Study: *(without the Sithe Projects)* ***Without Lakeview GS*** ***With Parkway TS*** *Without Cooksville TS*	58.60kA	67.98kA	74.24kA	84.15kA		
- Lakeview GS + Parkway TS: Difference	*-6.46kA*	*-0.42kA*	*-8.97kA*	*+2.75kA*		
From the Latest Study: *(without the Sithe Projects)* *Without Lakeview GS* *With Parkway TS* ***With Cooksville TS***	58.87kA	68.48kA	74.59kA	84.78kA		
+ Cooksville TS: Difference	*+0.27kA*	*+0.50kA*	*+0.35kA*	*+0.63kA*		
Present 'Margin' between fault levels & breaker ratings for incorporating new generation capacity	*21.13kA*	*11.52kA*	*21.41kA*	*11.22kA*		

TABLE 2 - Effect of Incorporating New Generation Capacity on the Fault Levels at Claireville TS

Fault Levels on the 230kV busbar at CLAIREVILLE TS for a Pre-fault Voltage of 250kV						
From the Latest Study:	***Symmetrical***		***Asymmetrical***		***Breaker Ratings***	
	3-phase	***L-G***	***3-phase***	***L-G***	***Symmetrical***	***Asymmetrical***
Without Lakeview GS *With Parkway TS* ***With Cooksville TS***	58.87kA	68.48kA	74.59kA	84.78kA	***80.0kA***	***96.0kA***
With the Sithe-Goreway Project	65.64kA	75.22kA	83.43kA	93.13kA		
+ Sithe-Goreway: Difference	*+6.83kA*	*+6.80kA*	*+8.91kA*	*+8.41kA*		
With the Sithe-Goreway Project ***With the Sithe-Southdown Project***	70.13kA	79.18kA	89.27kA	***96.84kA***		
+ Sithe-Southdown: Difference	*+4.48kA*	*+3.97kA*	*+5.84kA*	*+3.73kA*		
+ Sithe-Goreway + Sithe-Southdown: Difference	*+11.31kA*	*+10.77kA*	*+14.75kA*	*+12.14kA*		
With Sithe-Goreway, Boralex-Mississauga & GTAA Projects	67.71kA	77.15kA	86.14kA	94.35kA		
With Sithe-Goreway, Sithe-Southdown, Boralex-Mississauga & GTAA Projects	72.20kA	***81.06kA***	91.98kA	***99.13kA***		
+ S-Goreway, S-Southdown, Boralex-Mississauga & GTAA Projects: Difference	*+13.33kA*	*+12.58kA*	*+17.39kA*	*+14.35kA*		

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

TABLE 3 - Effect of Incorporating the New Generation Capacity on the Fault Levels on the A1H1 Busbar at Richview TS

Fault Levels on the 230kV busbar at RICHVIEW TS for a Pre-fault Voltage of 250kV							
	A1H1 BUSBAR	***Symmetrical***		***Asymmetrical***		***Breaker Ratings***	
		3-phase	***L-G***	***3-phase***	***L-G***	***Symmetrical***	***Asymmetrical***
From the Sithe SIA Report: 5th March 2001 *With Lakeview GS in-service* *Without Parkway TS* *Without Cooksville TS*		56.9kA	54.4kA	70.1kA	58.6kA	***69.5kA***	***83.4kA***
From the Latest Study:							
Without Lakeview GS *With Parkway TS* ***With Cooksville TS***		51.11kA	50.14kA	61.49kA	54.05kA		
With Sithe-Goreway Project		54.28kA	52.21kA	65.30kA	56.28kA		
+ Sithe-Goreway: Difference		*+3.20kA*	*+2.09kA*	*+3.85kA*	*+2.25kA*		
With Sithe-Goreway Project ***With Sithe-Southdown Project***		60.35kA	56.89kA	73.44kA	60.25kA		
+ Sithe-Southdown: Difference		*+6.08kA*	*+4.68kA*	*+8.15kA*	*+3.97kA*		
+ Sithe-Goreway + Sithe-Southdown: Difference		*+9.28kA*	*+6.77kA*	*+12.00kA*	*+6.22kA*		
With Sithe-Goreway, Boralex-Mississauga & GTAA Projects		55.19kA	52.78kA	66.39kA	56.90kA		
With Sithe-Goreway, Sithe-Southdown, Boralex-Mississauga & GTAA Projects		61.25kA	57.43kA	73.56kA	60.82kA		
+ S-Goreway, S-Southdown, Boralex-Mississauga & GTAA Projects: Difference		*+10.14kA*	*+7.29kA*	*+12.07kA*	*+6.77kA*		

TABLE 4 - Effect of Incorporating the New Generation Capacity on the Fault Levels on the A2H2 Busbar at Richview TS

Fault Levels on the 230kV busbar at RICHVIEW TS for a Pre-fault Voltage of 250kV						
A2H2 BUSBAR	***Symmetrical***		***Asymmetrical***		***Breaker Ratings***	
	3-phase	***L-G***	***3-phase***	***L-G***	***Symmetrical***	***Asymmetrical***
From the Sithe SIA Report: 5th March 2001 *With Lakeview GS in-service* *Without Parkway TS* *Without Cooksville TS*	57.2kA	54.0kA	69.9kA	59.2kA	***69.5kA***	***83.4kA***
From the Latest Study:						
Without Lakeview GS *With Parkway TS* ***With Cooksville TS***	53.47kA	52.57kA	64.54kA	57.67kA		
With Sithe-Goreway Project	57.25kA	55.05kA	69.10kA	60.39kA		
+ Sithe-Goreway: Difference	*+3.82kA*	*+2.50kA*	*+4.61kA*	*+2.75kA*		
With Sithe-Goreway Project ***With Sithe-Southdown Project***	61.20kA	58.04kA	73.87kA	63.67kA		
+ Sithe-Southdown: Difference	*+3.95kA*	*+3.00kA*	*+4.77kA*	*+3.28kA*		
+ Sithe-Goreway + Sithe-Southdown: Difference	*+7.77kA*	*+5.50kA*	*+9.38kA*	*+6.03kA*		
With Sithe-Goreway, Boralex-Mississauga & GTAA Projects	58.35kA	55.73kA	70.43kA	61.14kA		
With Sithe-Goreway, Sithe-Southdown, Boralex-Mississauga & GTAA Projects	62.26kA	58.69kA	75.14kA	64.38kA		
+ S-Goreway, S-Southdown, Boralex-Mississauga & GTAA Projects: Difference	*+8.79kA*	*+6.12kA*	*+10.60kA*	*+6.71kA*		

TABLE 5 - Effect of Incorporating the New Generation Capacity on the Fault Levels at Bramalea TS

Fault Levels at BRAMALEA TS: 230kV							
		Symmetrical		***Asymmetrical***		***Breaker Ratings***	
		3-phase	***L-G***	***3-phase***	***L-G***	***Symmetrical***	***Asymmetrical***
From the Latest Study:	*Fault Levels on the 230kV busbar - for a Pre-fault Voltage of 250kV*					***No Breakers***	***No Breakers***
Without Lakeview GS With Parkway TS & ***With Cooksville TS***	*V72R*	21.01kA	18.97kA	24.88kA	21.51kA		
	V73R	21.01kA	18.80kA	24.88kA	21.32kA		
With Sithe-Goreway Project	*V72R*	29.17kA	28.81kA	36.49kA	36.67kA		
	V73R	28.90kA	28.36kA	36.16kA	36.07kA		
+ Sithe-Goreway: Difference	*V72R*	*+8.20kA*	*+9.97kA*	*+11.66kA*	*+15.33kA*		
	V73R	*+7.94kA*	*+9.66kA*	*+11.31kA*	*+14.91kA*		
With Sithe-Goreway Project & ***With Sithe-Southdown Project***	*V72R*	29.79kA	29.21kA	37.26kA	37.19kA		
	V73R	29.52kA	28.73kA	36.93kA	36.57kA		
+ Sithe-Southdown: Difference	*V72R*	*+0.62kA*	*+0.41kA*	*+0.78kA*	*+0.52kA*		
	V73R	*+0.61kA*	*+0.40kA*	*+0.80kA*	*+0.51kA*		
+ Sithe-Goreway + Sithe-Southdown: Difference	*V72R*	*+8.82kA*	*+10.38kA*	*+12.44kA*	*+15.85kA*		
	V73R	*+8.55kA*	*+10.06kA*	*+12.11kA*	*+15.42kA*		
With Sithe-Goreway, Boralex-Mississauga & GTAA	*V72R*	31.51kA	31.75kA	39.74kA	40.71kA		
	V73R	29.71kA	29.20kA	37.20kA	37.17kA		
With Sithe-Goreway, Sithe-Southdown, Boralex-Mississauga & GTAA	*V72R*	32.13kA	32.17kA	40.54kA	41.24kA		
	V73R	30.30kA	29.58kA	37.93kA	37.66kA		
+ S-Goreway, S-Southdown, Boralex-Mississauga & GTAA: Difference	*V72R*	*+11.12kA*	*+13.20kA*	*+15.66kA*	*+19.73kA*		
	V73R	*+9.29kA*	*+10.78kA*	*+13.05kA*	*+16.34kA*		

