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CONNECTION ASSESSMENT & APPROVAL PROCESS

PRELIMINARY ASSESSMENT REPORT

For the 4th Transformer Project at the Imperial Oil Complex in Sarnia.

Installation of a Second 230/27.6kV DESN Station

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Preliminary Assessment Report

For the 4th Transformer Project at the Imperial Oil Complex in Sarnia.

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, on a preliminary basis, 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 a System Impact Assessment of the proposed connection should be conducted 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. This report has been prepared solely for use by the connection applicant, Hydro One 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 it is using the most recent version of this report. The IMO expects the connection applicant and affected transmitter to discuss the connection project with any persons located in the vicinity of the project and to advise the IMO of any concerns they might express about the impact of the project on system reliability.

Hydro One

Special Notes and Limitations of Study Results

The results reported in this preliminary feasibility study are based on the information available to Hydro One, at the time of the study, suitable for a preliminary assessment of a new generation or load connection proposal.

The short circuit and thermal loading levels have been computed based on the information provided by the connection proponent at the time of the study. These levels may be higher or lower if the connection information changes as a result of, but not limited to, subsequent design modifications or when more accurate test measurement data is available.

This study does not assess the short circuit or thermal loading impact of the proposed connection on facilities owned by other load and generation (including OPGI) customers.

In this preliminary feasibility study, short circuit adequacy is assessed only for Hydro One breakers and does not include other Hydro One facilities. The short circuit results are only for the purpose of assessing the capabilities of existing Hydro One breakers and identifying upgrades required to incorporate the proposed connection. These results should not be used in the design and engineering of new facilities for the proposed connection. The necessary data will be provided by Hydro One and discussed with the connection proponent upon request.

The ampacity rating of Hydro One facilities are established based on assumptions used in Hydro One for power system planning studies. The actual ampacity ratings during operations may be determined in real-time and are based on actual system conditions, including ambient temperature, wind speed and facility loading, and may be higher or lower than those stated in this study.

The additional facilities or upgrades, which are required to incorporate the proposed connection, have been identified to the extent permitted by a preliminary assessment. Additional facility studies may be necessary to confirm constructability and the time required for construction. System impact or further studies at more advanced stages of the project development may identify additional facilities that need to be provided or that require upgrading.

Preliminary Assessment Report for the Imperial Oil 4th Transformer Project
The Installation of a New DESN Station at their Complex in Sarnia

1. Introduction

The Imperial Oil Complex is currently supplied from St. Andrews 115/27.6kV TS and from the existing DESN (Dual-Element Spot Network) station at the site. This DESN station consists of the two 230/27.6kV step-down transformers, T3 & T4, together with a third 230/27.6kV step-down transformer, T2, that is used as a switchable-spare in the event that either of the main transformers should fail or be out-of-service for maintenance. The switchable-spare transformer can be placed in-service within a period of between two & four hours.

The present peak load on the DESN station is approximately 103MVA, with a further 36MVA of load being supplied from St. Andrews TS.

This proposal covers the work involved to permanently connect the switchable-spare transformer, T2, and to install a new 230/27.6kV transformer, T1, in order to establish a second DESN station, located directly adjacent to the existing DESN station at the Imperial Oil Complex.

By establishing a second DESN station, Imperial Oil intends to address voltage decline concerns that occur upon the loss of either of the existing transformers T3 or T4, and to avoid overloading the remaining transformer whenever transformer T3 or T4 is out-of-service as a result of a contingency. The new DESN station is to be used to supply Substation 2A at the Imperial Oil Complex via the two existing 27.6kV feeders M1 & M2.

Diagram 1 shows the existing supply arrangement at the Imperial Oil Complex, while Diagram 2 shows the proposed arrangement following the installation of a fourth step-down transformer to establish the second DESN station.

This latter Diagram also shows the two 21.6MVAr - 29.0kV capacitor banks that Imperial Oil is planning to install at the new DESN station. Initially only $^{2}/_{3}$ of the capacitor cans are to be installed so that each bank will be rated at 14.4MVAr.

The scheduled in-service date for the new DESN station is July 2002.

Loads at the Imperial Oil Complex

Once all four step-down transformers are in-service at the Imperial Oil Complex there would be sufficient capacity to allow those loads that are currently supplied from the 115/27.6kV St. Andrews TS to be transferred to the new facilities. On the assumption that this transfer will occur, loadings of 74MVA on the T1/T2 transformer combination, and 65MVA on the T3/T4 combination have therefore been assumed in this assessment.

