

Independent Electricity
System Operator
Station A, Box 4474
Toronto, Ontario M5W 4E5
t 905 855 6100
www.ieso.ca

CONNECTION ASSESSMENT & APPROVAL PROCESS

SYSTEM IMPACT ASSESSMENT REPORT

Claireville TS to Cherrywood TS 500kV Corridor:

Unbundle the 500kV Super-Circuits C550V & C551V

Applicant: Hydro One Networks Inc.

CAA ID No. 2006-EX297

Transmission Assessments & Performance Department

FINAL Version

Date: 18th January 2007

HYDRO ONE NETWORKS Inc.: CLAIREVILLE TS TO CHERRYWOOD TS 500kV CORRIDOR

Unbundling of the 500kV Circuits C550V & C551V

1. Introduction

Two 500kV double-circuit transmission lines, each approximately 46km in length, occupy a portion of the existing transmission corridor between Claireville TS and Cherrywood TS. The remainder of the right-of-way accommodates the 230kV double-circuit line, V71RP & V75P, between Claireville TS and Parkway TS and the 230kV double-circuit line, C35P & C36P, between Parkway TS and Cherrywood TS.

The two circuits on each of the 500kV lines are commoned together via inter-circuit ties and operated as individual 'super-circuits' as shown in Diagram 1.

In 2005, the 500/230kV Parkway transformer station was established with an initial complement of two 750MVA 500/230kV auto-transformers. Each auto-transformer was connected to one of the 500kV 'super-circuits'.

During the last five years the 500kV facilities at Cherrywood TS have experienced a number of high-impact incidents including five breaker-failure conditions; two loss of air pressure to the air-blast circuit breakers; and three episodes involving icing of equipment within the 500kV switchyard.

Under the Hydro One strategy to phase out the air-blast circuit breakers and their associated compressed air systems, the existing 500kV circuit breakers at Cherrywood TS are scheduled to be replaced in 2011.

To improve the reliability of the Bulk Electricity System and to enhance the operational flexibility during outage conditions Hydro One is proposing to unbundle the two 'super-circuits' between Clairville TS and Cherrywood TS.

Consideration is also being given to advancing the replacement of four of the existing air-blast circuit breakers at Cherrywood TS so that all four breakers in two of the existing four diameters would then be of an SF₆ design. The intent would be to reduce the exposure, either from possible breaker-failure conditions or from problems associated with the compressed air system at Cherrywood TS, of the 500kV connections between Bowmanville TS/Darlington GS and Claireville TS to outages.

2. Proposed Work

Diagram 2 shows the proposed unbundling of the 500kV circuits C550V & C551V together with the new facilities that would be required at both Claireville TS and Cherrywood TS for the termination of the two new circuits that would result from the unbundling. A total of three new 500kV breakers would be required at Claireville TS and a minimum of four new 500kV breakers at Cherrywood TS.

If the replacement of the two existing air-blast circuit breakers in each of the diameters in which the new breakers are to be installed can be advanced, then this would result in an arrangement with two diameters equipped solely with SF₆ equipment, as shown in Diagram 3. This arrangement would be expected to address many of the operational security concerns that presently exist at Cherrywood TS

2.1 Darlington Generation Rejection SPS

The existing G/R Scheme allows either unit G1 or unit G2 at Darlington NGS to be selected for rejection in response to the following contingencies:

- Loss of the 500kV 'super-circuit' C550V, detected at Cherrywood TS
- Loss of the 500kV 'super-circuit' C551V, detected at Cherrywood TS

With the unbundling of the 500kV 'super-circuits' C550V & C551V, this scheme will need to be modified.

3. Specification for New 500kV Facilities

3.1 Claireville TS - GIS Equipment

Circuit Breakers:

Number required:	3
Fault Interrupting Capability:	80kA symmetrical
Current rating:	4000A
Maximum continuous operating voltage:	550kV
LIL Rating:	1800kV
Interrupting time:	2-cycles
Closing resistors:	Yes
Out-of-phase switching:	Yes

Disconnect Switches:

Maximum continuous operating voltage:	550kV
Current rating:	4000A
Motorised:	Yes

Ground Switches:

Type	Interrupter
Maximum continuous operating voltage:	550kV
Minimum continuous current rating:	600A
Short-circuit rating:	63kA
Interruption capability: Inductive	420A rms - followed by a transient recovery voltage with an initial rate-of-rise of 89kV/ms & a crest value of 83kV peak. Final voltage: 30kV rms.
Capacitive	30A rms - followed by a transient recovery voltage with a crest value of 110kV peak
LIL Rating:	1800kV peak
Motorised:	Yes

Buswork:

Maximum continuous operating voltage:	550kV
Current rating: Main busbars & line entrances	4320A [3740MVA at 500kV]
Minimum short-circuit rating: All new bus-work	100kA symmetrical

3.2 Cherrywood TS - AIS Equipment

Circuit Breakers:

Number required:	4
Fault Interrupting Capability:	80kA symmetrical
Current rating:	4000A
Maximum continuous operating voltage:	550kV
LIL Rating:	1800kV
Interrupting time:	2-cycles
Closing resistors:	Yes
Out-of-phase switching:	Yes

Disconnect Switches:

Maximum continuous operating voltage:	550kV
Current rating:	4000A
Motorised:	Yes

Ground Switches:

Type	Interrupter
Maximum continuous operating voltage:	550kV
Minimum continuous current rating:	600A
Short-circuit rating:	63kA
Interruption capability: Inductive	420A rms - followed by a transient recovery voltage with an initial rate-of-rise of 89kV/ms & a crest value of 83kV peak. Final voltage: 30kV rms.
Capacitive	30A rms - followed by a transient recovery voltage with a crest value of 110kV peak
LIL Rating:	1800kV peak
Motorised:	Yes

Buswork:

Maximum continuous operating voltage:	550kV
Current rating: Main busbars & line entrances	4320A [3740MVA at 500kV]
Minimum short-circuit rating: All new bus-work	100kA symmetrical

The equipment that has been proposed will meet the requirements of both the Market Rules and the Transmission System Code. In addition, the amperage ratings will be adequate for the expected duty under all the operating conditions that are presently anticipated.

4. Proposed Schedule

The new facilities are planned to be in-service by the summer-2009.

5. Assessment

5.1 Thermal Ratings

The thermal ratings for the critical sections of the 230kV circuits from Cherrywood TS to either Parkway TS or Richview TS that were used in this assessment have been summarised in Table 1.

The corresponding rating for the 500kV circuits on the Claireville TS to Cherrywood TS and on the Cherrywood TS to Bowmanville TS corridors have been summarised in Table 2.

TABLE 1									
Thermal Ratings of the 230kV Circuits from Cherrywood TS to either Parkway TS Or Richview TS									
			<i>Ratings at 35°C Ambient: 4km/hr wind: MVA at 240kV</i>						
<i>Circuit</i>	<i>Conductor</i>	<i>Sag Temp</i>	<i>Continuous at 93°C</i>	<i>Long-Term 'Emergency' at 127°C or Sag Temperature, if lower</i>			<i>15-min LTR at Sag Temperature</i>		
C4R: Cherrywood TS to Richview TS (initial section to Malvern TS)									
Cherrywood to Str 886	1192.5kcmil 54/19	150°C	1060A	440MVA	1400A	582MVA	1890A	785MVA	<i>Pre-load of 1060A</i>
Str 886 to Str 895	1843.2kcmil 72/7	93°C/127°C	1350A	561MVA	1790A**	744MVA	2160A	898MVA	<i>Pre-load of 1350A</i>
Str 895 to Malvern TS	1192.5kcmil 54/19	145°C	1060A	440MVA	1400A	582MVA	1840A	764MVA	<i>Pre-load of 1060A</i>
C5R: Cherrywood TS to Richview TS (initial section to Malvern TS)									
Cherrywood to Str 886	1192.5kcmil 54/19	150°C	1060A	440MVA	1400A	582MVA	1890A	785MVA	<i>Pre-load of 1060A</i>
Str 886 to Str 895	1843.2kcmil 72/7	93°C/127°C	1350A	561MVA	1790A**	744MVA	2160A	898MVA	<i>Pre-load of 1350A</i>
Str 895 to Malvern TS	1192.5kcmil 54/19	143°C	1060A	440MVA	1400A	582MVA	1810A	752MVA	<i>Pre-load of 1060A</i>
C35P: Cherrywood TS to Parkway TS									
Cherrywood to Parkway TS	1924kcmil 69/19	127°C	1370A	569MVA	1820A	756MVA	2290A	952MVA	<i>Pre-load of 1370A</i>
C36P: Cherrywood TS to Parkway TS									
Cherrywood to Str 8A	1843.2kcmil 72/7	93°C/127°C	1350A	561MVA	1790A**	744MVA	2160A	898MVA	<i>Pre-load of 1350A</i>
Str 8A to Parkway TS	1924kcmil 69/19	127°C	1370A	569MVA	1820A	756MVA	2290A	952MVA	<i>Pre-load of 1370A</i>
C18R: Cherrywood TS to Richview TS									
Cherrywood TS to Richview TS	1843.2kcmil 72/7	93°C/127°C	1350A	561MVA	1790A**	744MVA	2160A	898MVA	<i>Pre-load of 1350A</i>
C20R: Cherrywood TS to Richview TS									
Cherrywood TS to Richview TS	1843.2kcmil 72/7	93°C/127°C	1350A	561MVA	1790A**	744MVA	2160A	898MVA	<i>Pre-load of 1350A</i>