TABLE 5 (Continued) - Effect of Incorporating the New Generation Capacity on the Fault Levels at Bramalea TS

Fault Levels at BRAMALEA TS: 27.6kV & 44kV						
		Symmetrical		***Asymmetrical***		***Breaker Ratings***
		3-phase	***L-G***	***3-phase***	***L-G***	
From the Latest Study:	*Fault Levels on the 27.6kV & 44kV busbars - for Pre-fault Voltages of 29kV & 46.6kV*					
Without Lakeview GS With Parkway TS & ***With Cooksville TS***	*B27.6kV*	12.67kA	10.03kA	16.64kA	13.85kA	
	Y27.6kV	12.71kA	10.05kA	16.69kA	13.88kA	
	EZ44kV	17.79kA	7.57kA	23.80kA	9.75kA	
	JQ44kV	16.99kA	7.59kA	22.10kA	9.70kA	
With Sithe-Goreway Project	*B27.6kV*	12.83kA	10.10kA	17.03kA	14.02kA	***3-phase Faults:*** *Values are within the limits specified in the Transmission System Code - 17kA for the 27.6kV busbars & 20kA for the 44kV busbar* ***Single Line-to-Ground Faults:*** *Values are within the limits specified in the Transmission System Code - 12kA for the 27.6kV busbars & 19kA for the 44kV busbar* ***Asymmetrical Fault Currents*** *are provided for information only.*
	Y27.6kV	12.88kA	10.12kA	17.00kA	14.04kA	
	EZ44kV	18.12kA	7.61kA	24.25kA	9.73kA	
	JQ44kV	17.26kA	7.63kA	22.71kA	9.75kA	
With Sithe-Goreway Project & ***With Sithe-Southdown Project***	*B27.6kV*	12.85kA	10.10kA	17.05kA	14.03kA	
	Y27.6kV	12.90kA	10.13kA	17.11kA	14.05kA	
	EZ44kV	18.16kA	7.61kA	24.30kA	9.73kA	
	JQ44kV	17.29kA	7.63kA	22.75kA	9.76kA	
With Sithe-Goreway, Boralex-Mississauga & GTAA	*B27.6kV*	12.87kA	10.11kA	17.08kA	14.04kA	
	Y27.6kV	12.92kA	10.14kA	17.14kA	14.07kA	
	EZ44kV	***21.80kA***	7.99kA	28.82kA	10.11kA	
	JQ44kV	17.32kA	7.64kA	22.80kA	9.77kA	
With Sithe-Goreway, Sithe-Southdown, Boralex-Mississauga & GTAA	*B27.6kV*	12.89kA	10.12kA	17.10kA	14.05kA	
	Y27.6kV	12.93kA	10.14kA	17.16kA	14.08kA	
	EZ44kV	***21.83kA***	7.99kA	28.86kA	10.11kA	
	JQ44kV	17.35kA	7.64kA	22.81kA	9.77kA	
+ S-Goreway, S-Southdown, Boralex-Mississauga & GTAA: Difference	*B27.6kV*	*+0.22kA*	*+0.09kA*	*+0.46kA*	*+0.20kA*	
	Y27.6kV	*+0.22kA*	*+0.09kA*	*+0.47kA*	*+0.20kA*	
	EZ44kV	*+4.04kA*	*+0.42kA*	*+5.06kA*	*+0.36kA*	
	JQ44kV	*+0.36kA*	*+0.05kA*	*+0.71kA*	*+0.07kA*	
Contribution from the GTAA Project	***EZ44kV***	***3.62kA***	*-*	***4.79kA***	*-*	*From the two gas-turbine units*

TABLE 6 - Effect of Incorporating the New Generation Capacity on the Fault Levels at Woodbridge TS

Fault Levels at WOODBRIDGE TS: 230kV								
		Symmetrical		***Asymmetrical***		***Breaker Ratings***	
		3-phase	***L-G***	***3-phase***	***L-G***	***Symmetrical***	***Asymmetrical***
From the Latest Study:	*Fault Levels on the 230kV busbar - for a Pre-fault Voltage of 250kV*					***No Breakers***	***No Breakers***
*Without Lakeview GS With Parkway TS & **With Cooksville TS***	*V74R*	47.59kA	49.00kA	56.63kA	54.67kA		
	V75R	47.70kA	49.00kA	56.76kA	54.68kA		
With Sithe-Goreway Project	*V74R*	51.92kA	52.32kA	62.61kA	57.40kA		
	V75R	52.05kA	52.34kA	62.77kA	57.42kA		
+ Sithe-Goreway: Difference	*V74R*	*+4.33kA*	*+3.32kA*	*+5.98kA*	*+2.73kA*		
	V75R	*+4.35kA*	*+3.34kA*	*+6.01kA*	*+2.74kA*		
With Sithe-Goreway Project & ***With Sithe-Southdown Project***	*V74R*	54.68kA	54.21kA	65.95kA	59.47kA		
	V75R	54.82kA	54.23kA	66.12kA	59.49kA		
+ Sithe-Southdown: Difference	*V74R*	*+2.76kA*	*+1.89kA*	*+3.34kA*	*+2.07kA*		
	V75R	*+2.77kA*	*+1.89kA*	*+3.35kA*	*+2.07kA*		
+ Sithe-Goreway + Sithe-Southdown: Difference	*V74R*	*+7.09kA*	*+5.21kA*	*+9.32kA*	*+4.80kA*		
	V75R	*+7.12kA*	*+5.23kA*	*+9.36kA*	*+4.81kA*		
With Sithe-Goreway, Boralex-Mississauga & GTAA	*V74R*	53.27kA	53.28kA	64.29kA	58.45kA		
	V75R	53.40kA	53.30kA	64.40kA	58.47kA		
With Sithe-Goreway, Sithe-Southdown, Boralex-Mississauga & GTAA	*V74R*	56.00kA	55.12kA	67.53kA	60.47kA		
	V75R	56.14kA	55.14kA	67.71kA	60.49kA		
+ S-Goreway, S-Southdown, Boralex-Mississauga & GTAA: Difference	*V74R*	*+8.41kA*	*+6.12kA*	*+10.90kA*	*+5.80kA*		
	V75R	*+8.44kA*	*+6.14kA*	*+10.95kA*	*+5.81kA*		

TABLE 6 (Continued) - Effect of Incorporating the New Generation Capacity on the Fault Levels at Woodbridge TS

