CONNECTION ASSESSMENT & APPROVAL PROCESS

ASSESSMENT SUMMARY

Applicant: *Hydro One Networks Inc.*

Project: *Midhurst TS: Establish a Second 230kV DESN*

CAA ID No. 2003-EX130

Long Term Forecasts & Assessments Department
Consistent Information Set Department

Date: *15th May 2003*

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ASSESSMENT SUMMARY

HYDRO ONE NETWORKS Inc.

Midhurst TS - Establish a 2nd 230/44kV DESN Station

1. General Description

Barrie 115/44kV TS is supplied via the dedicated radial 115kV circuits E3B & E4B from Essa TS, as shown in Diagram 1. While the existing 115kV circuits have sufficient thermal capacity to accommodate an expansion of Barrie TS to meet the increasing load in the area, the two 107MVA, 230/115kV auto-transformers at Essa TS are already fully loaded. Increasing the load at Barrie TS would therefore require these two auto-transformers to be replaced with higher-rated units, or for the auto-transformer capacity to be increased through the installation of a third auto-transformer.

Midhurst TS, which is supplied from the two 230kV circuits M6E & M7E between Essa TS and Minden TS, could also be expanded to provide additional capacity to supply the load in the Barrie area. Since circuits M6E & M7E have sufficient thermal capacity available to supply additional load, expanding Midhurst TS - on the 230kV system, instead of Barrie TS - on the 115kV system, would avoid the need to uprate the existing 230/115kV facilities at Essa TS.

Hydro One is therefore proposing to establish a second 230/44kV DESN station at Midhurst TS to supply the increasing load in the Barrie area. Diagram 2 shows the additional facilities that it is proposed to install at this TS.

The scheduled completion date for the second DESN station at Midhurst TS is 1st November 2004.

2. Proposed Facilities

The new facilities that it is proposed to install at Midhurst TS are shown in Diagram 2.

Specification for the New Equipment

- *Step-down Transformers*

Transformer ratings	Two 75/100/125MVA, 230/44kV
Transformer nominal turns ratio	215.5kV : 44kV
Under-load tap-changer	± 40kV in +/-16 steps (33 positions)
Transformer connections	HV Y - ungrounded LV Y - grounded via a neutral reactor
Insulation level	900kV BIL on HV 250kV BIL on LV
Impedance	13% on 215.5kV-44kV 75 MVA

- *Neutral Reactors*

Neutral reactor type	Air-cored: One per phase
Neutral reactor ratings at 60Hz	5ohm, 4000A for 10 seconds
Insulation level	250kV BIL

- *230kV Disconnect Switches*

Type	Motorised
Rated voltage	230kV
Maximum operating voltage	250kV continuous
Continuous current	500A rms
Symmetrical short-circuit rating	17kA for 3 seconds

Asymmetrical short-circuit rating	38.5kA peak
Insulation level (minimum)	900kV BIL

- *44kV Transformer Breakers & Bus-tie Breakers*

Type	SF_6
Rated Voltage	44kV
Maximum operating voltage	48kV continuous
Continuous current	2500A rms
Symmetrical short-circuit rating	1500MVA

- *44kV Feeder Breakers*

Type	SF_6
Rated Voltage	44kV
Maximum operating voltage	48kV continuous
Continuous current	1200A rms
Symmetrical short-circuit rating	1500MVA

- *Surge Arresters*

230kV - Two sets of three (one set for each step-down transformer)

Type	Metal Oxide Gapless - station class
Maximum Continuous Operating Voltage (MCOV)	150kV rms (minimum)
Maximum equivalent front-of-wave impulse level	Not more than 634kV crest
Maximum discharge voltage for 8x20 µs 10 kA impulse current	Not more than 576kV crest
Maximum switching surge protection level	Not more than 518kV crest at 1kA
Temporary over-voltage capability	The arrester should be capable of withstanding power frequency overvoltage of not less than 195kV Phase-ground (rms) for a duration of not less than 0.5 second after the rated energy absorption.
Maximum energy dissipation per arrester	As recommended by ANSI/IEEE C62.11-1993
Pressure relief capability	As recommended by ANSI/IEEE C62.11-1993 Standard: not less than 20kA rms.