** Limited to 50 hours per year at 127°C

TABLE 2A		Thermal Ratings of the 500kV Circuits from Claireville TS to Cherrywood TS Corridor									
			<i>Ratings at 35°C Ambient: 4km/hr wind: MVA at 520kV</i>								
<i>Circuit</i>	<i>Conductor</i>	<i>Sag Temp</i>	<i>Continuous at 93°C</i>	<i>Long-Term 'Emergency' at 127°C or Sag Temperature, if lower</i>			<i>15-min LTR at Sag Temperature</i>				
C550V & C551V: Claireville TS to Cherrywood TS											
Claireville to Cherrywood	Quad 585.0kcmil 26/7	127°C	2810A	2531MVA	3660A	3296MVA	3920A	3531MVA	<i>Pre-load of 2810A</i>		

TABLE 2B		Thermal Ratings of the 500kV Circuits from Cherrywood TS to Bowmanville TS Corridor									
			<i>Ratings at 35°C Ambient: 4km/hr wind: MVA at 520kV</i>								
<i>Circuit</i>	<i>Conductor</i>	<i>Sag Temp</i>	<i>Continuous at 93°C</i>	<i>Long-Term 'Emergency' at 127°C or Sag Temperature, if lower</i>			<i>15-min LTR at Sag Temperature</i>				
B540C & B541C: Bowmanville TS to Cherrywood TS											
Bowmanville to Cherrywood	Quad 932.7kcmil 26/7	127°C	3750A	3377MVA	4910A	4422MVA	5510A	4963MVA	<i>Pre-load of 3750A</i>		
B542C & B543C: Bowmanville TS to Cherrywood TS											
Bowmanville to Cherrywood	Quad 585.0kcmil 26/7	127°C	2810A	2531MVA	3660A	3296MVA	3920A	3531MVA	<i>Pre-load of 2810A</i>		

5.2 Existing System Configuration

On 1st August 2006 at approximately 4.00pm EST, the following conditions were recorded on the system:

<i>Primary Demand:</i>	27016MW		
<i>Generation Facilities in-service:</i>	Pickering GS	5 units	
	Darlington GS	4 units	
	Lennox GS	4 units	
<i>Coincident Transfers:</i>			
	Combined Flow on the 500kV circuits into Cherrywood TS from Bowmanville TS		4935MW
	Combined Flow on the 500kV circuits from Cherrywood TS to Parkway TS		2981MW
	<i>Combined Flow through the 500/230kV auto-transformers:</i>	Cherrywood TS	2279MW
		Parkway TS	1201MW
		Claireville TS	2843MW

The results of a load flow study, with a system primary demand of approximately 27000MW, for the same generation dispatch as above are shown in Diagram 4. The values recorded on 1st August 2006 have been included for comparison.

The following Table summarises the differences between the flows that were recorded and those obtained from the reference load flow study.

<i>Comparison between study results & recorded values</i>			
	<i>Actual</i>	<i>Load Flow</i>	<i>Difference</i>
• Flow into Cherrywood TS from Bowmanville TS	4935MW	4867MW	-68MW
• Flow from Cherrywood TS to Parkway TS	2981MW	2724MW	-257MW
• Flow through Cherrywood 500/230kV auto-transformers	2279MW	2126MW	-153MW
• Flow through Parkway 500/230kV auto-transformers	1201MW	1024MW	-177MW
• Flow through Claireville 500/230kV auto-transformers	2843MW	2779MW	-64MW

Since the correlation between the respective flows is reasonably good, this study was therefore used as the basis for the subsequent analysis in this assessment.

Diagram 5 shows the effect that operating with all six units at Pickering GS in-service together with the planned Portlands Energy Centre at the Hearn site would be expected to have on the flows on the Cherrywood TS to Claireville TS corridor.

This shows that the additional generation capacity would result in an increase of approximately 600MW in the flow on the 500kV circuits from Cherrywood TS to Parkway TS and an increase of approximately 500MW in the flow on the 230kV circuits from Cherrywood TS to either Parkway TS or Richview TS.

With this additional generating capacity assumed to be in-service, the effect of an outage involving one of the super-circuits between Cherrywood TS and Claireville TS is shown in Diagram 6.

The major portion of the 1660MW that had been flowing on the outaged super-circuit is shown to be picked up by the companion super-circuit (~1250MW) with the remainder being distributed across the 230kV circuits from Cherrywood TS to either Parkway TS or Richview TS (~410MW). Although it would be appropriate to use the long-term-emergency ratings for this outage condition, the resulting flows on these 230kV circuits, as shown in the following Table, remain within their *continuous* ratings:

<i>Flows on the 230kV Cherrywood x Parkway/Richview circuits with one 500kV super-circuit out-of-service</i>			
<i>230kV Circuit</i>	<i>Flows</i>		<i>Continuous Rating</i>
C4R	372.2MW/-46.3MVA _r	895A	1060A
C5R	400.4MW/-54.5MVA _r	964A	1060A
C35P	453.7MW/-11.2MVA _r	1083A	1370A
C36P	494.2MW/-11.5MVA _r	1179A	1370A
C18R	395.2MW/-26.6MVA _r	945A	1350A
C20R	396.0MW/-34.8MVA _r	948A	1350A

Diagram 7 shows the effect that a subsequent contingency involving one of the super-circuits would be expected to have when the companion super-circuit is already out-of-service.

With no 500kV connection between Cherrywood TS and Claireville TS, all of the flow on the 500kV circuits from Bowmanville TS would be forced through the four 500/230kV auto-transformers at Cherrywood TS. This would result in flows that would exceed the 10-day limited-time-ratings of these units. In addition, the flows on the 230kV circuits C4R, C5R, C35P & C36P are all shown to exceed their long-term-emergency ratings.

Diagram 8 shows the effect that the rejection of one of the units at Darlington GS would have on the post-contingency flows.

Rejecting one of the units at Darlington GS is shown to reduce the transfer on the 500kV circuits into Cherrywood TS from Bowmanville TS by approximately 730MW. This would be sufficient to reduce the flows through each of the auto-transformers to within their 10-day limited-time-ratings, following completion of the on-going work to replace the de-rated auto-transformer T14 with a new unit.

However, while the flows on the 230kV circuits from Cherrywood TS would also be reduced as a result of rejecting one of the units at Darlington GS, the reductions would not be sufficient to ensure that the flows on circuits C4R, C5R, C35P & C36P remain within their long-term-emergency ratings, as shown in the following Table:

<i>Post-Contingency Flows for the loss of one 500kV super-circuit, with the companion super-circuits already out-of-service, and following the rejection of one unit at Darlington GS</i>			
<i>230kV Circuit</i>	<i>Flows</i>		<i>Long-term-Emergency Rating</i>
C4R	635.2MW/-51.5MVA _r	1520A	1400A
C5R	676.1MW/-55MVA _r	1618A	1400A
C35P	950.5MW/50.1MVA _r	2271A	1820A
C36P	990.5MW/52.6MVA _r	2366A	1790A
C18R	672.5MW/-19.1MVA _r	1605A	1790A
C20R	664.4MW/-30.1MVA _r	1587A	1790A

The conclusion drawn from these results is that during periods with high transfers on the 500kV system it would be necessary to re-dispatch the generation capacity east of Cherrywood TS to reduce the transfers into Cherrywood TS whenever one of the super-circuits is out-of-service. With a sufficient reduction in these transfers, the long-term-emergency ratings of the 230kV circuits from Cherrywood TS to either Parkway TS or Richview TS could then be respected by initiating the rejection of one of the units at Darlington GS following a contingency involving the companion super-circuit.

5.3 With the 500kV Claireville-to-Cherrywood Super-Circuits Unbundled

Diagram 9 shows the flows for the situation with the super-circuits between Claireville TS and Cherrywood TS unbundled and with one of these circuits out-of-service. For this condition, the circuit selected for removal was one that had one of the Parkway auto-transformers connected to it, so as to further stress the system.

With one of the unbundled 500kV circuits, together with its associated 500/230kV auto-transformer at Parkway TS out-of-service, there would be an increased transfer through the auto-transformers at Cherrywood TS of approximately 240MW. For this limited increase, the resulting flows on the 230kV circuits between Cherrywood TS and either Parkway TS or Richview TS are therefore shown to remain well within their continuous ratings.

Diagram 10 shows the flows that would occur following a subsequent 500kV double-circuit contingency when one of the 500kV circuits is already out-of-service. Of the original flow of approximately 3300MW on the 500kV circuits from Cherrywood TS, with all circuits in-service (refer to Diagram 5), the remaining 500kV circuit between Cherrywood TS and Claireville TS is shown to carry approximately 2300MW (2495A). This would be within this circuit's continuous rating of 2810A and well within its long-term-emergency rating of 3660A.