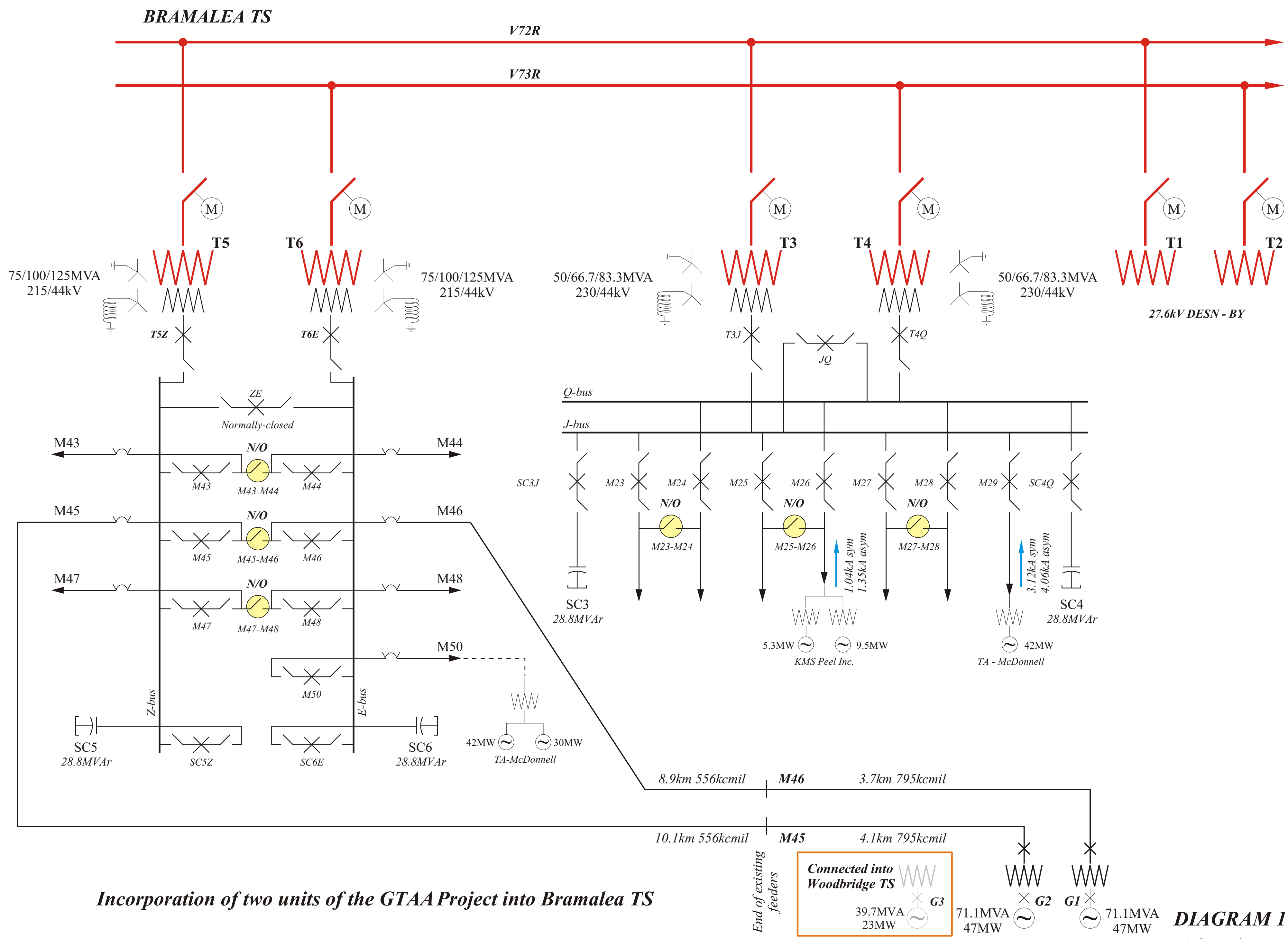
Fault Levels at WOODBRIDGE TS: 27.6kV & 44kV		Symmetrical 3-phase	Symmetrical L-G	Asymmetrical 3-phase	Asymmetrical L-G	Breaker Ratings
From the Latest Study:	*Fault Levels on the 230kV busbar - for a Pre-fault Voltage of 250kV*					
Without Lakeview GS With Parkway TS & ***With Cooksville TS***	*BY27.6kV*	16.09kA	11.60kA	21.53kA	16.24kA	***3-phase Faults:*** *Values are within the limits specified in the Transmission System Code - 17kA for the 27.6kV busbars & 20kA for the 44kV busbar* ***Single Line-to-Ground Faults:*** *Values are within the limits specified in the Transmission System Code - 12kA for the 27.6kV busbars & 19kA for the 44kV busbar* ***Asymmetrical Fault Currents*** *are provided for information only.*
	EQ44kV	11.18kA	5.28kA	14.99kA	7.40kA	
With Sithe-Goreway Project	*BY27.6kV*	16.15kA	11.62kA	21.61kA	16.27kA	
	EQ44kV	11.23kA	5.29kA	15.06kA	7.41kA	
+ Sithe-Goreway: Difference	*BY27.6kV*	*+0.06kA*	*+0.02kA*	*+0.08kA*	*+0.03kA*	
	EQ44kV	*+0.05kA*	*+0.01kA*	*+0.07kA*	*+0.01kA*	
With Sithe-Goreway Project & ***With Sithe-Southdown Project***	*BY27.6kV*	16.19kA	11.63kA	21.71kA	16.29kA	
	EQ44kV	11.26kA	5.30kA	15.10kA	7.41kA	
+ Sithe-Southdown: Difference	*BY27.6kV*	*+0.04kA*	*+0.01kA*	*+0.10kA*	*+0.02kA*	
	EQ44kV	*+0.03kA*	*+0.01kA*	*+0.04kA*	*+0.00kA*	
+ Sithe-Goreway + Sithe-Southdown: Difference	*BY27.6kV*	*+0.10kA*	*+0.03kA*	*+0.18kA*	*+0.05kA*	
	EQ44kV	*+0.08kA*	*+0.02kA*	*+0.11kA*	*+0.01kA*	
With Sithe-Goreway, Boralex-Mississauga & GTAA	*BY27.6kV*	16.19kA	11.63kA	21.67kA	16.29kA	
	EQ44kV	12.88kA	5.51kA	17.16kA	7.68kA	
With Sithe-Goreway, Sithe-Southdown, Boralex-Mississauga & GTAA	*BY27.6kV*	16.23kA	11.65kA	21.71kA	16.30kA	
	EQ44kV	12.91kA	5.52kA	17.20kA	7.69kA	
+ S-Goreway, S-Southdown, Boralex-Mississauga & GTAA: Difference	*BY27.6kV*	*+0.14kA*	*+0.05kA*	*+0.18kA*	*+0.06kA*	
	EQ44kV	*+1.73kA*	*+0.24kA*	*+2.21kA*	*+0.29kA*	
Contribution from the GTAA Project	***EQ44kV***	***1.65kA***	-	***2.20kA***	-	*From the single steam-turbine unit*

TABLE 7 - Effect of Incorporating the New Generation Capacity on the Fault Levels at the Other Principal Busbars in the GTA

<table>
<tr><th colspan="3">Fault Levels on the Principal Busbars in the GTA</th><th colspan="6">For a Pre-fault Voltage of 250kV, 127kV, 46.6kV or 29kV - as appropriate</th></tr>
<tr><th colspan="3" rowspan="2">Location</th><th colspan="2">Symmetrical</th><th colspan="2">Asymmetrical</th><th colspan="2">Breaker Ratings</th></tr>
<tr><th>3-phase</th><th>L-G</th><th>3-phase</th><th>L-G</th><th>Symmetrical</th><th>Asymmetrical</th></tr>
<tr><td rowspan="2">CHERRYWOOD TS</td><td>From the Latest Study:</td><td>DK1
DK2
DK3
DK4</td><td>47.98kA
44.97kA
44.67kA
46.05kA</td><td>52.66kA
49.66kA
48.29kA
50.29kA</td><td>61.94kA
59.27kA
57.94kA
59.72kA</td><td>66.72kA
63.56kA
62.44kA
63.72kA</td><td rowspan="2">60.0kA
(minimum)</td><td rowspan="2">70.3kA
(minimum)</td></tr>
<tr><td>With both Sithe Projects</td><td>DK1
DK2
DK3
DK4</td><td>49.44kA
46.12kA
46.08kA
47.27kA</td><td>53.43kA
50.59kA
49.38kA
51.26kA</td><td>63.88kA
60.79kA
60.28kA
61.30kA</td><td>67.70kA
64.76kA
63.21kA
64.95kA</td></tr>
<tr><td rowspan="3">PARKWAY TS</td><td colspan="2">From the Latest Study:</td><td>54.59kA</td><td>63.91kA</td><td>69.38kA</td><td>78.16kA</td><td rowspan="3">80.0kA</td><td rowspan="3">96.0kA</td></tr>
<tr><td colspan="2">With both Sithe Projects</td><td>57.55kA</td><td>66.60kA</td><td>73.14kA</td><td>81.46kA</td></tr>
<tr><td colspan="2">With all four Projects</td><td>57.91kA</td><td>66.93kA</td><td>73.60kA</td><td>81.85kA</td></tr>
<tr><td rowspan="6">MANBY EAST TS</td><td rowspan="2">From the Latest Study:</td><td>230kV</td><td>40.34kA</td><td>39.52kA</td><td>45.79kA</td><td>44.10kA</td><td>70.0kA</td><td>80.4kA</td></tr>
<tr><td>115kV</td><td>27.13kA</td><td>32.52kA</td><td>35.17kA</td><td>42.05kA</td><td>38.8kA
(minimum)</td><td>45.5kA
(minimum)</td></tr>
<tr><td rowspan="2">With both Sithe Projects</td><td>230kV</td><td>45.77kA</td><td>43.69kA</td><td>52.81kA</td><td>48.76kA</td><td>70.0kA</td><td>80.4kA</td></tr>
<tr><td>115kV</td><td>28.25kA</td><td>33.69kA</td><td>37.17kA</td><td>43.96kA</td><td>38.8kA
(minimum)</td><td>45.5kA
(minimum)</td></tr>
<tr><td rowspan="2">With all four Projects</td><td>230kV</td><td>46.31kA</td><td>44.03kA</td><td>53.45kA</td><td>49.14kA</td><td>70.0kA</td><td>80.4kA</td></tr>
<tr><td>115kV</td><td>28.35kA</td><td>33.78kA</td><td>37.31kA</td><td>44.09kA</td><td>38.8kA
(minimum)</td><td>45.5kA
(minimum)</td></tr>
</table>

