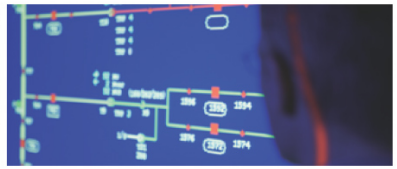
Update 1 on
Additional South Transfer Mitigations

29 May 2008

To be read in conjunction with
"South Transfer Limits – Updated for 2008"

TRANSPOWER



SYSTEM OPERATOR

Purpose

- To summarise additional mitigations to increase south transfer including those:
  - Already implemented by the System operator
  - Currently under investigation
- To be read in conjunction with “South transfer limits – updated for 2008” presentation at http://www.systemoperator.co.nz/?id=6556
- This update current as at 29 May 2008

South transfer power system limits

- Four traditional power system pinch points

1. Export south out of the Taranaki Region
2. Transfer south from Bunnythorpe to Haywards
3. Transfer south over HVDC & Impact of Wellington load
4. South Island instantaneous reserves to cover HVDC south transfer configuration

South transfer power system limits

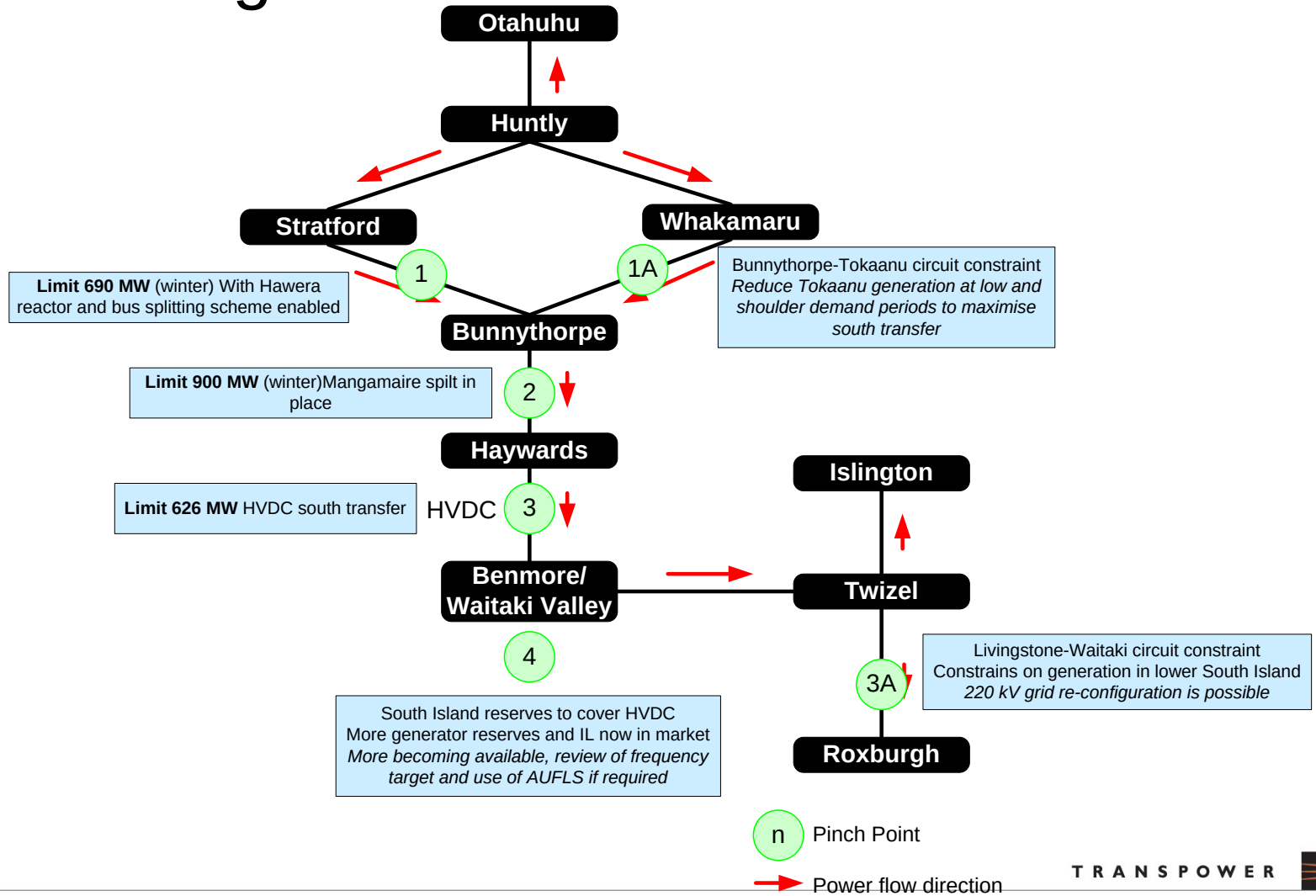
- Two additional pinch points emerging

1A. Export south of Whakamaru
- Bunnythorpe to Tokaanu

3A. Transfer from the Watiaki Valley into the South Island with low Otago/Southland generation.

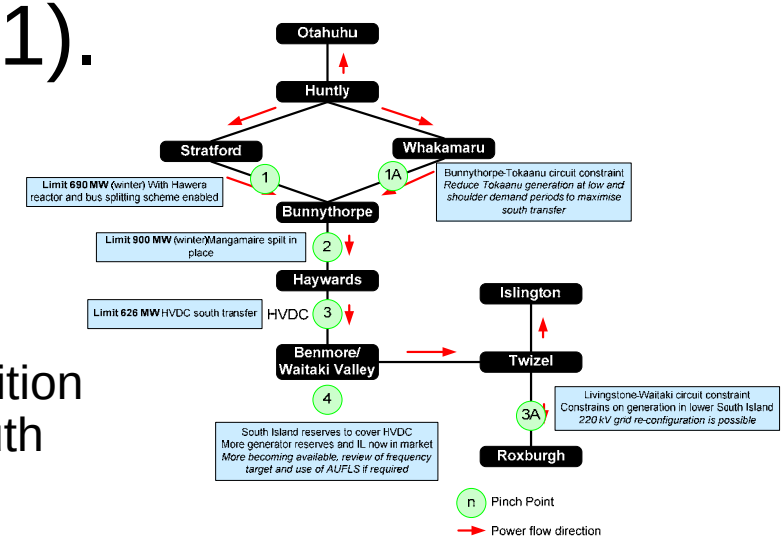
These two additional potential constraints have been added to the next slide.

Power flow during south transfer and low Southland generation conditions



Export south out of the Taranaki region (Constraint 1).

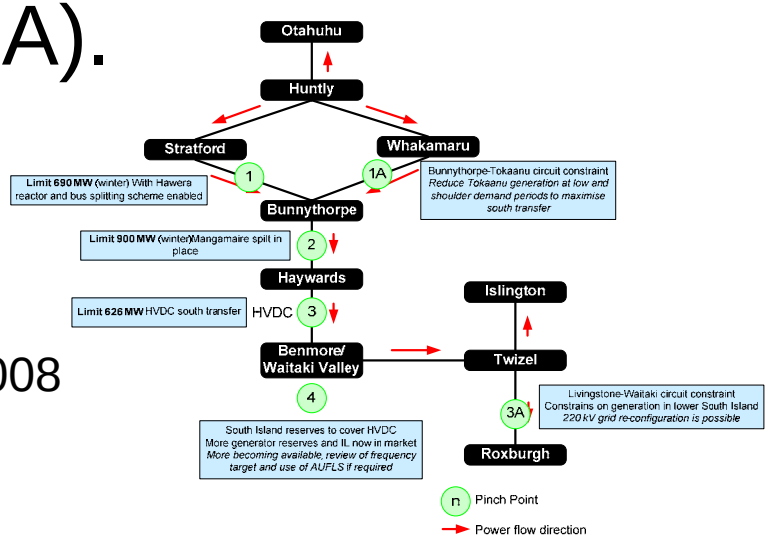
- Status
  - Hawera reactor in service
  - Not expected to be a constraint with addition of 100 MW generation from New Plymouth