44kV - Two sets of three (one set for each step-down transformer)

Type	Metal Oxide Gapless - station class
Maximum Continuous Operating Voltage (MCOV)	30kV rms (minimum)
Maximum equivalent front-of-wave impulse level	Not more than 169kV crest
Maximum discharge voltage for 8x20 µs 10 kA impulse current	Not more than 153kV crest
Maximum switching surge protection level	Not more than 138kV crest at 500A
Temporary over-voltage capability	The arrester should be capable of withstanding power frequency overvoltage of not less than 40kV Phase-ground (rms) for a duration of not less than 1second after the rated energy absorption.
Maximum energy dissipation per arrester	As recommended by ANSI/IEEE C62.11-1993
Pressure relief capability	As recommended by ANSI/IEEE C62.11-1993 Standard: not less than 20kA rms.

3. Connection Arrangement

The new DESN Station is to be constructed adjacent to the existing facilities at Midhurst TS and is to be equipped with two step-down transformers, having the same rating as the existing units.

Each transformer is to be connected to the respective 230kV circuit, M6E or M7E, via a motorised disconnect switch. The disconnect switches are to be capable of interrupting the full magnetising current of each transformer.

Diagram 2 provides details of the 44kV busbar arrangement at the new DESN station, with a normally-closed bus-coupler breaker interconnecting the two 44kV busbars. The development is to include eight 44kV feeder positions.

A single station service transformer, SS3, is also to be installed at the new DESN station to complement the two station service transformers, SS1 & SS2, that are supplied from the existing DESN station.

Surge arresters are to be installed on the HV & LV terminals of each step-down transformer.

Under-Frequency Load-Shedding

Hydro One has confirmed that Under-Frequency Load-Shedding facilities will be installed to meet the requirements of Reference 2 of Appendix 4.3 of the Market Rules. These facilities are required to have the capability to automatically reject up to 35% of the load supplied from the new facility in response to 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.

Voltage Reduction

Hydro One has also confirmed that facilities will be installed, as required under Reference 4 of Appendix 4.3 of the Market Rules, to allow separate reductions in the supply voltage of 3% and 5% to be initiated remotely so as to achieve reductions in load at the TS.

Supervisory Control

Facilities are to be installed to allow remote supervisory control of the equipment at the second DESN station.

4. Assessment

Rating of the existing 230kV Circuits

Line Section	***Continuous Thermal Rating at 30^{o}C & 4km/hr wind***			
	Circuit M6E		***Circuit M7E***	
	Conductor Operating Temperature	***Rating (MVA at 240kV)***	***Conductor Operating Temperature***	***Rating (MVA at 240kV)***
Essa TS to Midhurst TS	93^{o}C	870A (360MVA)	93^{o}C	870A (360MVA)
	124^{o}C	1100A (457MVA)	127^{o}C	1120A (465MVA)
Midhurst TS to Orillia TS	60^{o}C	515A (214MVA)	60^{o}C	515A (214MVA)
Orillia TS to Coopers Falls Jct.	61^{o}C	520A (216MVA)		
Coopers Falls Jct. to Minden TS				

Note: Since the critical section of circuits M6E & M7E between Essa TS to Midhurst TS have been 'sagged' for maximum conductor operating temperatures of 124°C & 129°C, respectively, the ratings have been given for the following temperatures:

- the annealing temperature of 93°C (the shaded cells), and
- an emergency operating temperature of 124°C & 127°C for circuits M6E & M7E, respectively.

Circuit Loadings

Diagram 3 shows the normal flow distribution, with all transmission elements in-service.

This shows that the flows on the section of circuits M6E & M7E between Orillia TS and Coopers Falls Junction are normally close to zero.

This means that the loads at Midhurst TS and Orillia TS are normally supplied from Essa TS, while the remaining loads at Muskoka TS, TCPL Bracebridge TS, Wallace TS & Minden TS, together with some of the loads associated with circuits M80B & M81B, are normally supplied from Des Joachims GS.

For an 'extreme weather' peak value of approximately 265MVA for the loads at Midhurst TS and Orillia TS, the flow on the section of each circuit between Essa TS and Midhurst TS (of ~ 135MVA per circuit) would be well within its continuous thermal rating (of 360MVA).

Diagram 4 shows the corresponding flow distribution with the 230kV circuit M6E out-of-service.