The related increase of approximately 1040MW (250MW following the outage of the first circuit + 790MW following the subsequent double-circuit contingency) in the combined flow on the 230kV circuits from Cherrywood TS to either Parkway TS or Richview TS would not be sufficient to cause any of these circuits to exceed their long-term-emergency ratings.

For this situation with both of the auto-transformers at Parkway TS removed from service, the combined transfer through the Cherrywood auto-transformers would increase by approximately 990MW (240MW following the initial outage of the first circuit + 750MW following the subsequent double-circuit contingency). However, this increase would not be sufficient for the flows through the auto-transformers to exceed their continuous ratings, let alone their 10-day limited-time-ratings.

Consequently, for transfers on the 500kV system similar to those that have been assumed in this assessment, there would be no need to employ generation rejection at Darlington GS for this contingency/outage condition once the unbundling of the super-circuits has been completed.

5.4. Conclusions from the Analysis for the Claireville-to-Cherrywood Corridor

Had all six units at Pickering GS been operational during the system peak that was recorded on the 1st August 2006, the transfers on the 500kV Cherrywood TS x Claireville TS transmission corridor would have been higher. Furthermore, the Portlands Energy Centre at the Hearn site once it is fully operational by the summer 2009, will also increase the transfers on this corridor.

For the peak transfers that are expected to occur on the 500kV Cherrywood TS x Claireville TS transmission corridor with the existing resources, the analysis has shown the following;

- that with the 500kV super-circuits still bundled, any outage involving either of the Cherrywood TS x Claireville TS super-circuits would require generation east of Cherrywood TS to be re-dispatched to reduce the transfers on the remaining 500kV super-circuit. This reduction would need to be sufficient to ensure that with one unit at Darlington GS automatically rejected in response to a subsequent contingency involving the companion super-circuit, that the following flows remain within the appropriate emergency ratings of the equipment:

- the flows through the Cherrywood 500/230kV auto-transformers must remain within their 10-day limited-time-ratings, and
- the flows on the 230kV circuits from Cherrywood TS to either Parkway TS or Richview TS must remain within their long-term-emergency ratings.
- that with the 500kV super-circuits unbundled, it would not be necessary to re-dispatch the generation in preparation for a subsequent contingency involving the companion 500kV double-circuit line between Cherrywood TS & Claireville TS.

Furthermore, it would not be necessary to initiate generation rejection of one of the units at Darlington GS in response to a double-circuit contingency while one 500kV circuit is already out-of-service,

5.5 Analysis of the Cherrywood-to-Bowmanville Corridor

Diagram 11 shows the flows on the remaining circuits when one of the lower-rated Cherrywood-to-Bowmanville 500kV circuits is out-of-service. The maximum flow on the remaining 500kV circuits between Cherrywood TS and Bowmanville TS is approximately 1825A which would be well within the continuous ratings of these circuits as summarised in Table 2B.

Diagram 12 shows the flows following a subsequent 500kV double-circuit contingency on this corridor.

The flow of ~ 4570MVA on the remaining 500kV circuit B542C would exceed both its 15-minute LTR and its long-term emergency rating.

Diagram 13 shows the effect that rejecting one of the units at Darlington GS would have on the flow on the remaining circuit. Although it would be reduced to ~ 3826MVA, it would still exceed both the 15-minute LTR and the long-term emergency rating of this circuit.

It is also worth noting that, had the remaining circuit been one of the higher-rated ones, B540C or B541C, then the post-contingency flow, prior to the rejection of one of the generating units at Darlington GS, would still have exceeded its long-term emergency rating. However, following the rejection of a single Darlington unit, the post-contingency flow would then have been reduced to within the circuit's long-term emergency rating.

5.6 Conclusions from the Analysis for the Cherrywood-to-Bowmanville Corridor

For the flow conditions that were experienced on 1st August 2006, the analysis shows that an outage involving one of the Cherrywood-to-Bowmanville 500kV circuits could have required the output from Darlington GS to have been reduced by between approximately 1000MW and 1400MW, depending on the particular circuit that is initially affected. This would be reduced to between 200MW and 600MW had provision been available to automatically reject one of the generating units at Darlington GS in the event of a subsequent double-circuit contingency.

With the higher transfers that are expected to occur on the Cherrywood-to-Bowmanville corridor, it is therefore recommended that while the scope of the existing Darlington G/R Scheme is being enhanced to accommodate the unbundled 500kV circuits between Claireville TS and Cherrywood TS, it also be expanded to recognised contingencies involving the 500kV circuits on the Cherrywood-to-Bowmanville corridor.

6. Breaker-Failure Conditions at Cherrywood TS

Diagram 14 shows the existing arrangement of the 500kV switchyard at Cherrywood TS with the particular breakers that have experienced breaker-failure conditions during the period since 2001 identified.

With the exception of breaker W3L540, each of these conditions has involved a breaker that is adjacent to one of the main busbars and the response would therefore have involved the removal of the associated main busbar from service. With one of the main busbars out-of-service, the system would need to be able to sustain a single-circuit contingency together with an associated stuck-breaker condition.

For the stuck-breaker conditions that involved either breaker JL541 or JL550, then the J-Busbar would have to be removed from service. A subsequent contingency involving one of the circuits B542C, C551V, B540C or B43C together with a stuck-breaker condition could have resulted in the automatic removal of the A-Busbar from service.

Consequently, with one of the 500kV circuits at Cherrywood TS out-of-service together with both main busbars, only limited connectivity would therefore remain between the circuits from Bowmanville TS and the circuits to Claireville TS.

To ensure that the system would be capable of sustaining such a contingency following the particular breaker failure conditions that have been experienced, a major reduction in the output from Darlington GS had to be implemented.

For the stuck-breaker condition that involved the 500kV breaker W3L540, breakers L540A & W3L550 would have had to have been removed from service, isolating the 500kV circuit B540C and the 500/230kV auto-transformer T16. However, following the switching required to isolate the stuck-breaker, both of the main 500kV busbars would still have remained in-service. While a subsequent contingency involving one of the remaining 500kV circuits together with a stuck-breaker condition could have resulted in the automatic removal of one of the main busbars from service, the continued presence of the other main busbar would have ensured sufficient connectivity between the circuits from Bowmanville SS and those to Claireville TS, via the Cherrywood busbar, that the restrictions imposed on the output from Darlington GS would have been less severe.

Since the planned unbundling of the 500kV super-circuits will result in a Claireville-Cherrywood circuit being directly associated with a Cherrywood-Bowmanville circuit on each 500kV diameter, the loss of both main busbars together with one of the 500kV circuits would leave sufficient connectivity through Cherrywood TS that imposing limits on the output of Darlington GS would either become unnecessary or would be significantly reduced.

Furthermore, the subsequent replacement of the air-blast circuit breakers with SF₆ units is also expected to significantly reduce the number of breaker-failure conditions that are experienced at Cherrywood TS.

7. Future Increases in the Transfers on the Cherrywood TS to Claireville TS

With the announcement on 14th November 2006 of the decision to proceed with the development of the 1250MW Ontario - Hydro Quebec Interconnection with an expected completion date of December 2009, the transfers on both the Cherrywood-to-Bowmanville and the Claireville-to-Cherrywood corridors are expected to increase.

With any increase in the transfers on these corridors, the unbundling of the 500kV super-circuits between Claireville TS & Cherrywood TS, together with the enhancement/expansion of the Darlington G/R Scheme, are therefore expected to have further benefits than those indicated by the analysis performed for this assessment.

Increasing the number of units that could be armed for rejection at Darlington GS from one to two, in order to limit the extent of possible reductions in the output from this facility whenever elements are out-of-service, should therefore be investigated.

8. Enhancement/Expansion of the Darlington Generation Rejection SPS

Diagram 15 shows the proposed functional specification for the modified SPS.

This includes both the enhanced facilities that will be required to accommodate the unbundling of the 500kV circuits between Claireville TS and Cherrywood TS, as well as the expanded facilities that have been recommended to recognise contingencies involving the 500kV circuits on the Cherrywood-to-Bowmanville corridor.

While the Scheme shows a capability to arm only a single unit at Darlington GS for rejection at any instant, it is recommended that consideration be given when designing the SPS to include provision for it to be expanded to allow a second generating unit to be armed. With the higher transfers that are expected to occur over the Cherrywood-to-Bowmanville corridor, especially once the new Ontario-Hydro Quebec Interconnection has been completed, the arming of a second unit whenever one of the circuits on this corridor is out-of-service may be preferable to constraining the output of Darlington GS.

It should be emphasised that the final arrangement of the SPS will be determined following consultation with both Hydro One and OPG. NPCC approval will also have to be obtained before the enhanced/expanded version of the SPS can be deployed.

9. Customer Impact Assessment

Hydro One Networks Inc. has informed the IESO that because no customers will be directly affected by the proposed work that a formal Customer Impact Assessment for the Project will not be required.