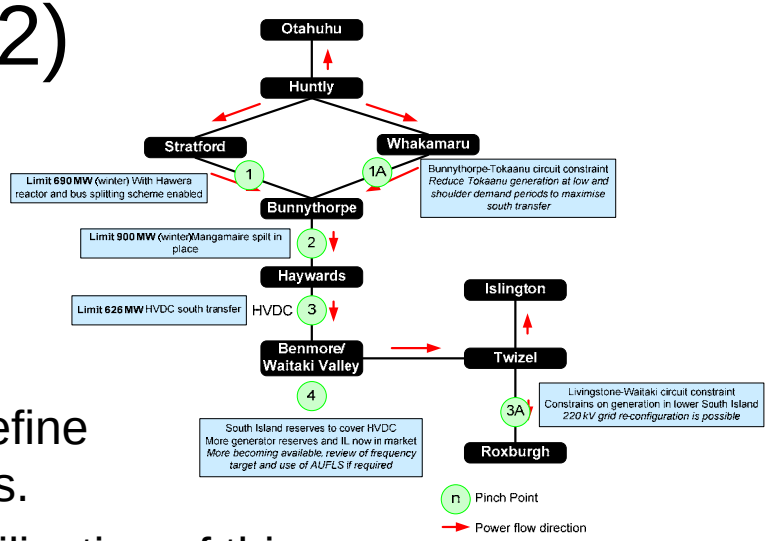
- Additional mitigation measures
  - Automatic post fault splitting scheme for 110 kV link from Stratford to Bunnythorpe at Hawera still to be enabled if required
  - When enabled transfer limit on Stratford to Bunnythorpe up to 690 MW (winter)

Transfer from Tokaanu to Bunnythorpe (Constraint 1A).

- Status
  - Generation injection at Tokaanu can result in potential constraint on transfer from Tokaanu to Bunnythorpe
  - Additional generation available at Huntly in 2008 over previous years increases south transfer through central NI grid
  - 1 MW of additional generation at Tokaanu has same effect on the constraint as 2 MW increase in generation north of Whakamaru.
  - Significance of this issue will reduce as NI demand increases over the winter months.
- Additional mitigation measures
  - Participants scheduling generation to maximise transfer south, including reducing Tokaanu generation at low and shoulder demand periods.

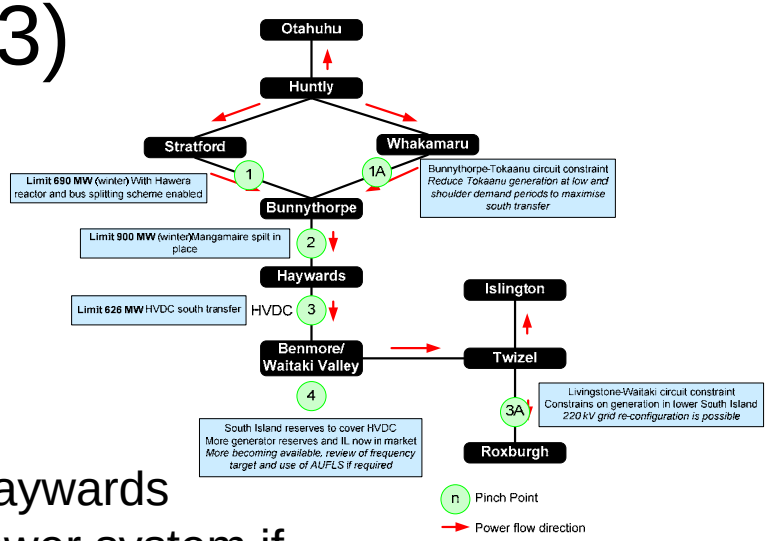


Transfer from Bunnythorpe to Haywards (Constraint 2)