This shows that the flow on the companion circuit over the section between Essa TS and Midhurst TS (of ~290MVA) would remain well within the continuous rating of the circuit.

Furthermore, the post-contingency voltages, following tap-changer action, show a decline of less than 3%, which would be within the IMO's criteria.

Conclusions

The proposal to establish a second 230/44kV DESN station at Midhurst TS will not materially affect either the reliability or the load meeting capability of the IMO-controlled grid.

5. IMO's Connection Requirements

Power Factor

Reference 1 of Appendix 4.3 of the Market Rules requires the power factor for Connected Wholesale Customers and Distributors to be within the range of 0.90 lagging and 0.90 leading as measured at the defined meter point. Since the defined meter point is required to be at a voltage greater than 50kV, this means that the power factor at the 230kV terminals of the new MTS will be required to exceed 0.90 lagging.

The peak loading recorded at Midhurst TS during the last summer indicates that the power factor *at the LV busbar* was approximately 0.89. After allowing for the reactive power losses in the two step-down transformers the power factor at the defined meter point would be less than the 0.90 required by the Market Rules.

It is therefore required that provision be included in the plan to develop Midhurst TS for the installation of shunt capacitors.

Monitoring

Facilities are to be installed to meet the IMO's monitoring requirements as detailed in Appendicies 4.16 & 4.17 of the Market Rules.

6. Need for a System Impact Assessment

Based on the results of this assessment it has been concluded that establishing a second 230/44kV DESN station at Midhurst TS will have no adverse impact on the IMO-controlled grid and that no further analysis is necessary.

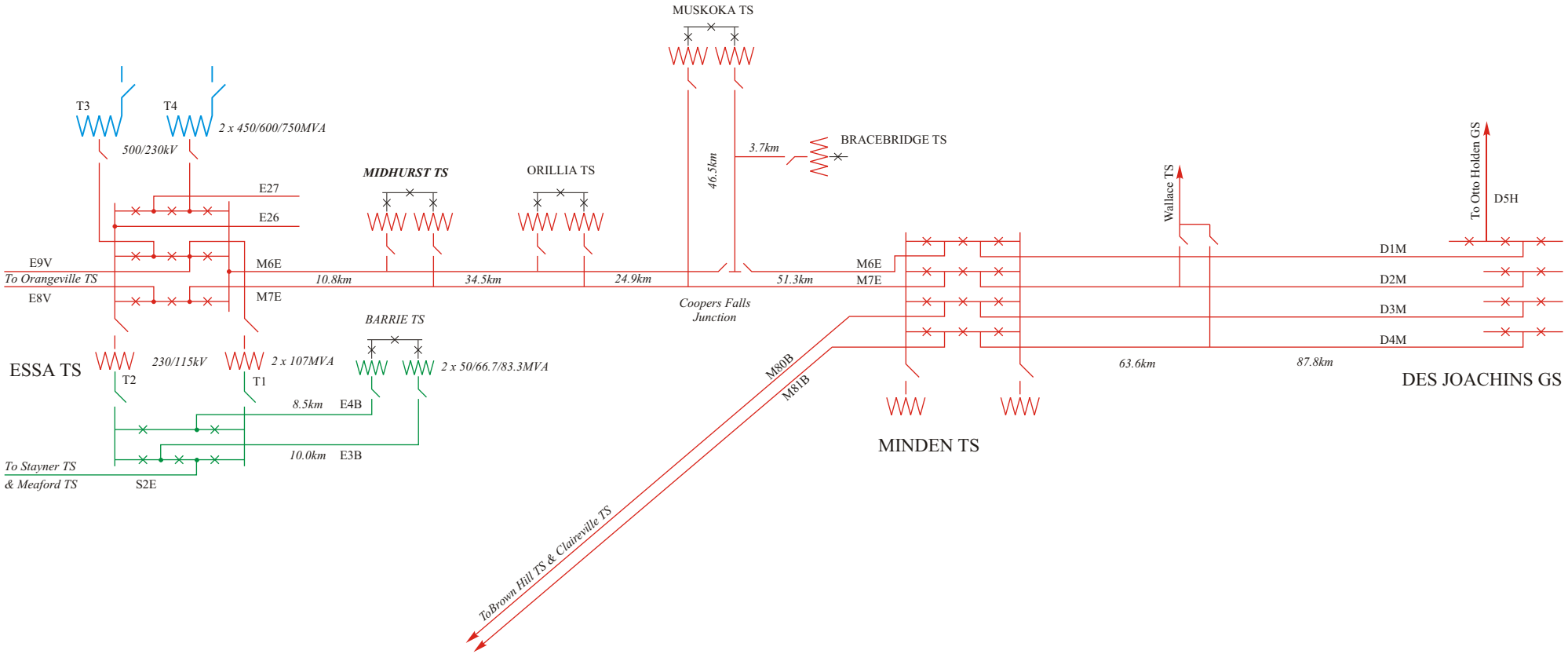
A separate System Impact Assessment will therefore not be required for this Project.