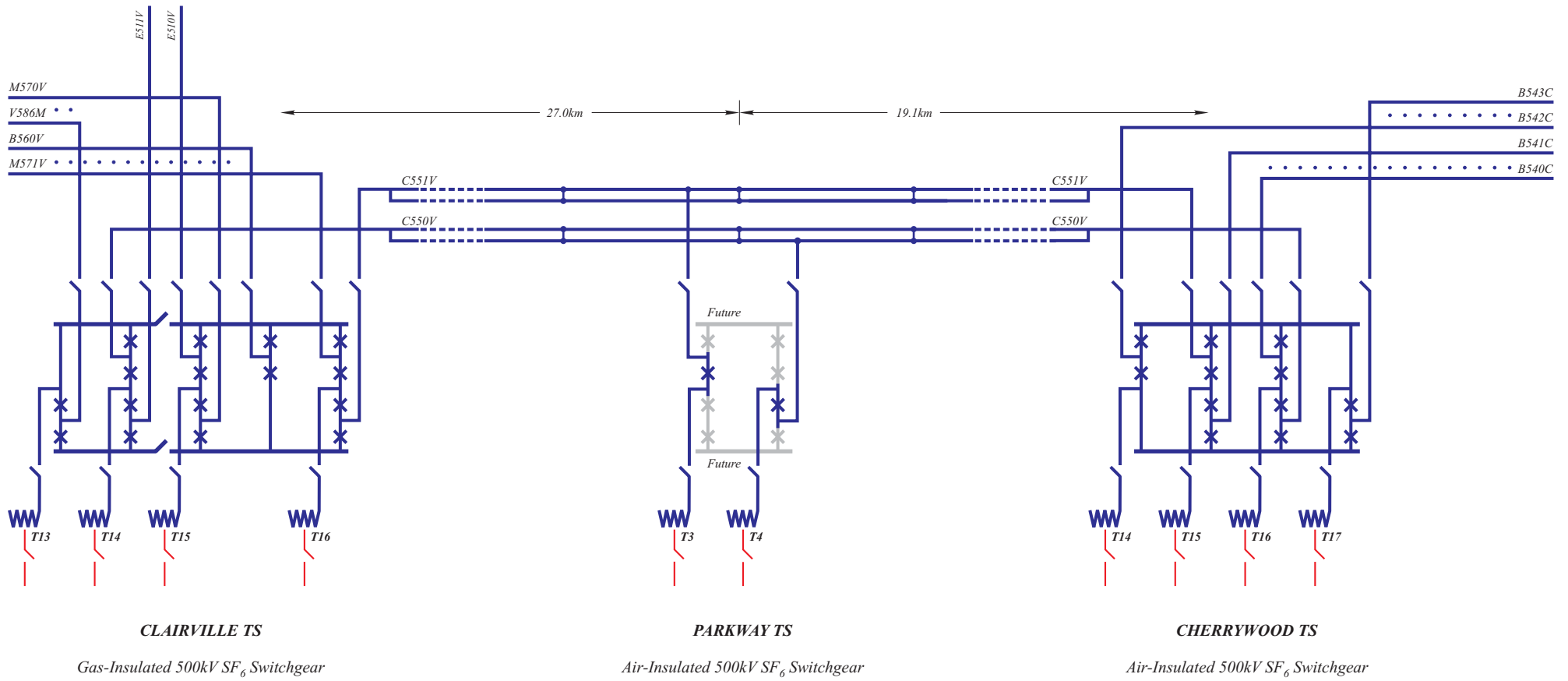
10. Notification of Approval of the Connection Proposal

Since it has been determined that the proposed work involving the unbundling of the 500kV super-circuits between Claireville TS and Cherrywood TS, together with the termination of each of the new circuits on to the 500kV busbars at Claireville TS and Cherrywood TS, will materially improve the reliability of the IESO-controlled grid, it is therefore recommended that a Notification of Approval of the Connection Proposal be issued.

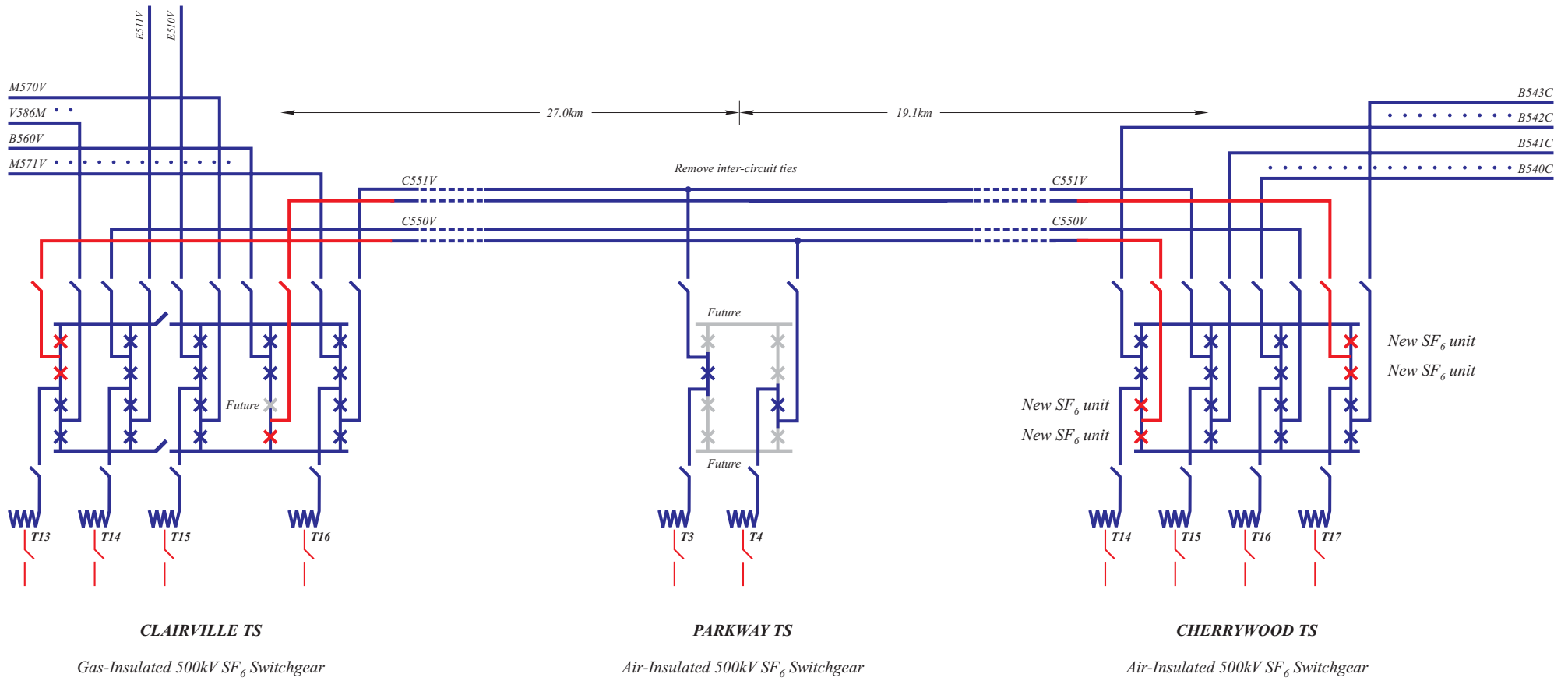
It is also recommended that while the Darlington SPS is being modified to accommodate the additional contingency conditions that will result from the unbundling of the 500kV super-circuits, the scope of the SPS should be expanded to include those contingency conditions that are shown in Diagram 15 that could occur on the Bowmanville-to-Cherrywood 500kV corridor.

It is also recommended that the expanded SPS should include provision to allow a second unit to be armed for generation rejection at Darlington GS.

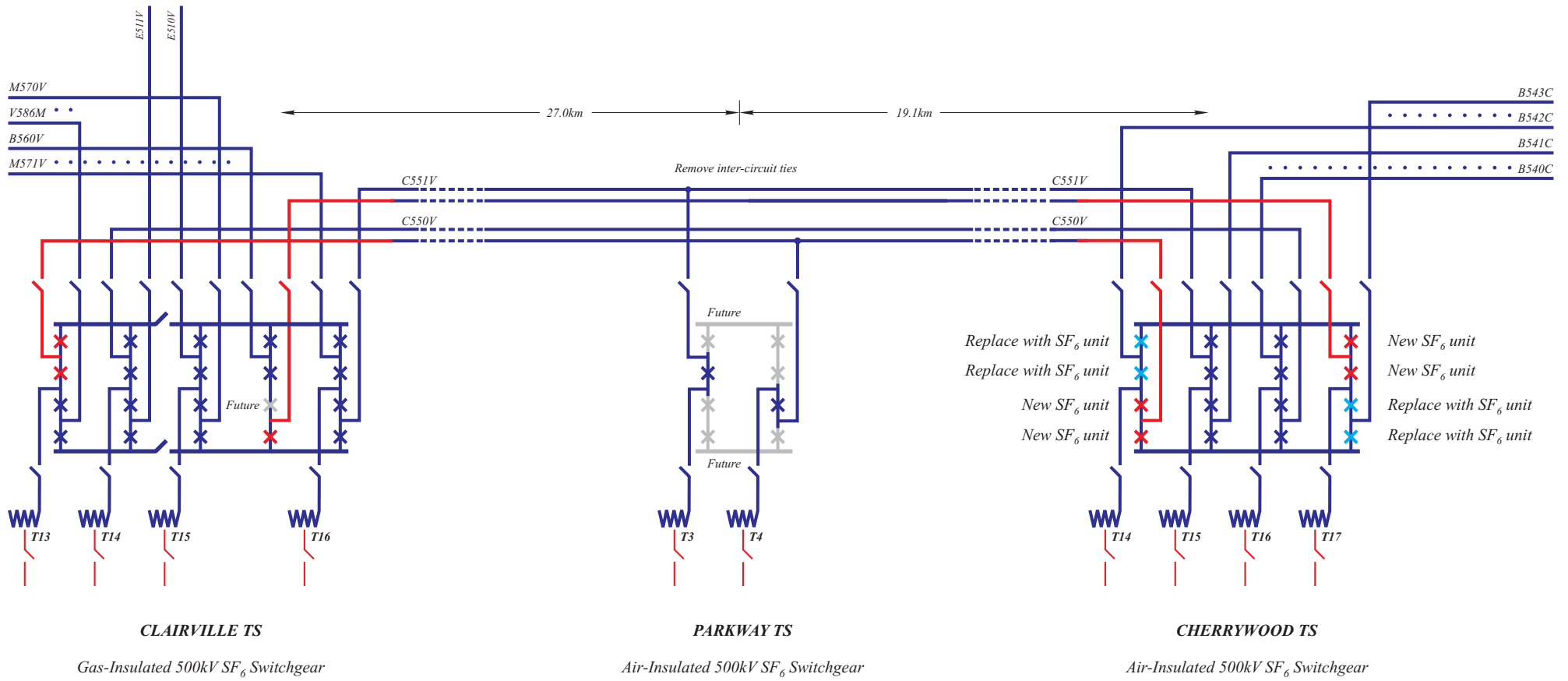
Furthermore, should Hydro One Networks Inc. decide to include the replacement of the adjacent 500kV air-blast breakers at Cherrywood TS with new SF₆ units in those particular diameters that are affected by the new terminations, then this work is also to be covered by the Notification of Approval.