- Status
  - Operational split in the Wairarapa 110 kV link at Mangamaire, in place
  - Transfer limit increased from 868 MW to 900 MW and voltage stability tool used to refine limit further depending on system conditions.
  - Daily reporting on SO website shows the utilisation of this critical route.
- Additional mitigation measures
  - Further studies on transfer limit underway. Limit is voltage at Haywards for the loss of a transmission circuit or TCC generator.
  - Additional generation at New Plymouth will help raise transfer limit above 900 MW
  - Constraint will be optimised in real time by monitoring voltage stability limits

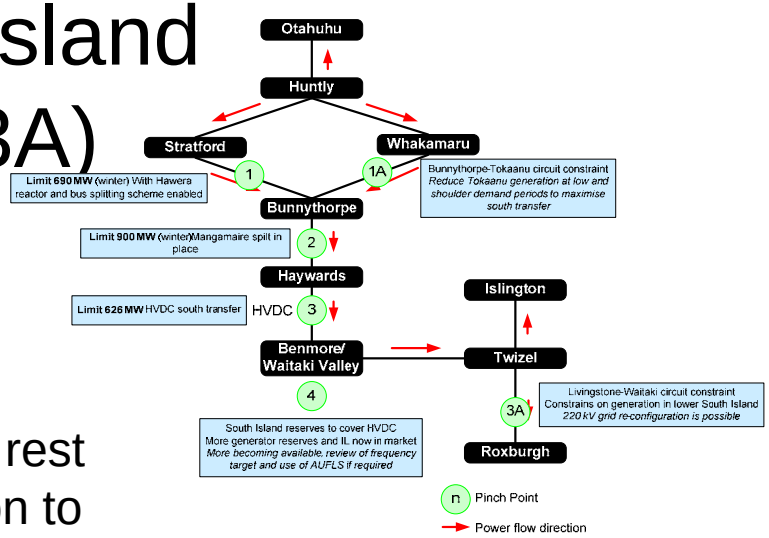
HVDC South transfer limits Pole 2 only (Constraint 3)



- Status:
  - No change in limit.
  - The 626 MW limit for transfer sent from Haywards is to ensure stability of the North Island power system if Pole 2 trips.

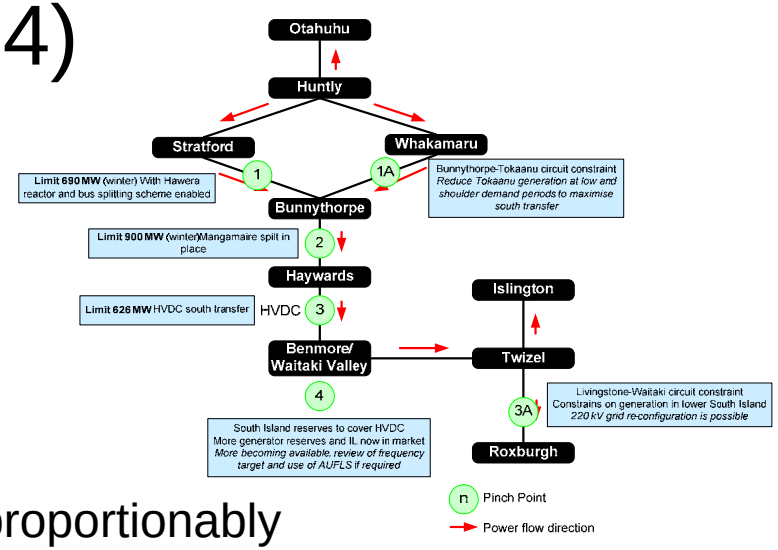
Transfer from the Waitaki Valley into the South Island (Constraint 3A)

- Status:
  - Low generation in Otago/Southland resulting in constraint on Livingstone-Waitaki circuit.
  - When binding separates Waitaki Valley from rest of South Island requiring additional generation to meet demand changes from Otago/Southland.