TABLE 7(Continued) - Effect of Incorporating the New Generation Capacity on the Fault Levels at the Other Principal Busbars in the GTA

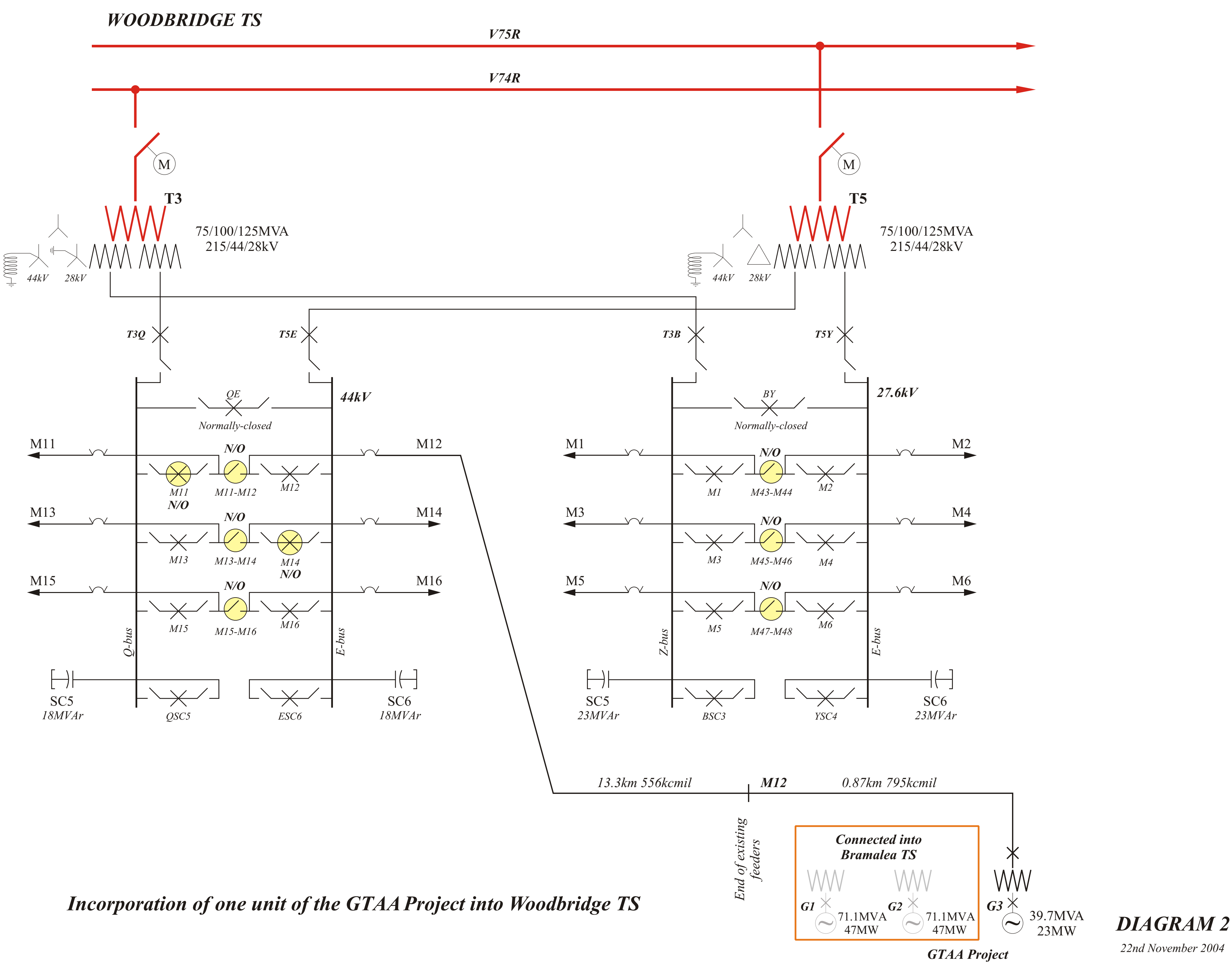
MANBY WEST TS	***From the Latest Study:***	*230kV*	38.69kA	38.28kA	43.92kA	43.37kA	***70.0kA***	***80.4kA***
		115kV	27.37kA	32.48kA	36.32kA	41.57kA	***38.8kA*** *(minimum)*	***45.5kA*** *(minimum)*
	With both Sithe Projects	*230kV*	45.00kA	43.34kA	51.93kA	49.10kA	***70.0kA***	***80.4kA***
		115kV	28.73kA	33.92kA	37.84kA	43.86kA	***38.8kA*** *(minimum)*	***45.5kA*** *(minimum)*
	With all four Projects	*230kV*	45.47kA	43.63kA	52.48kA	49.43kA	***70.0kA***	***80.4kA***
		115kV	28.82kA	34.01kA	37.96kA	43.97kA	***38.8kA*** *(minimum)*	***45.5kA*** *(minimum)*
COOKSVILLE TS	***From the Latest Study:***		40.66kA	36.88kA	46.16kA	40.46kA	***63.0kA***	***76.0kA***
	With both Sithe Projects		50.13kA	45.52kA	58.61kA	49.93kA		
	With all four Projects		50.70kA	45.80kA	59.27kA	49.38kA		



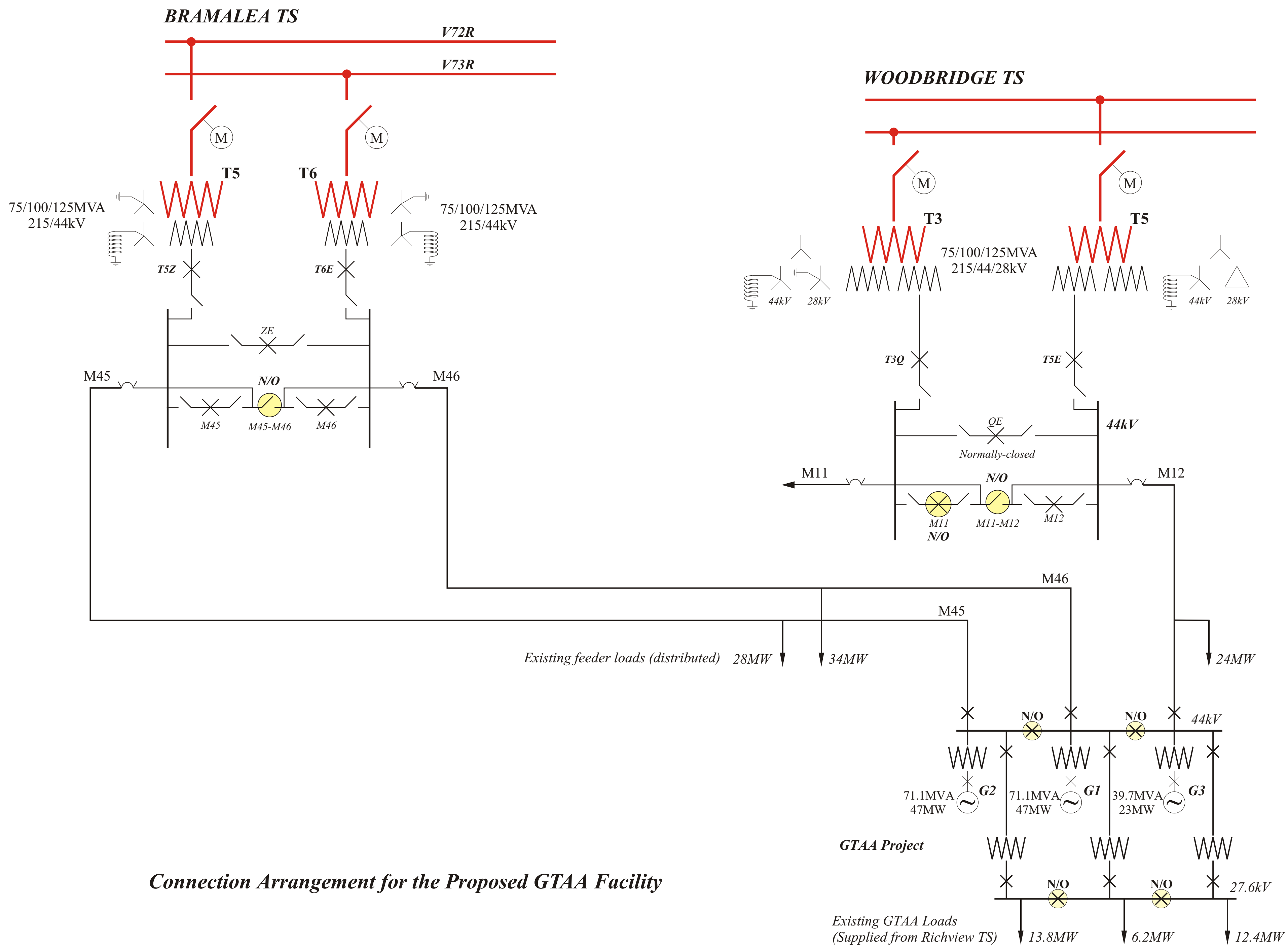
Incorporation of two units of the GTAA Project into Bramalea TS