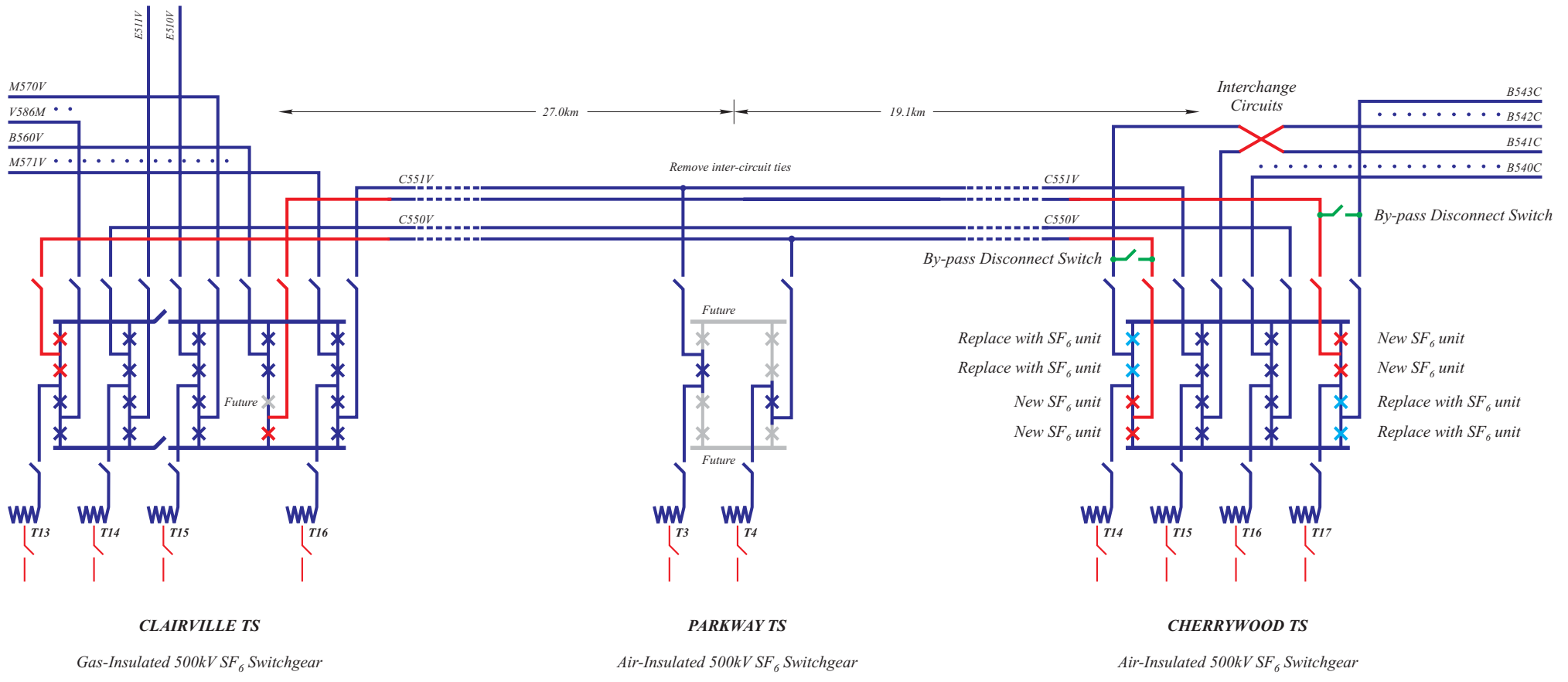
Claireville-Cherrywood Corridor: Existing Facilities



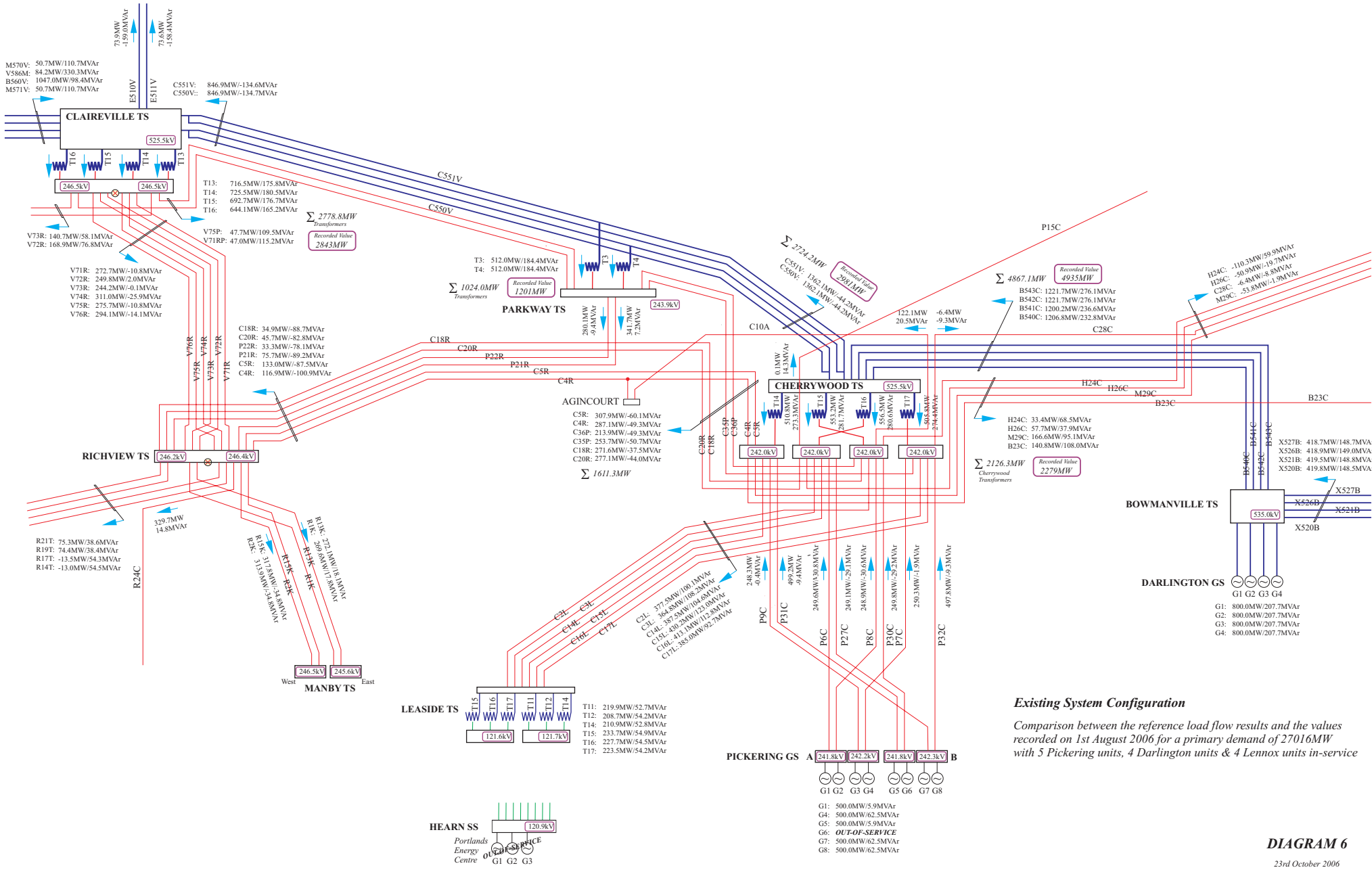
Claireville-Cherrywood Corridor: Proposed Facilities