2. Connection Arrangement

As shown in Diagram 1, two 230kV circuit-switchers, consisting of separately-mounted interrupting (switching) units and isolating devices, are used to connect the switchable-spare transformer to the appropriate 230kV circuit whenever it is required to be brought into service.

Imperial Oil is proposing to permanently connect the existing switchable-spare step-down transformer, T2, to the 'G' Jitney busbar. The new step-down transformer T1, is then to be connected to the 'F' Jitney busbar. Currently it is Imperial Oil's intention to retain the two existing circuit-switchers in the new arrangement and to use them for isolating the two transformers of the newly formed DESN station.

[It should be noted that Imperial Oil does not intend to utilise the interrupting capability of the circuit-switchers for fault clearance.]

Should Imperial Oil decide to remove the interrupting portion of the circuit switchers and to relocate the disconnect switches (the isolating portion of the devices), then these will need to be motorised, to comply with the Transmission System Code.

In accordance with conventional practice, the 27.6kV busbar of the new DESN station is to be equipped with a bus-section breaker (rated at 3000 amp and 1500MVA - 31KA) that will be operated normally-closed. In addition, the LV connection of each step-down transformer on to the respective halves of the 27.6kV busbar is to be via its own breaker (rated at 2500 amp and 1500MVA - 31kA).

One capacitor bank is to be connected to each half of the 27.6kV busbar, and switched via a single breaker (rated at 2000 amp and 1500MVA - 31kA).

Schedule F of the Transmission System Code requires redundant communication channels *and* paths to be provided for the Remote Trip/Transfer Trip signals to the terminal breakers associated with the circuits N6S & N7S.

3. Comments on the Connection Arrangement

The existing supply arrangement at the Imperial Oil Complex consists of a modified DESN station design that employs two 27.6kV bus section breakers to allow the switchable-spare transformer, T2, to be connected to the LV busbar.

The proposed modifications at the Imperial Oil Complex will establish a second DESN station which will be of a conventional design with only a single LV bus section breaker.

The existing connection to transformer T2 from the existing DESN station is to become idle once the new DESN station has been established.

Furthermore, in order to comply with the requirements of the Transmission System Code that requires an isolating disconnect switch at the junction between the Transmitter's and the Customer's facilities, Imperial Oil is proposing to install a manually-operated disconnect switch in circuit N6S and circuit N7S, on the line-side of each Jitney busbar.

With the arrangement as proposed, faults associated with any of the four step-down transformers would initiate tripping of the terminal breakers at Sarnia-Scott TS; the TransAlta facility; and at Bayer Rubber. Isolation of the faulted transformer would then occur via its motorised disconnect switch, or if they are retained in the final design for transformers T1 and T2, via the appropriate circuit switcher. It would then be possible to restore the 230kV circuit to service.

A breaker failure condition involving any of the 27.6kV breakers associated with the connection of each step-down transformer on to its 27.6kV busbar would initiate a similar response.

Faults associated with either of the 230kV Jitney busbars or the transformer disconnect switches (or circuit switchers, if they are retained) would also result in a similar response, but since the main in-line disconnects are to be manually operated, there would be a short delay before the circuit could be returned to service. However, faults involving these switches or the Jitney busbars are expected to be extremely rare.

Step-down Transformers

The new transformer is to have the same specification as its companion unit, T2.

Rating:	60/80/100MVA
Ratio:	214.5/28kV
Under-load Tap Changer Range:	+16.5% to -12.6% in 25 taps
Impedance:	21.5% on 80MVA

These values are similar to those for step-down transformers T3 & T4.

27.6kV Feeders

The two 27.6kV feeders to Substation 2A that currently originate from the existing DESN station are to be reterminated on to the new 27.6kV busbars. These feeders are equipped with twin 795kcmil conductors and are approximately 3000 feet (914 metres) in length.

Impact on Reliability

Although the new facilities will marginally increase the exposure for possible interruptions, the fault incidence rate for transformers has traditionally been very low. Consequently, the proposed arrangement is not expected to have any material impact on the reliability of the IMO-controlled grid.