DIAGRAM 1

22nd November 2004



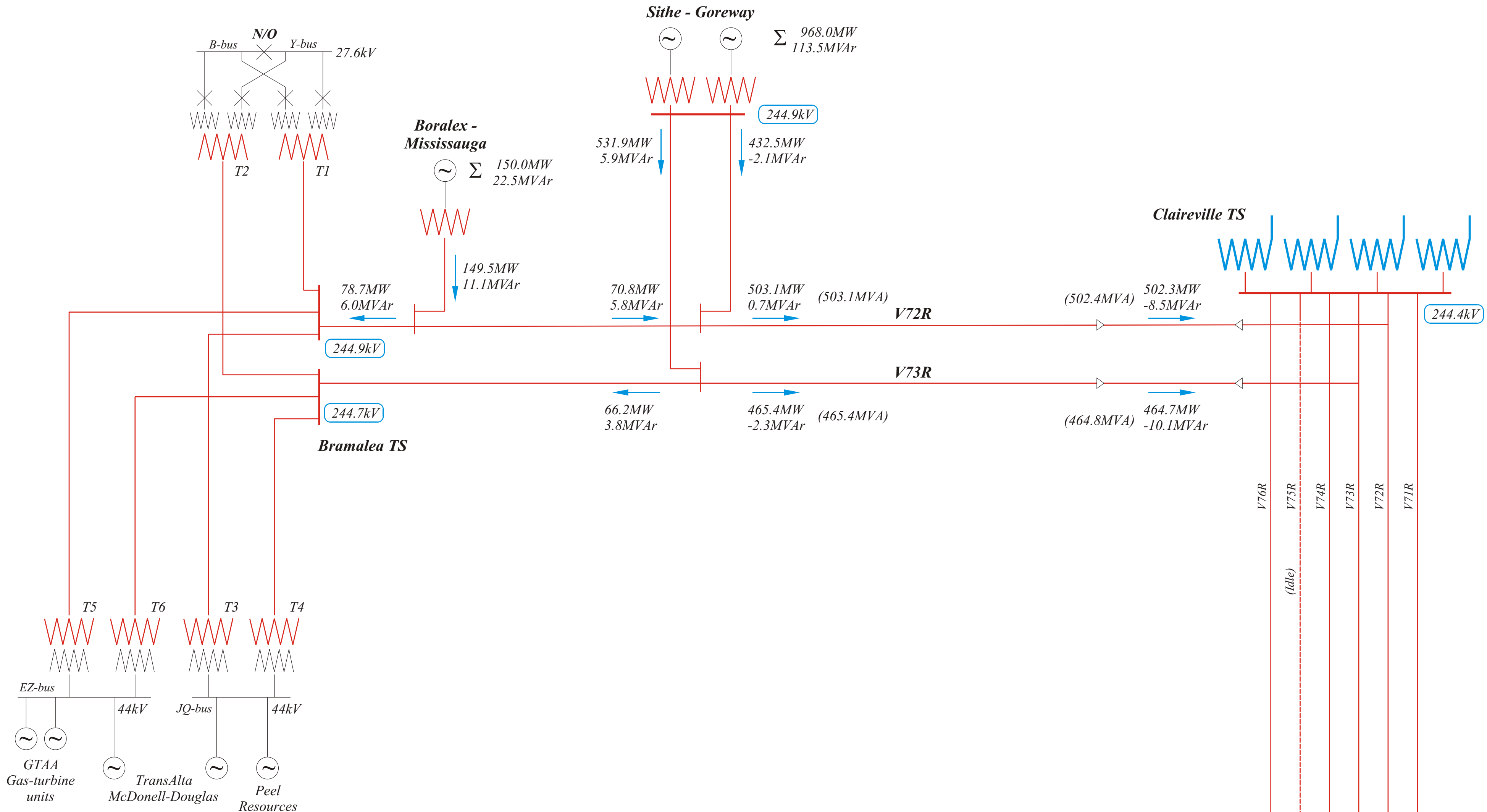
Incorporation of one unit of the GTAA Project into Woodbridge TS



Connection Arrangement for the Proposed GTAA Facility

DIAGRAM 3

22nd November 2004



Σ 343MW (380MVA at 0.9 pf) + 20MW of Airport load transferred from Richview TS
Load at Bramalea TS

Σ 124.8MW 6MVAr
Existing Generation at Bramalea TS

Σ 94MW 4MVAr
New GTAA Generation at Bramalea TS

Σ 171MVAr
Shunt Capacitors at Bramalea TS

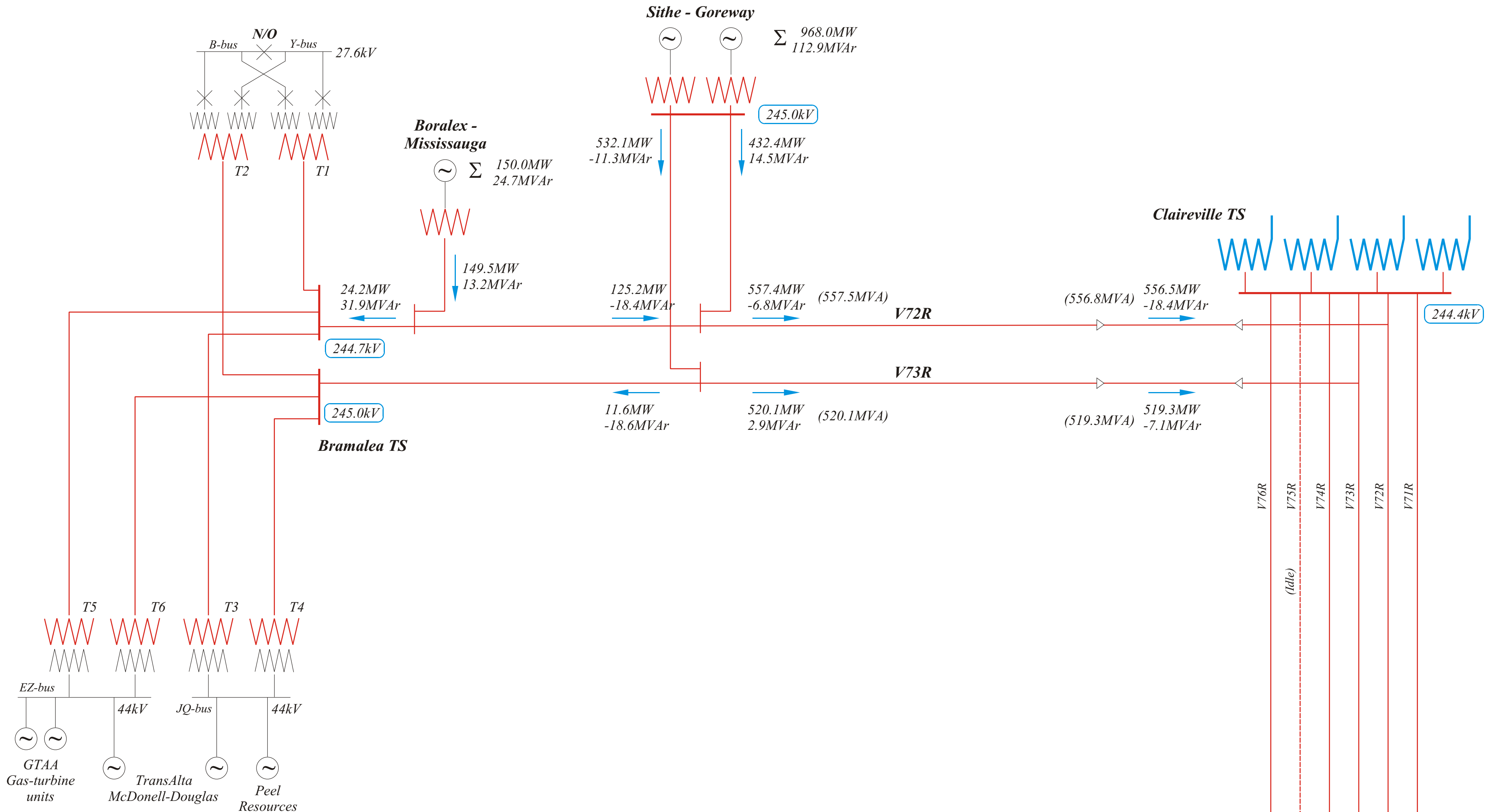
Transfers with Loads at Bramalea TS at their Expected Peak Values