Claireville-Cherrywood Corridor: Recommended Facilities



Claireville-Cherrywood Corridor: Recommended Facilities - Additional Changes



Existing System Configuration
 Comparison between the reference load flow results and the values recorded on 1st August 2006 for a primary demand of 27016MW with 5 Pickering units, 4 Darlington units & 4 Lennox units in-service

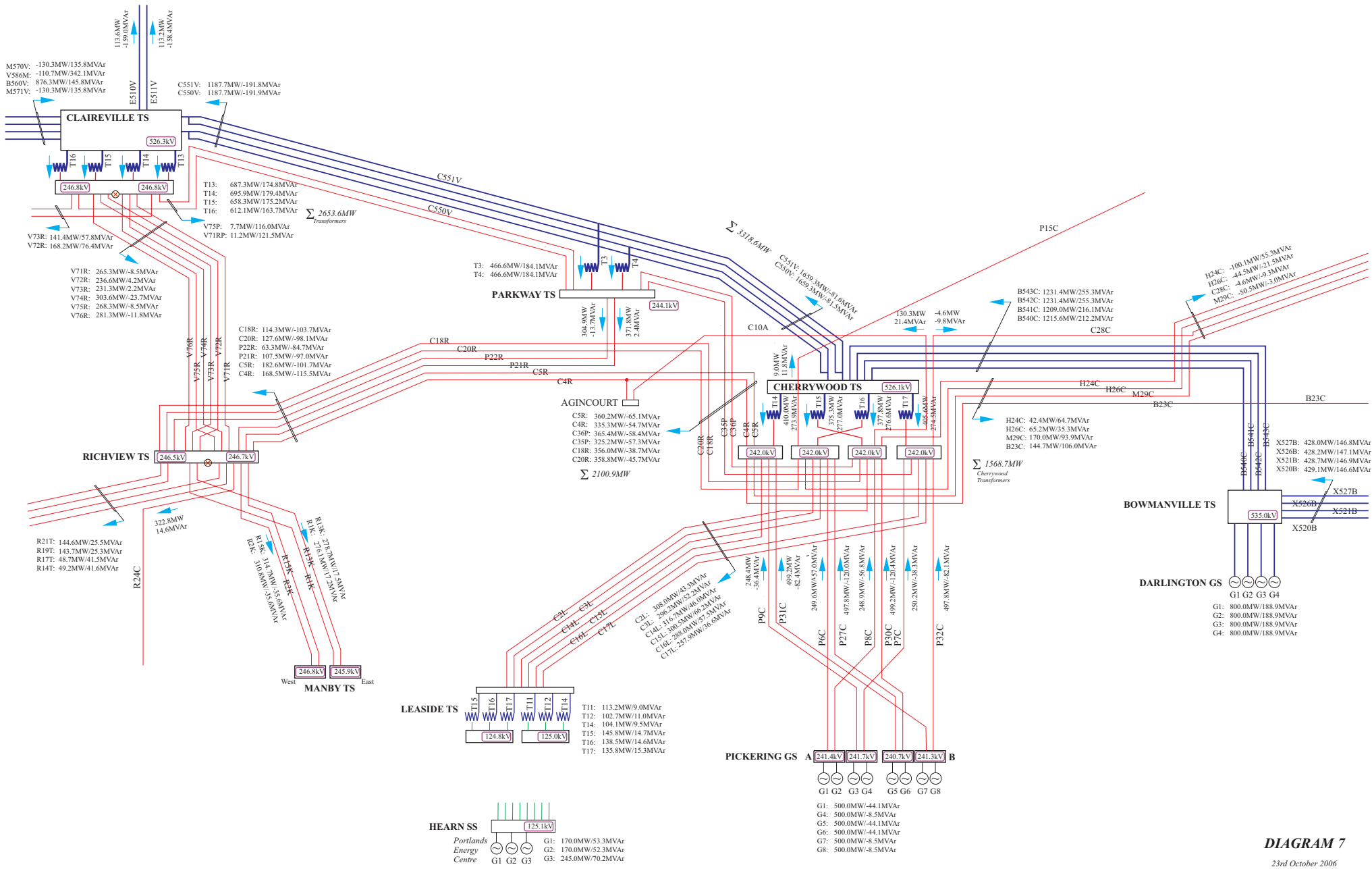
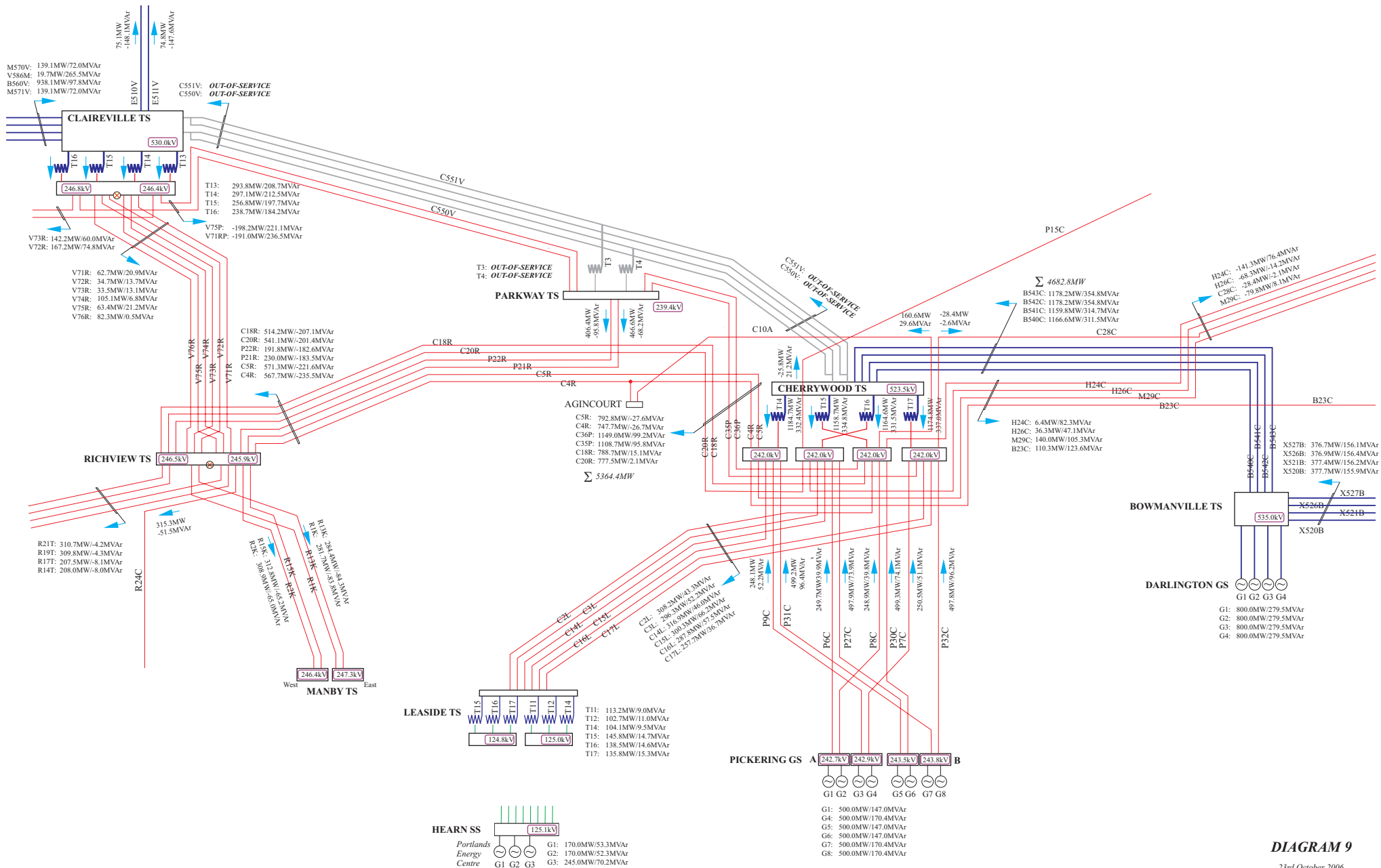