4. Power Factor at the Defined Meter Point

The Market Rules (Appendix 4.3: Reference 1) require that Connected Wholesale Customers and Distributors connected to the IMO-controlled grid operate at a power factor within the range of 90% lagging and 90% leading, as measured at the *defined meter point.* The location of the *defined meter point* is established by the IMO and is normally at the point of connection to the Transmitter's network.

Based on the information provided it would appear that with the two existing 18MVAr (at 30kV) capacitor banks and the two new 14.4MVAr (at 29kV) capacitor banks in-service, Imperial Oil should be able to maintain the power factor of their load, as measured at the high voltage terminals of their step-down transformers at 90% or higher. However, Imperial Oil will need to confirm this.

Telemetered Data

The Market Rules (Chapter 4, Section 7.5) require all Connected Wholesale Customers and Distributors that are connected to the IMO-controlled grid to provide the IMO with the data detailed in Appendix 4.17 for the IMO to direct operations of the IMO-controlled grid. The respective Performance Standards that have to be met when supplying these data are given in Appendix 4.22.

Discussions will need to be held with the IMO regarding the provision of a suitable RTU and the associated communication facilities for telemetering the data to the control centre.

5. Fault Level Analysis

The new DESN station was included in the system model for the fault level analysis that was performed for Imperial Oil's proposal to incorporate new generating capacity at 230kV.

These studies confirmed that the new DESN station would have only a marginal impact on the line-to-ground fault levels in the area.

6. Impact on the Local Facilities

Thermal Rating of Circuits N6S & N7S

Once the remedial work has been completed at Bayer Junction, the individual, *continuous* rating for circuits N6S and N7S will be 365MVA (at 240kV) at an ambient temperature of 30^{o}C with a wind speed of 4km/hr.

This rating will be adequate to supply the entire peak load at the Imperial Oil Complex (projected at 140MVA) and at Bayer Rubber (30MVA) with either 230kV circuit out-of-service.

Voltage Declines

The attached plot shows the voltage profile on the 230kV busbar at Scott TS, recorded during the year-2000. This shows a 'normal' variation in voltage of between 244kV and 238kV. This range is expected to increase once new generation comes into service within the area, and the existing 115kV series-connected reactors are removed from Sarnia-Scott TS. Due to its close 'electrical' proximity, the 230kV voltage at the Imperial Oil Complex will be virtually identical to that at Scott TS.

For an assumed voltage of 241kV at Sarnia-Scott TS and 29.0kV on the LV busbar at Imperial Oil, the voltage declines recorded for a contingency involving one of the 230kV circuits to Imperial Oil which would result in the loss of one step-down transformer at each of the DESN stations, were 1.0kV on the 230kV system and 0.7kV (2.4%) on the 27.6kV system. These would be well within the IMO criterion of 10%.

Capacitor Switching

The Market Rules (Appendix 4.4: Reference 1) limits the maximum voltage change for capacitor switching operations to a maximum of 4%, for *Transmitters*.

With no additional generating facilities in-service, studies showed that switching a 10.8MVAr capacitor bank (as specified in Imperial Oil's original proposal) while one of the transformers at the T1/T2 DESN station is out-of-service would result in a voltage change of 3.6%. This would increase to 4.8% for the 14.4MVAr banks that Imperial Oil is now planning to install. Once these capacitor banks are equipped with their full complement of cans to provide a rating of the 21.8MVAr, the voltage change that is expected to occur on switching will increase to 7.2%.

This change in voltage would be in violation of the 4% limit, *as it applies to Transmitters*, which is quoted in the Market Rules. However, since the voltage change would be confined to Imperial Oil's own facilities, it is not expected to be a concern to the IMO.

Once additional generating facilities are placed in-service then the size of the capacitor bank that could be switched before the 4% limit is violated would increase.

However, it is recommended that Imperial Oil review their proposal to increase the size of each of the new capacitor banks at a future date.

These results also suggest that the switching of the existing 18MVAr capacitor banks, particularly when step-down transformer T3 or T4 is out-of-service, could result in a change in voltage that would exceed the 4% criterion in the Market Rules.

7. Other Requirements for Connection

Reduction in Demand through Voltage Reduction or Interruption

The Market Rules (Chapter 5: Clause 10.3) require that Connected Wholesale Customers reduce their demand through reductions in the distribution voltage (of 3% and 5%) or through interruption of selected load, when so directed by the IMO.