With the Sithe-Goreway, Boralex-Mississauga & GTAA Projects In-service

With a Common 230kV Busbar at the Sithe Facility

DIAGRAM 4

28th September 2004



Σ 240MW (266MVA at 0.9 pf) + 14MW of Airport load transferred from Richview TS
Load at Bramalea TS

Σ 124.8MW 6MVAr
Existing Generation at Bramalea TS

Σ 94MW 4MVAr
New GTAA Generation at Bramalea TS

Σ 112MVAr
Shunt Capacitors at Bramalea TS

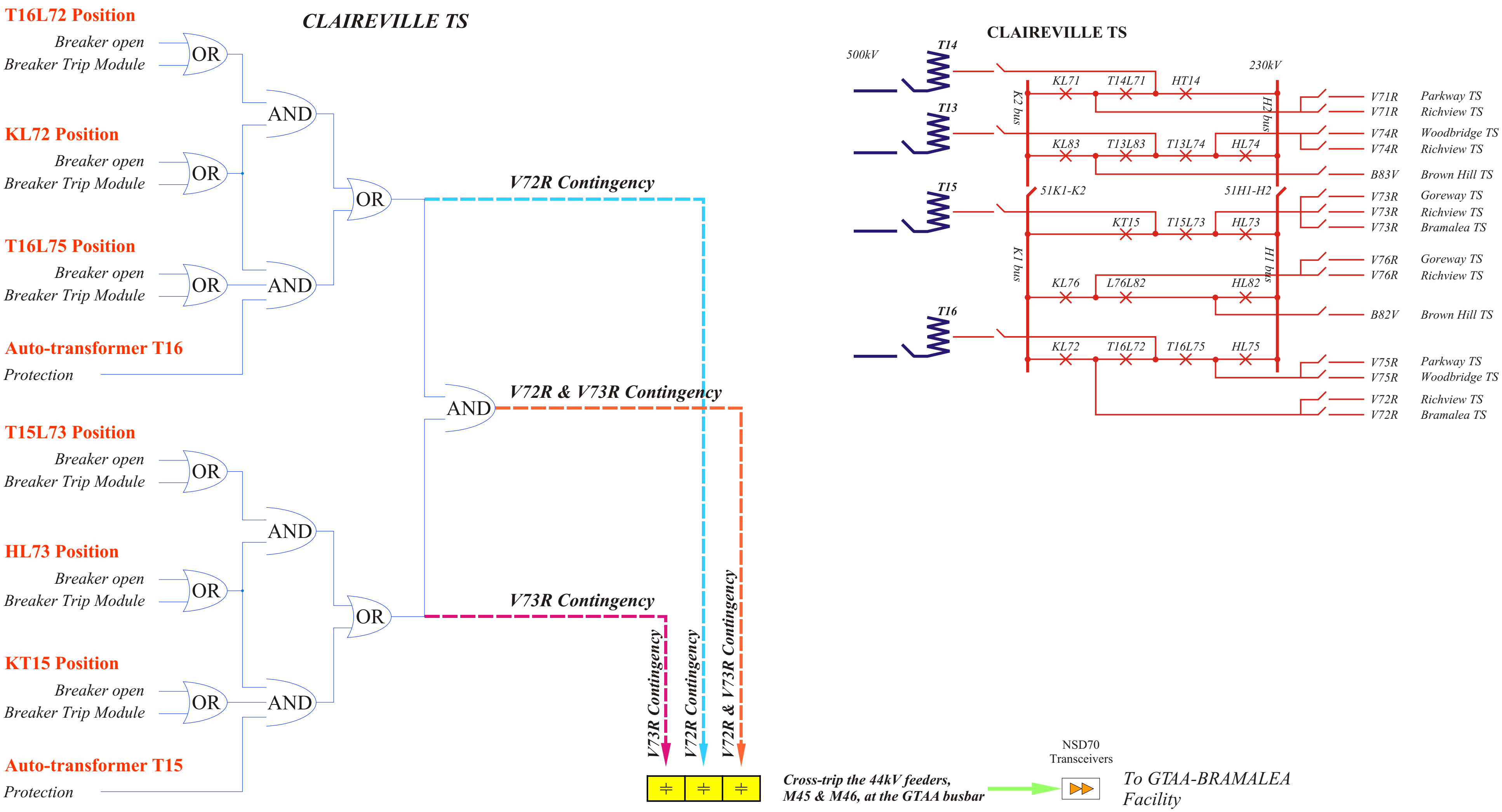
Transfers with Loads at Bramalea TS at 70% of their Expected Peak Values