DIAGRAM 7
23rd October 2006



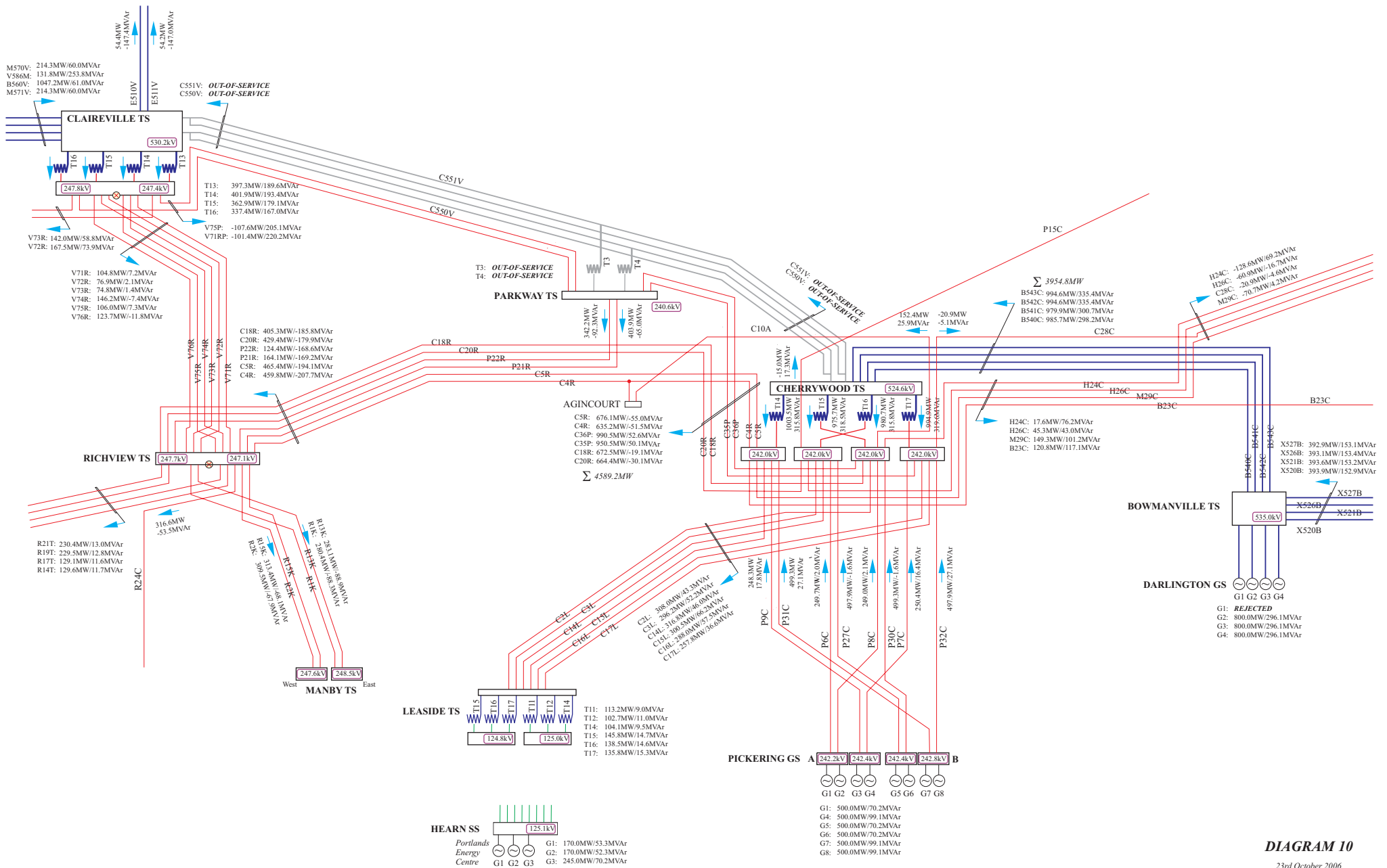


DIAGRAM 10

23rd October 2006

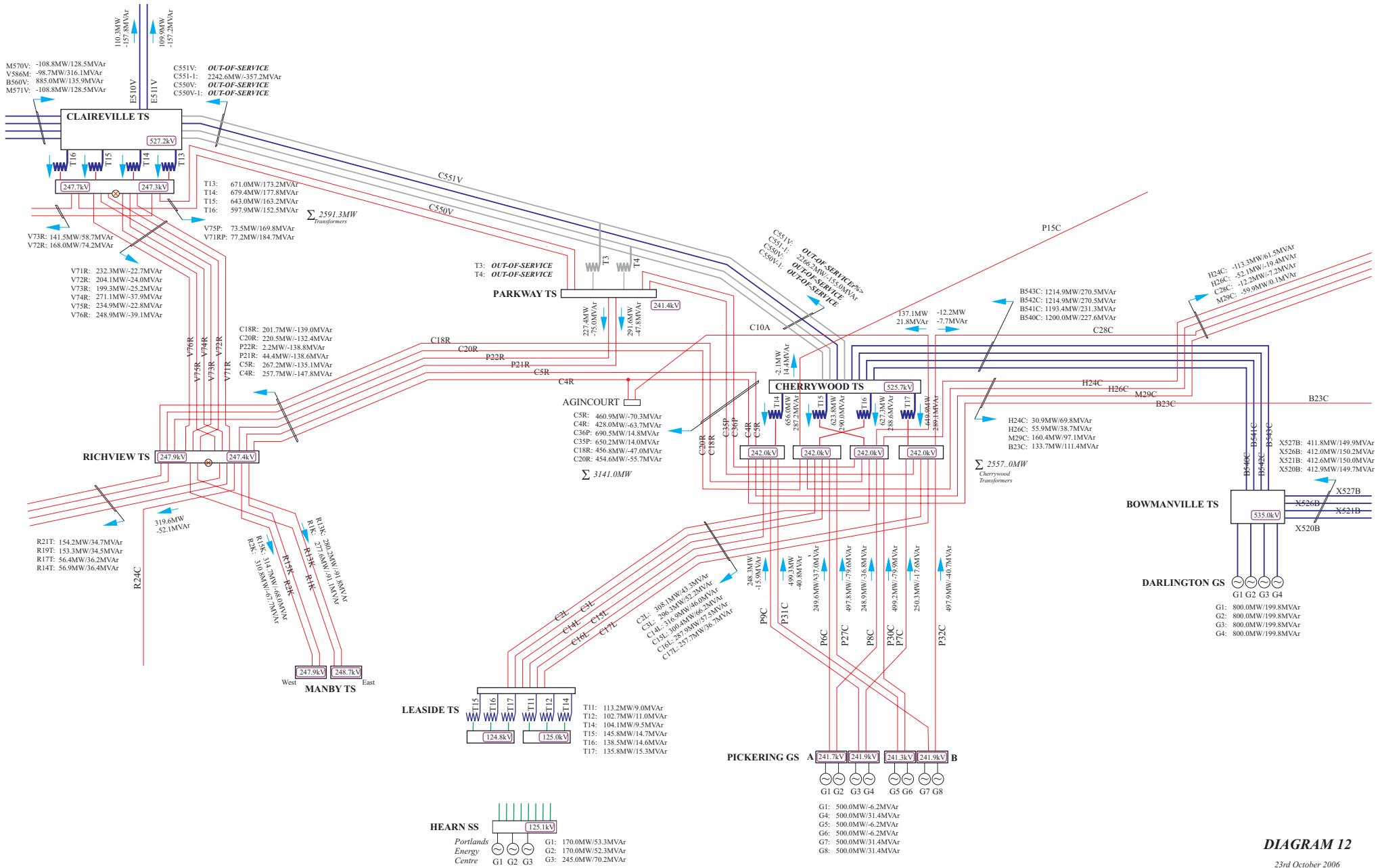


DIAGRAM 12
 23rd October 2006

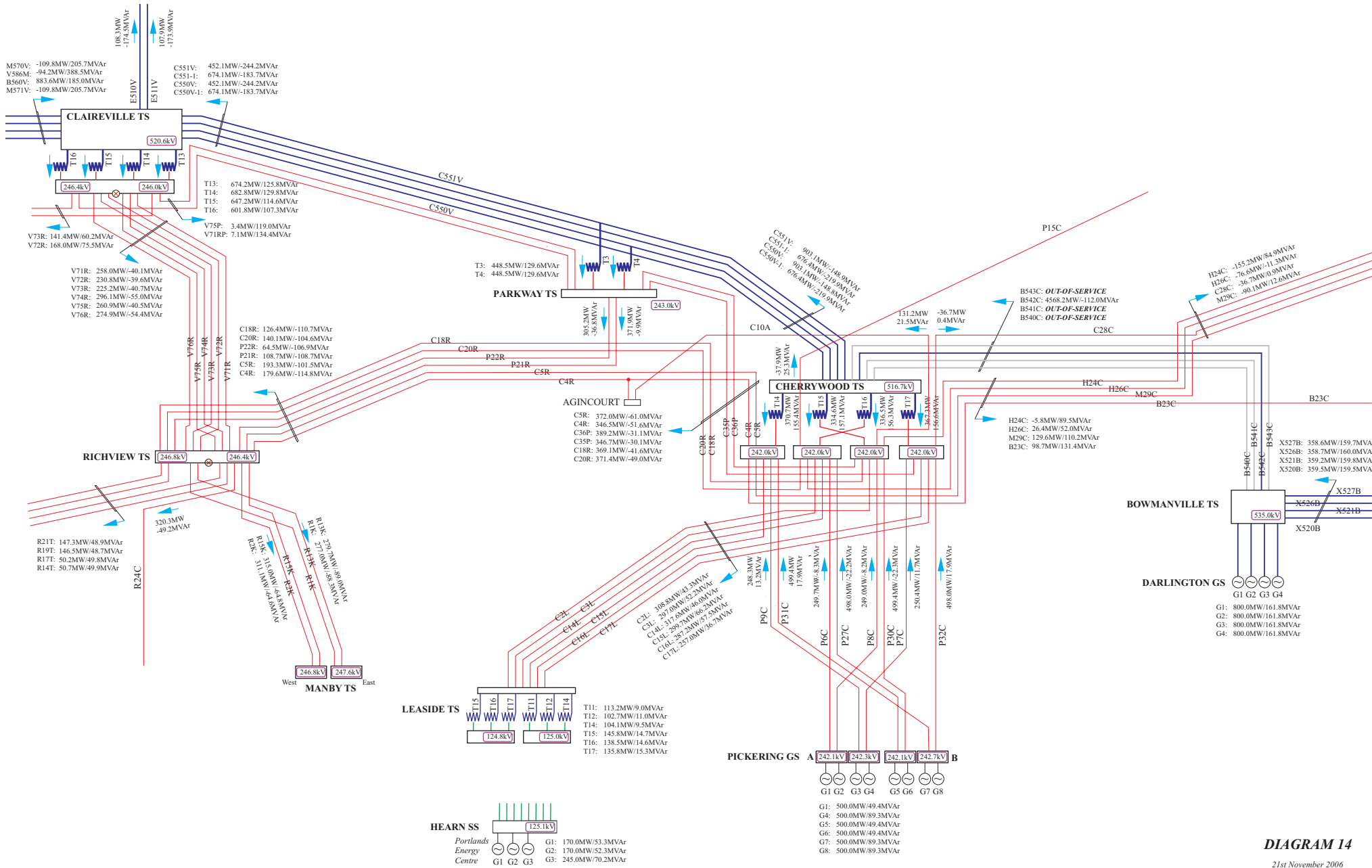