7. Customer Impact Assessment

Since this work will have no impact on local customers or their facilities, Hydro One has notified the IMO that a Customer Impact Assessment will not be required for this Project.

8. Notification Of Approval

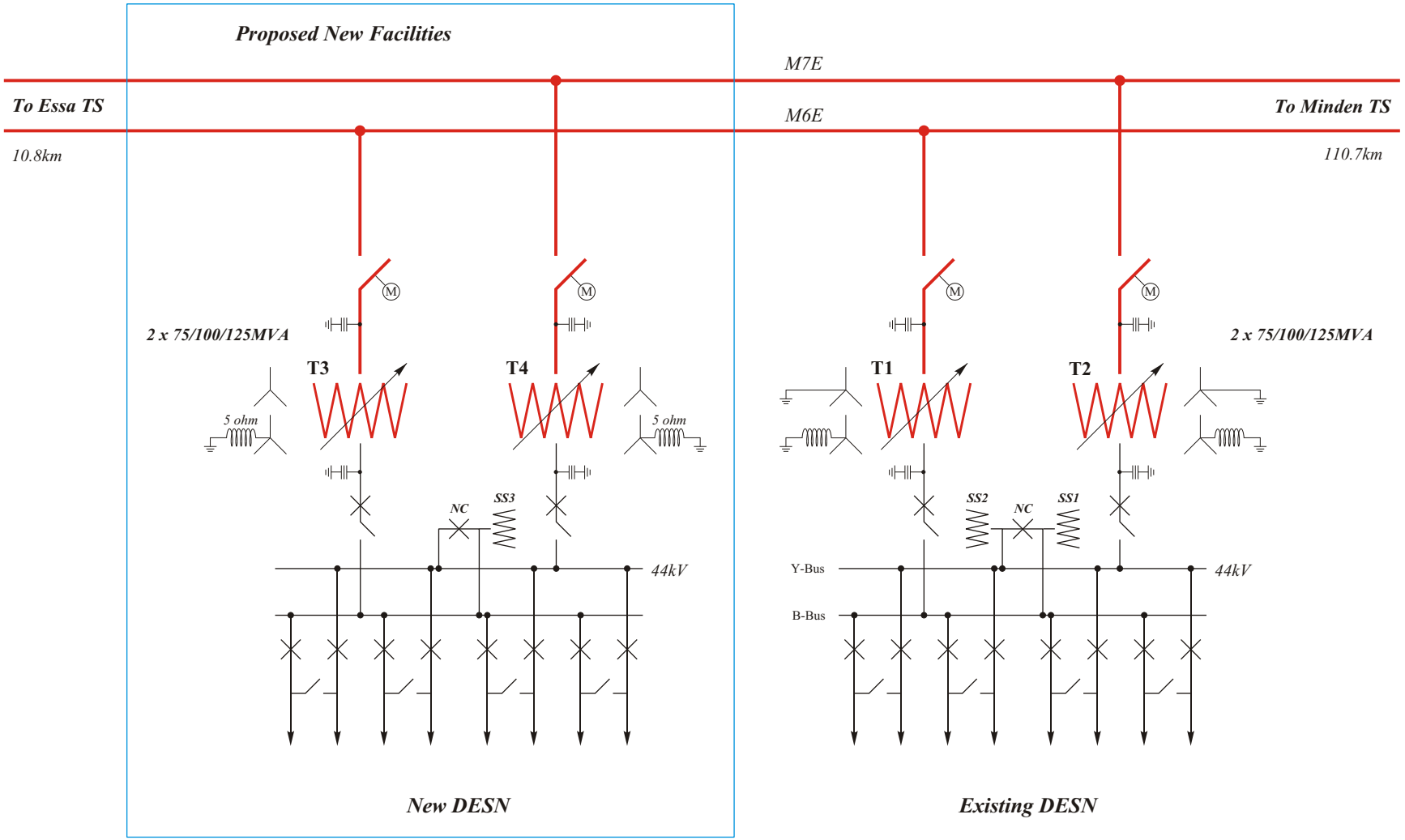
It is therefore recommended that a Notification of Approval of the Connection Proposal be issued.