With the Sithe-Goreway, Boralex-Mississauga & GTAA Projects In-service

With a Common 230kV Busbar at the Sithe Facility

DIAGRAM 5

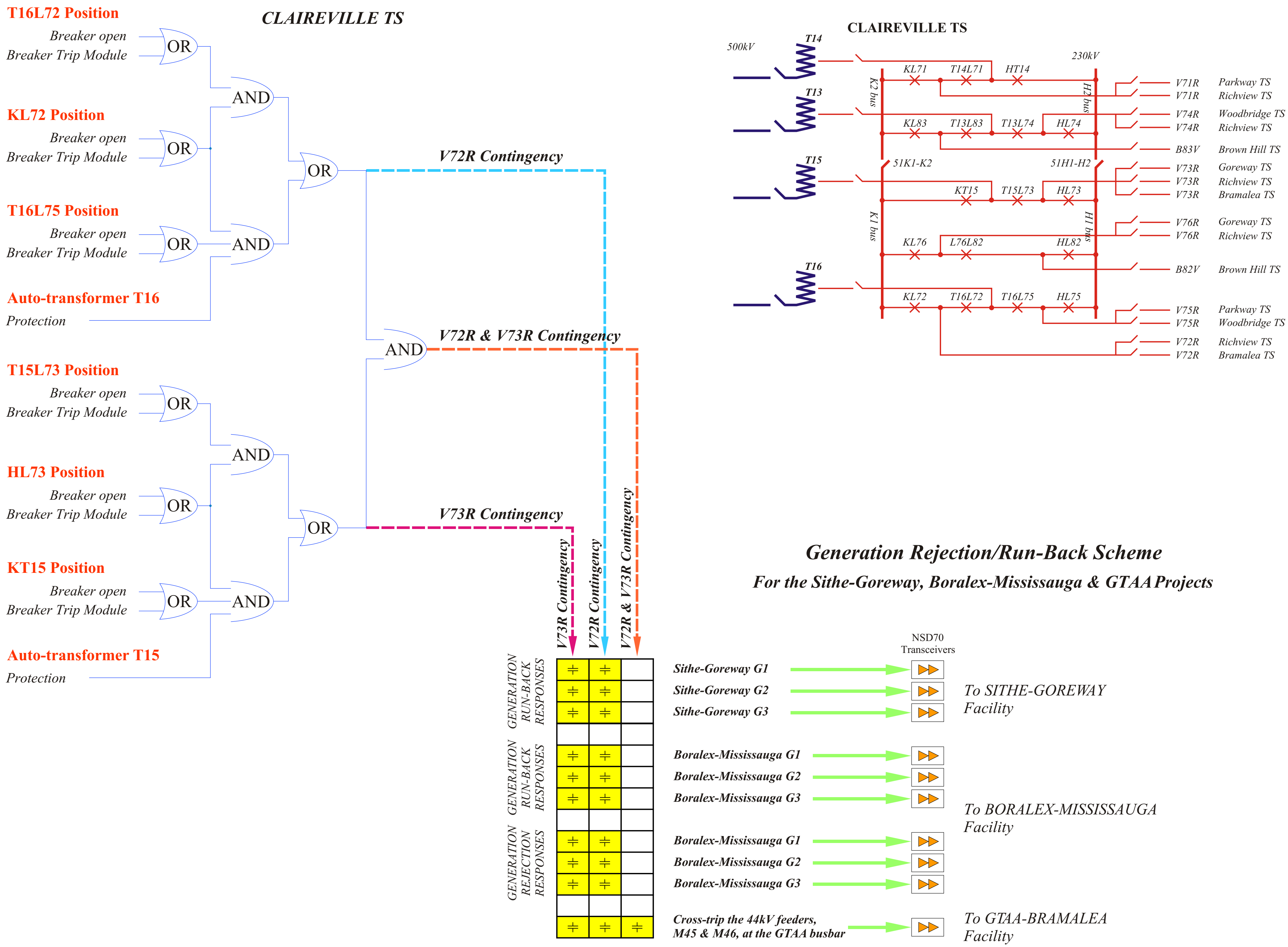
28th September 2004



CROSS-TRIPPING SCHEME FOR THE GTAA PROJECT

DIAGRAM 6

28th September 2004



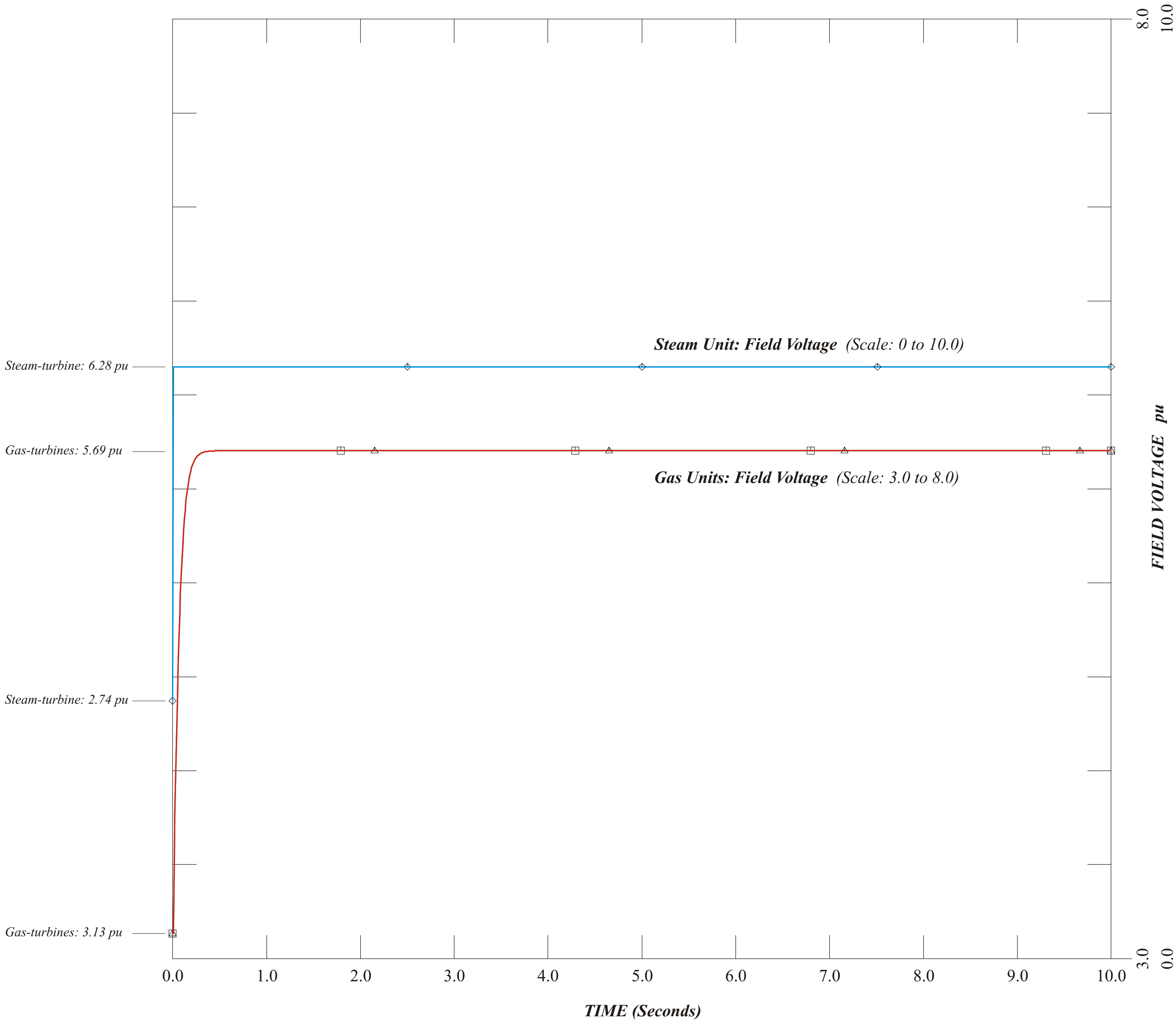
Generation Rejection/Run-Back Scheme

For the Sithe-Goreway, Boralex-Mississauga & GTAA Projects

GENERATION REJECTION/RUN-BACK & CROSS-TRIPPING RESPONSES

DIAGRAM 7

28th September 2004