DIAGRAM 14

21st November 2006

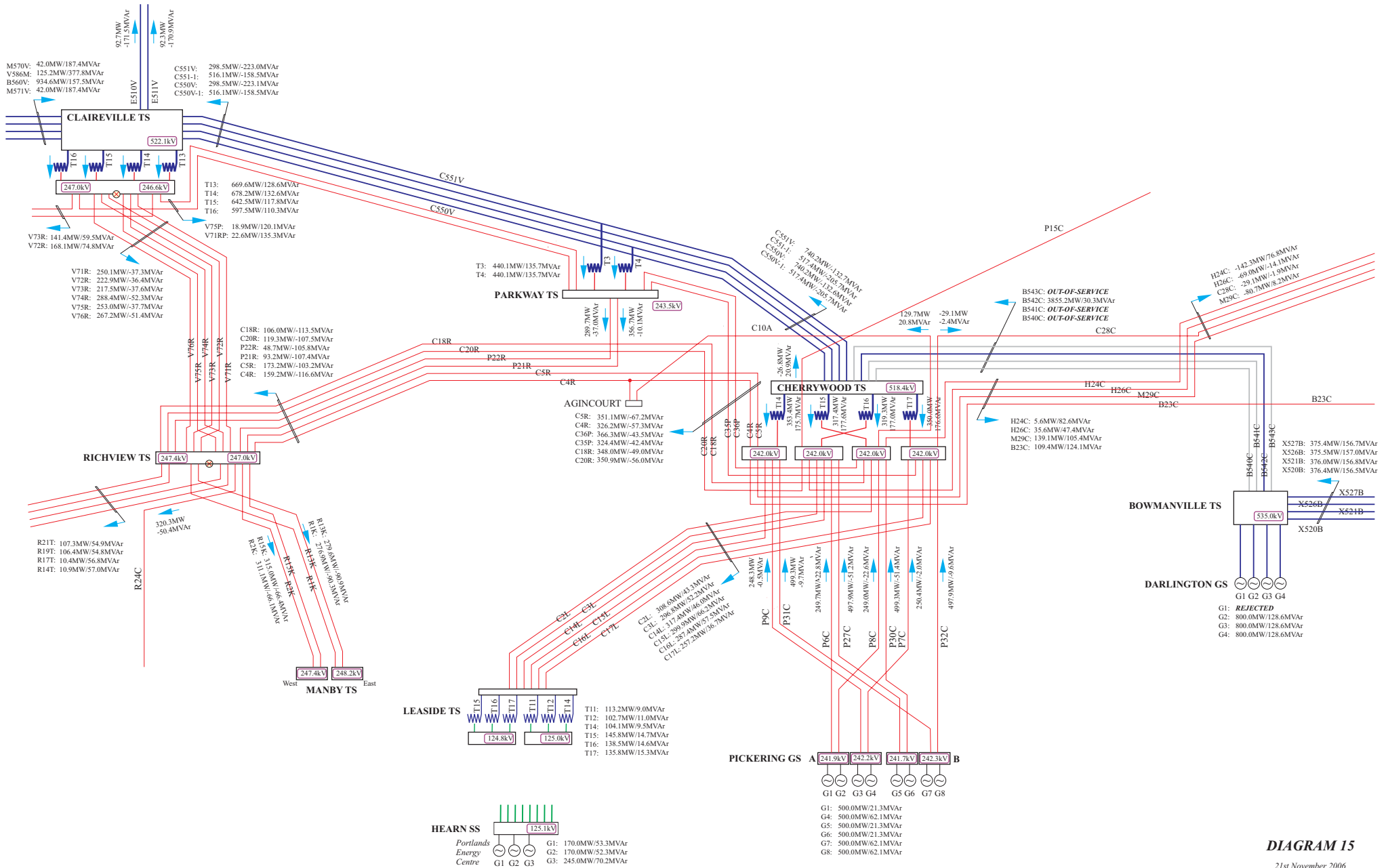
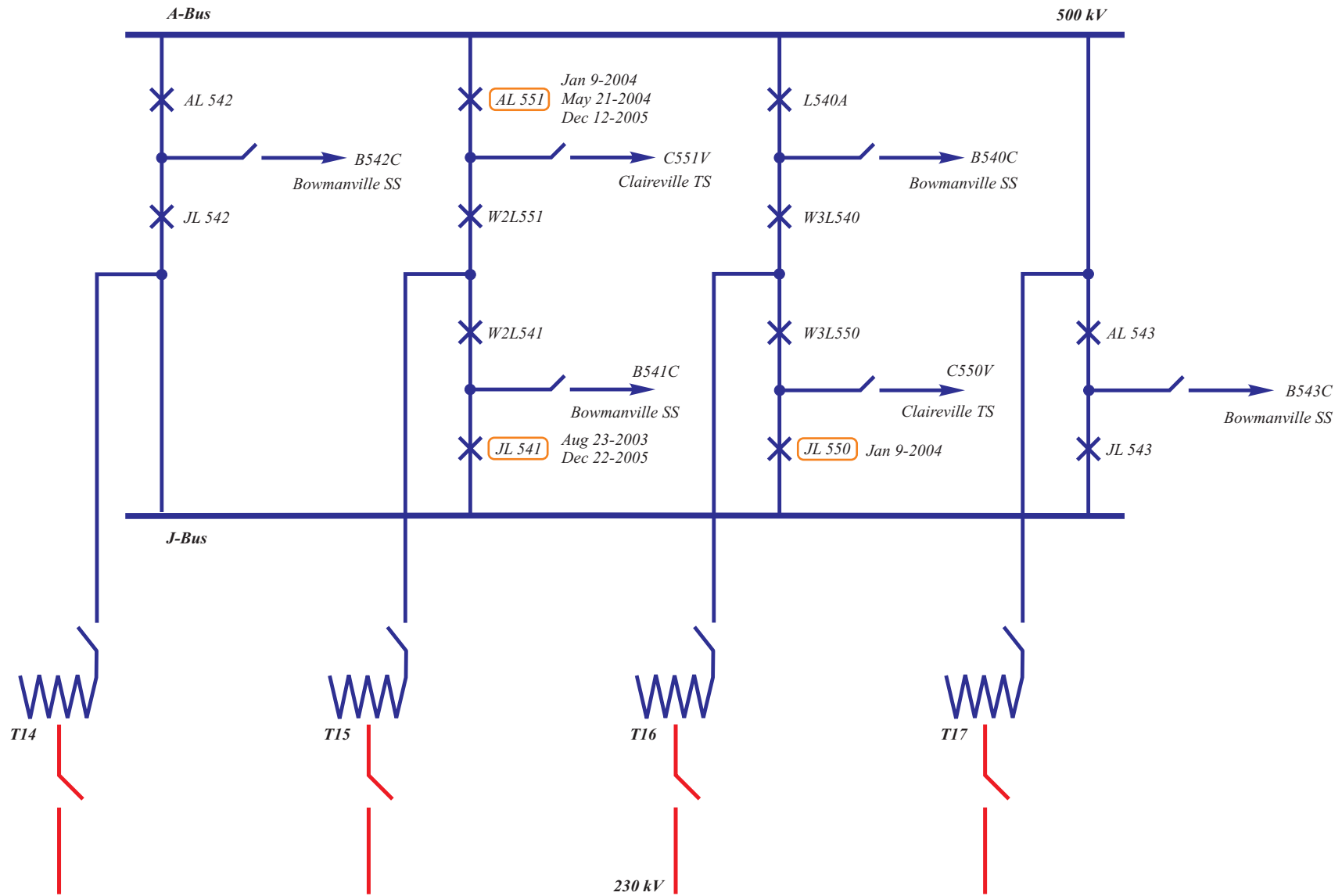


DIAGRAM 15

21st November 2006



Cherrywood 500kV Switchyard

DIAGRAM 16

20th November 2006