- Additional Mitigations
  - Possibility of splitting the 220 kV network at Waitaki is being investigated. Not a straightforward solution as likely to reduce the transfer limit into the upper South Island.
  - Different generation profiles with river chain generation to extent feasible

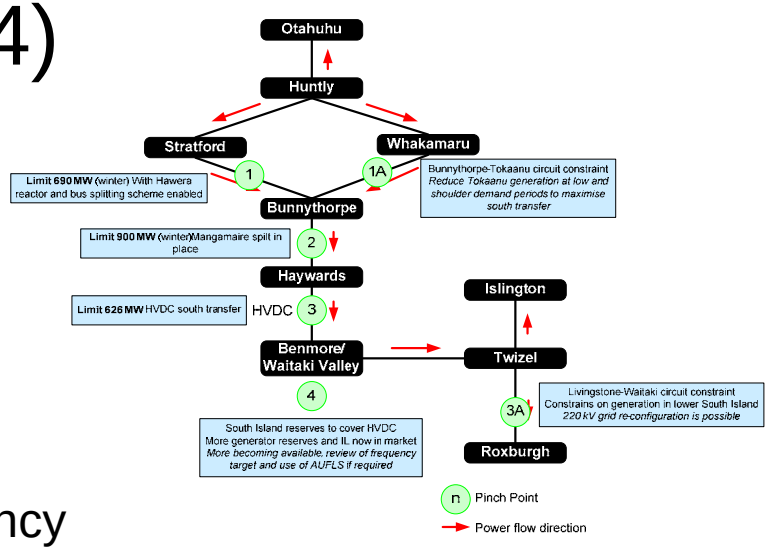
South Island Instantaneous Reserve Availability (Constraint 4)



- Status.
  - Fast Reserve is the common binding limit on overnight HVDC transfer.
  - Additional 300 MW of generator and IL instantaneous reserve made available.
  - Fast Reserve requirement will increase disproportionably as HVDC MW transfer increases – especially overnight – see additional notes at end
  - Increased south transfer during the day compared to previous times of high south transfer is still resulting in overall high daily energy transfer.

South Island Instantaneous Reserve Availability (Constraint 4)

- Additional Mitigations
  - Additional 200 MW of SI generator reserve may be possible. Currently being tested and modelled in RMT.
  - Studying the impact of lowering the frequency target for South Island Contingent Event and relying on Block 1 SI AUFLS for part of the reserve requirement being considered. This is for when all other options have been exhausted.