The required reduction in demand has to be completed within 5 minutes of receipt of the instruction, and the IMO has to be notified when it has been done.

Under-Frequency Load-Shedding

In accordance with the Market Rules (Appendix 4.3: Reference 2 and Chapter 5: Clause 10.4.6) the IMO will also require that an automatic under-frequency load-shedding scheme be installed at the Imperial Oil Complex, and that it have the capability to reject up to 35% of any new load at the Complex in response to a declining system frequency. The appropriate settings for the under-frequency load-shedding scheme will be provided by the IMO prior to commissioning of the new facilities.

8. System Impact Assessment

Based on the results of this Preliminary Assessment it is concluded that no further analysis is required for this Project. It is therefore proposed to forego the System Impact Assessment.

9. Notification of Approval

It is therefore recommended that a Notification of Approval of the Connection Proposal be issued for this Project. The Applicant is required to obtain the necessary approvals as may be required by the OEB and other regulatory authorities.

10. Next Steps

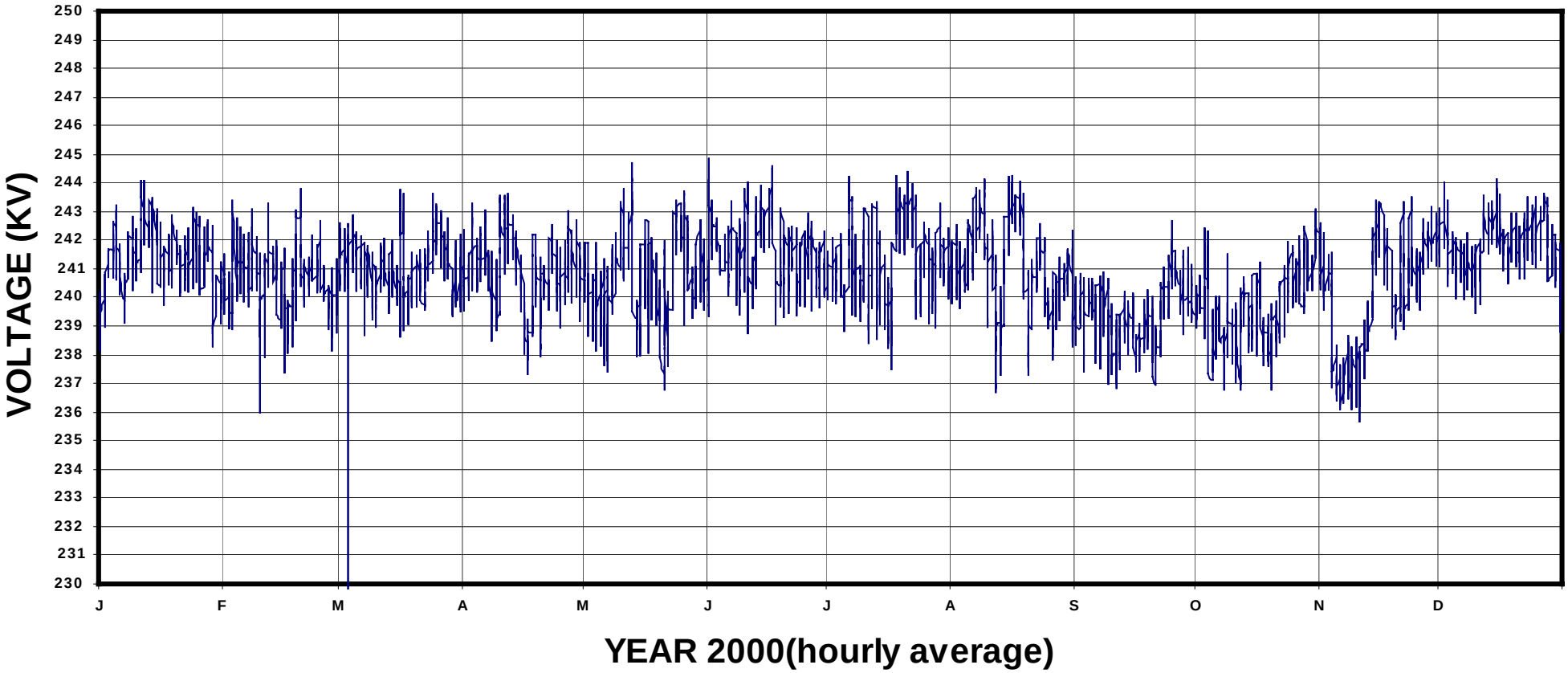
Provision should be made in the schedule for this Project for the following activities that need to be completed for Market Entry:

- Authorisation as a Market Participant
- Registration of Facilities
- Registration of the Metering Installation

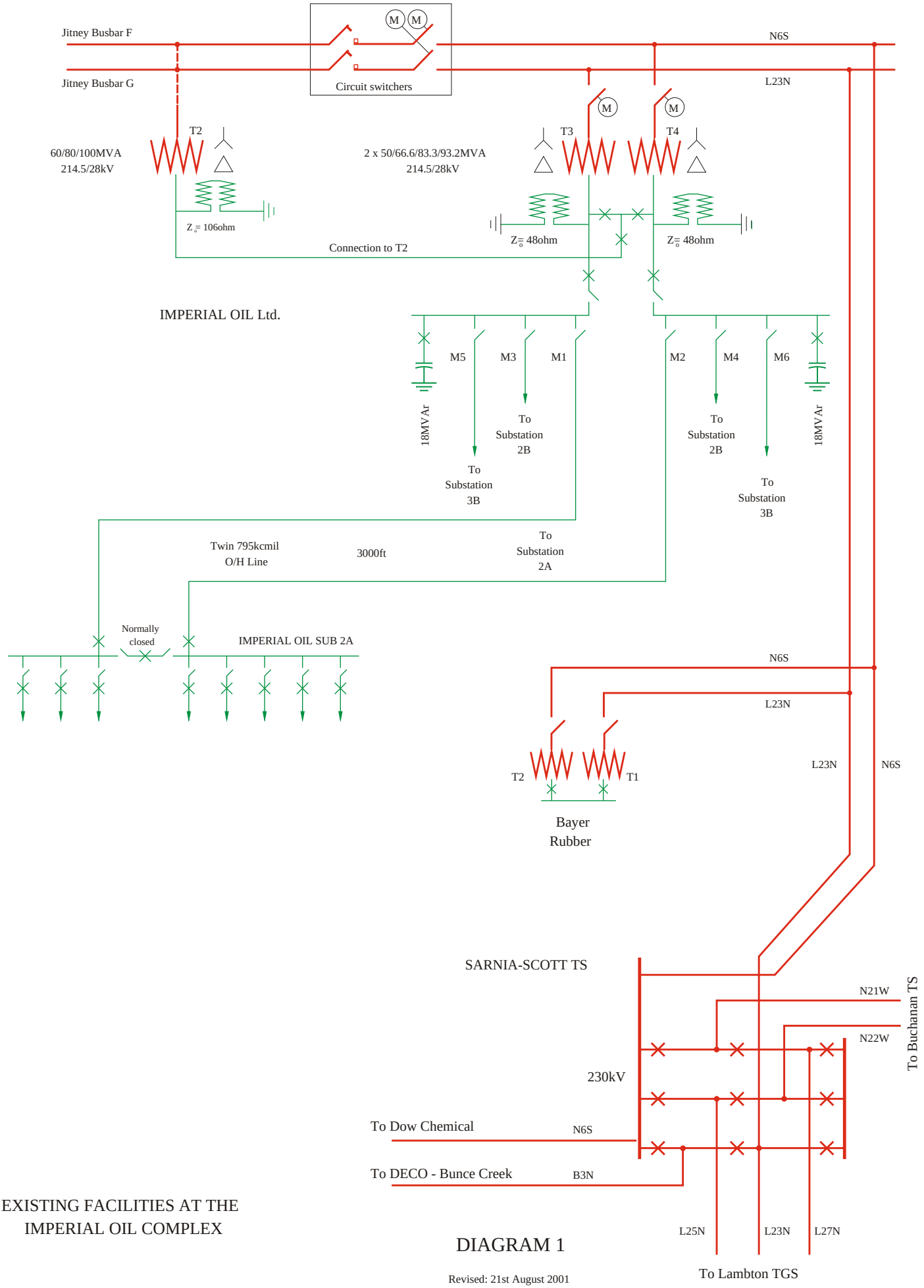
These activities can require a lead-time of between six and eight months, particularly if telemetry is involved to monitor the status of the facilities.