Existing Transmission Facilities in the Essa TS - Minden TS - Des Joachims GS Corridor

DIAGRAM 1

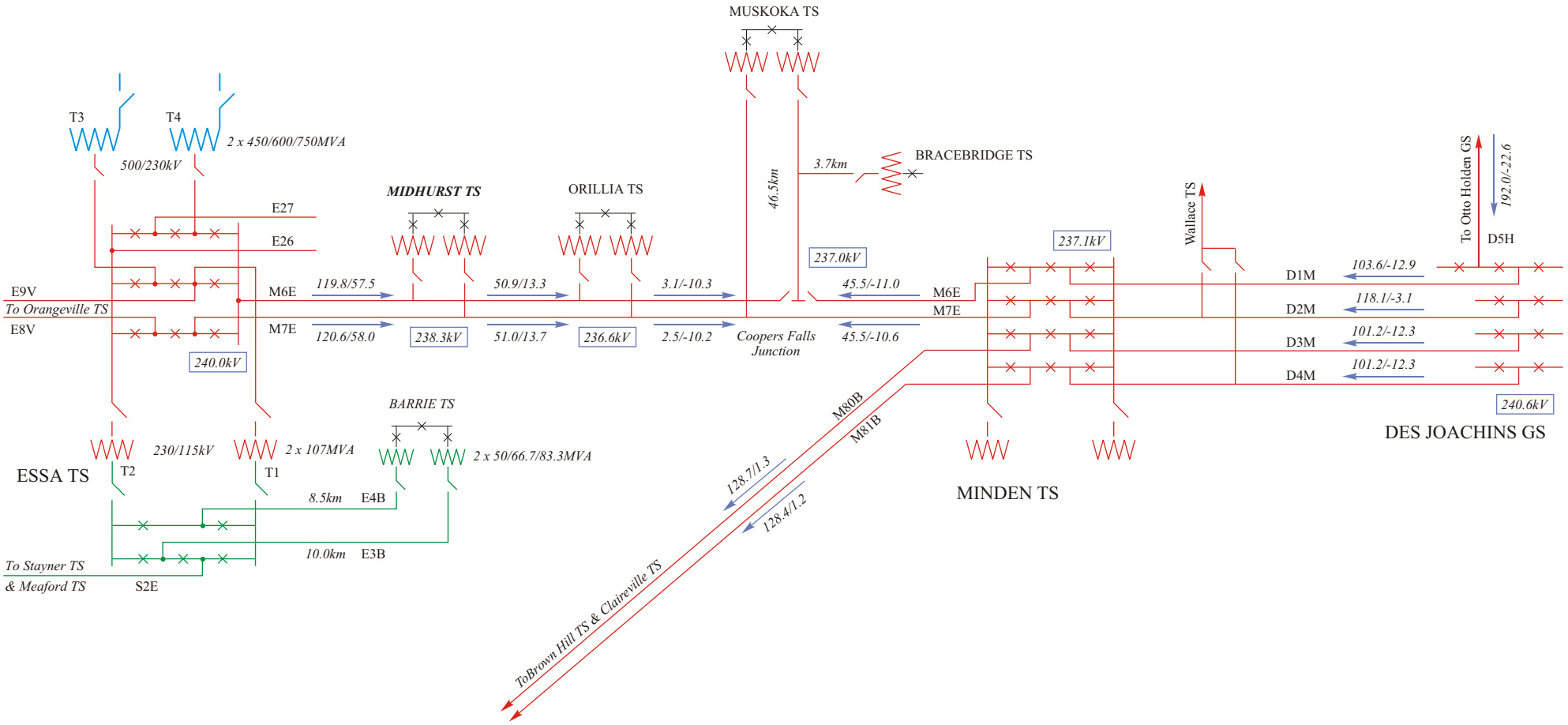
3rd May 2003



Proposed Expansion of Midhurst TS

DIAGRAM 2

3rd May 2003

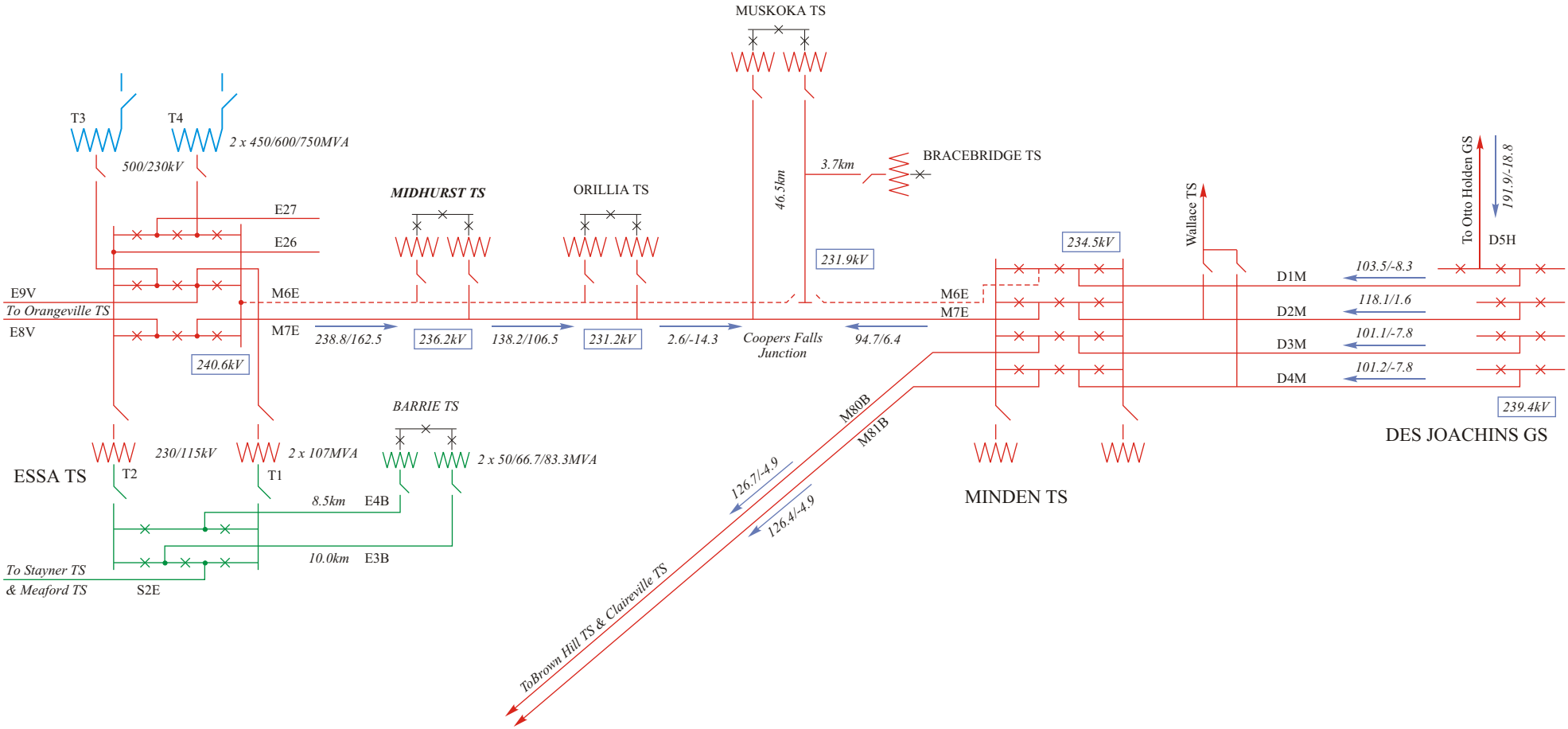


Load Flow Study Results for the Summer-2006 Peak Condition: Extreme Weather Load Forecast

With all Transmission Elements In-service

DIAGRAM 3

3rd May 2003



Load Flow Study Results for the Summer-2006 Peak Condition: Extreme Weather Load Forecast

With circuit M6E out-of-service

DIAGRAM 4

3rd May 2003