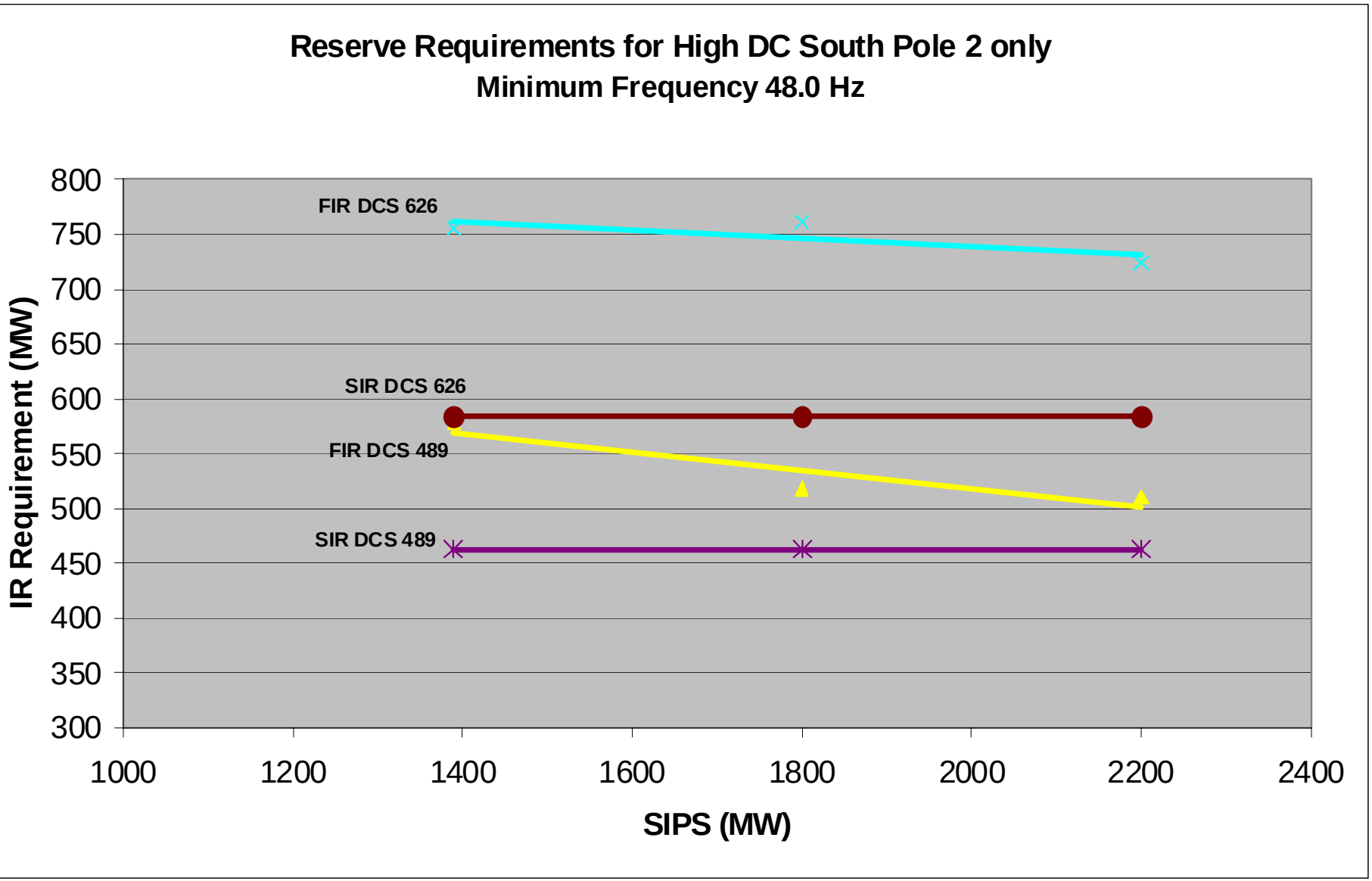


Why is the SI FIR requirement so high for HVDC South Transfer?

- Requirement for reserves to arrest the fall of frequency at or before 48 Hz for a contingent event such as the loss of Pole 2.
- Fast Instantaneous Reserves are specified for maximum response at 6 seconds.
- This coincides with the frequency "turn-around" point of 48 Hz in the standard under frequency event.
- A large loss of injection into a small power system will result in a very rapid frequency decline.
- Additional FIR is required as the available reserve has less time to do its work to arrest the decline of frequency.

Why is the SI FIR requirement so high for HVDC South Transfer?

- Situation
  - In the South Island overnight with the loss of 500 MW on Pole 2 the frequency reaches 48 Hz between 3-4 seconds after the event.
  - In the case of PLSR and TWD generators may not have ramped up to the full output required at 6 seconds.
  - IL has had less time to have an effect (ie only ~2 seconds rather than 4).
- The change in FIR with increasing DC South is shown in the next chart


Reserve Requirements for High DC South Pole 2 only
Minimum Frequency 48.0 Hz
FIR DCS 626
SIR DCS 626
FIR DCS 489
SIR DCS 489
IR Requirement (MW)
800
750
700
650
600
550
500
450
400
350
300
1000
1200
1400
1600
1800
2000
2200
2400
SIPS (MW)

What is being done to mitigate the reduced time for reserve to respond?

- South Island Interruptible Load has been modelled as tripping at 0.2 seconds after the frequency falls to 49.2 Hz (the actual tested tripping time). It is usually modelled to trip at the contractual performance requirement of 1.0 second after 49.2 Hz.

- Trip settings for some TWD FIR reserve have been set to a higher frequency (49.4 Hz) and re-modelled in RMT accordingly.

- Selected generating stations are being modified so that the TWD or PLSR response ramps very quickly to a fixed MW independently of governor response.