Further information can be found on the IMO's web site -

www.theimo.com/imoweb/marketEntry/me.asp



Scott 230kV Voltage: Recorded during the Year-2000



EXISTING FACILITIES AT THE IMPERIAL OIL COMPLEX

DIAGRAM 1

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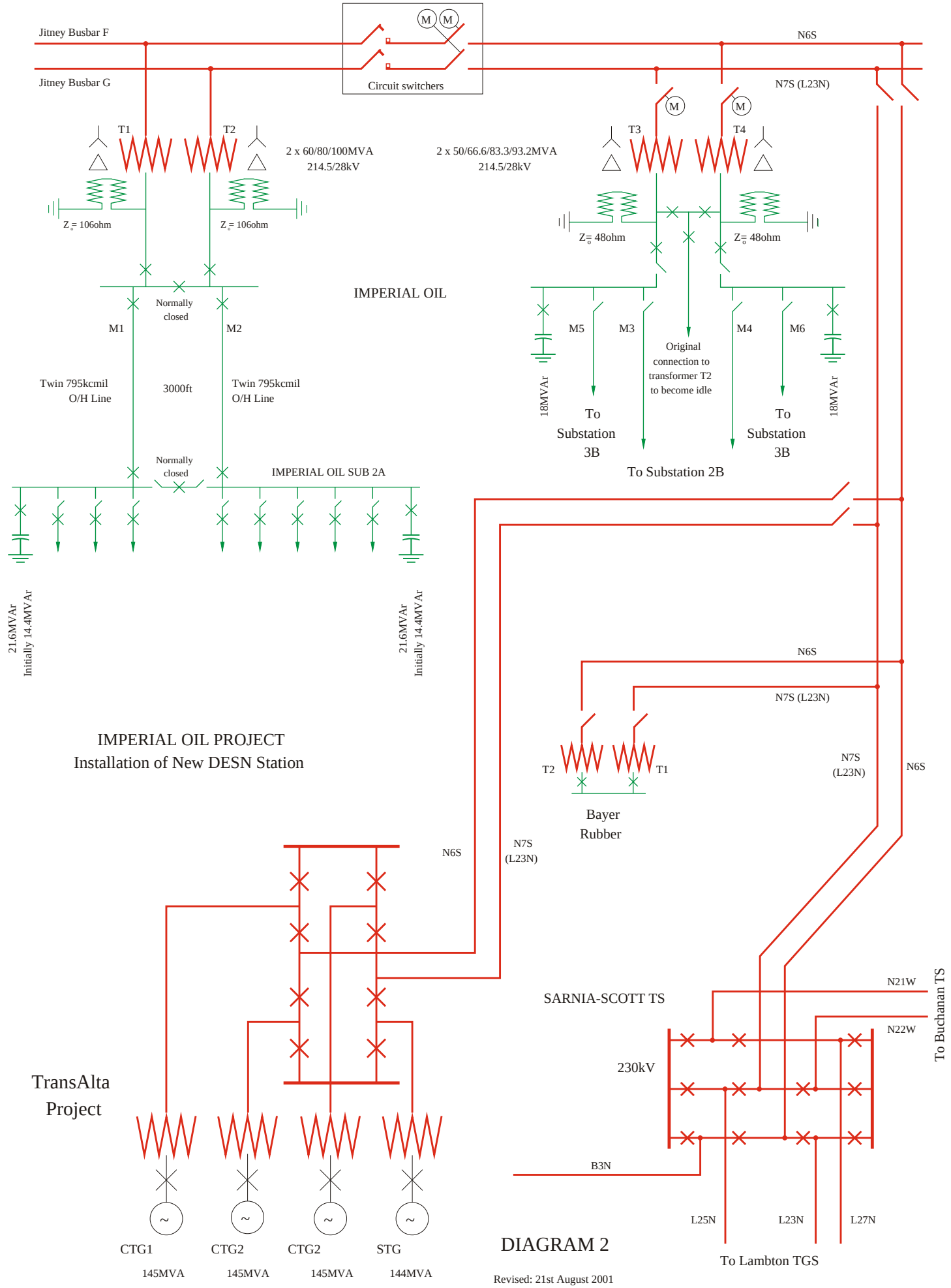

IMPERIAL OIL PROJECT
Installation of New DESN Station

TransAlta Project

DIAGRAM 2

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