GTAA Project: Response Ratio Test

DIAGRAM 8

29th September 2004

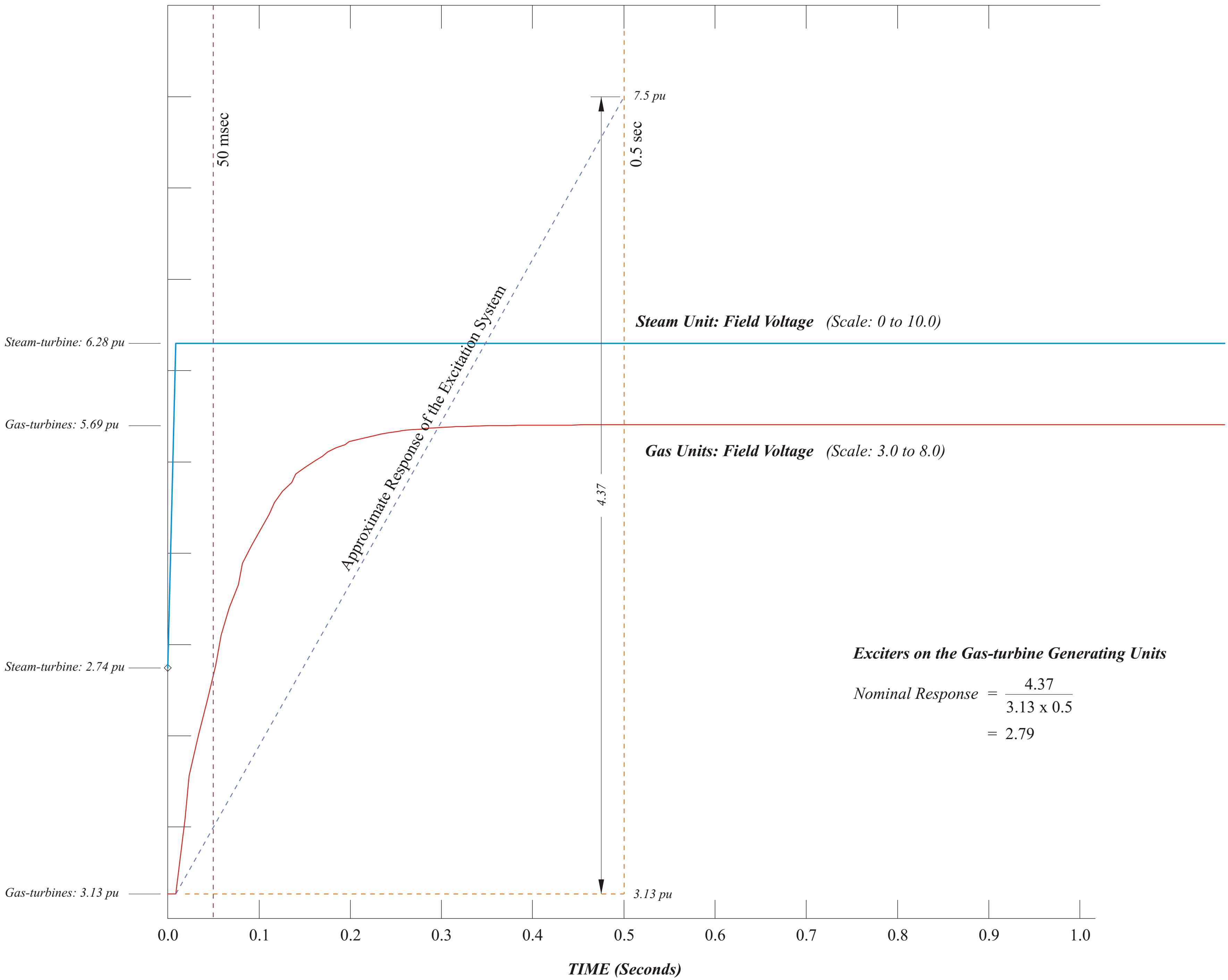
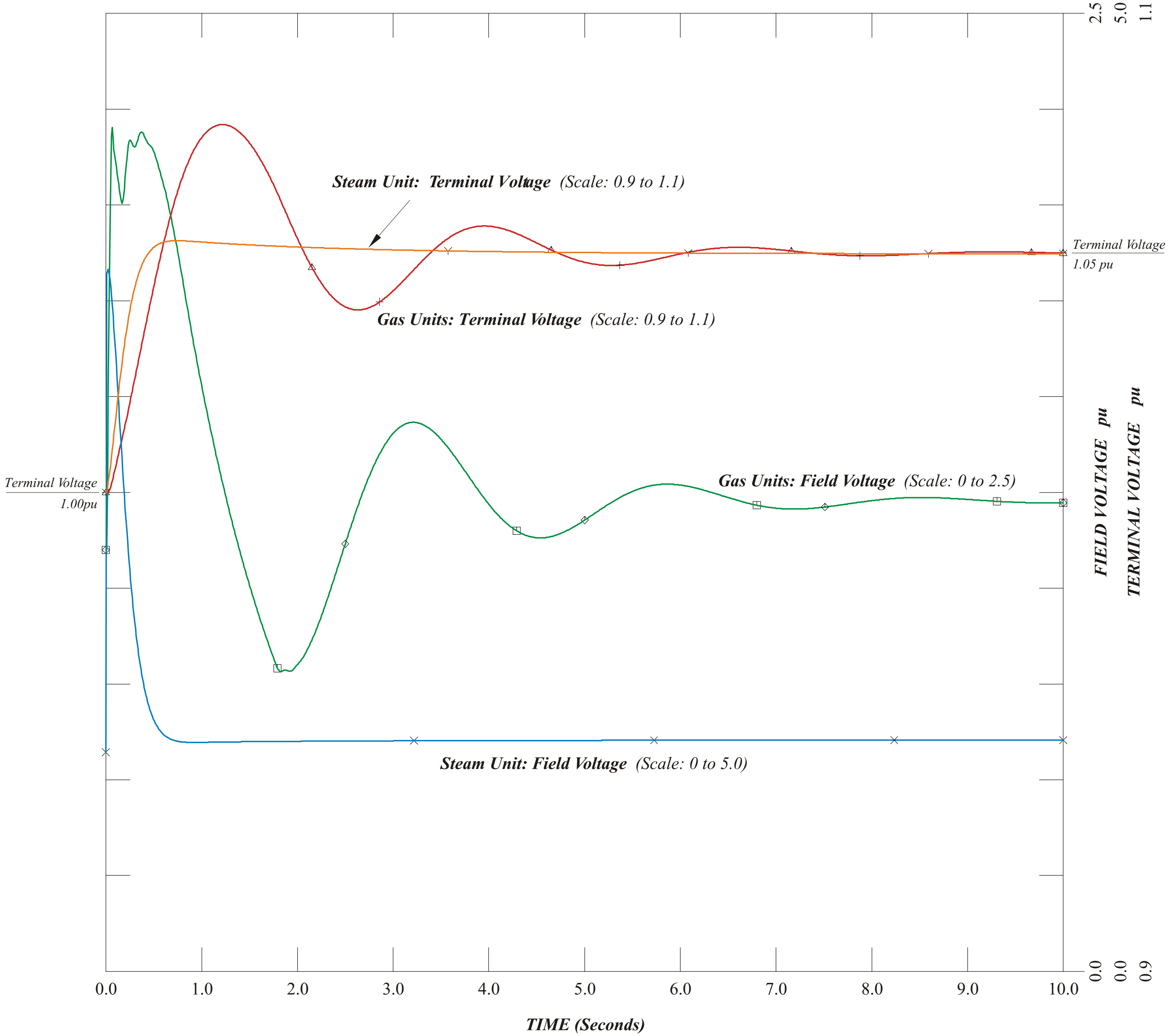


DIAGRAM 9

GTAA Project: Response Ratio Test (Expanded Scale)

29th September 2004

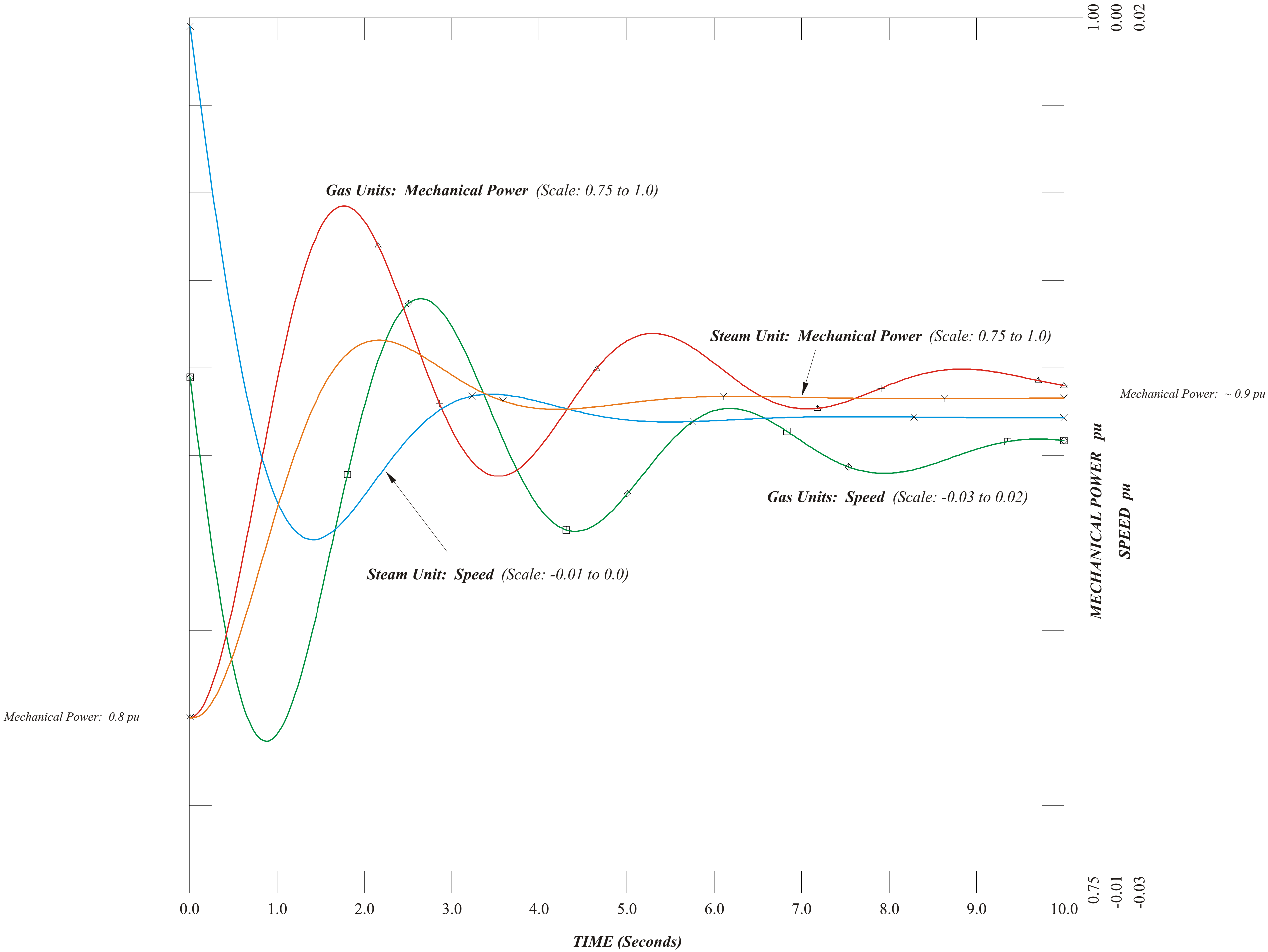


GTAA Project: Open-Circuit Step-Response

[to a 5% increase in generator terminal voltage]

DIAGRAM 10

29th September 2004



GTAA Project: Governor Response Test

[to a 10% increase in the electrical load]

DIAGRAM 11

29th September 2004