National Market for Instantaneous Reserves Project

Design Features - Simple Descriptions

System Operator

Transpower New Zealand Limited

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Keeping the energy flowing




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IMPORTANT

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INTRODUCTION

The SO and EA have been working together for some time to improve frequency keeping and instantaneous reserve market arrangements.

This work, along with the commissioning of the new HVDC controls in 2013, enabling transfer of frequency keeping and reserve between islands, has culminated in a number of capital projects to improve market competition, reliability of supply and efficiency of procurement. These projects have been grouped under the Reserves and Frequency Management (RFM) programme, a joint EA and SO programme of work.

The National Market for Instantaneous Reserves (NMIR) project is a project within the RFM programme and will introduce the changes required to create a national market for reserves by allowing reserves to be procured in one island to cover generation risk in the other.

Shared reserves between islands allows the generation risk being covered by instantaneous reserves to be evaluated as the largest single national risk rather than the combined total of the largest single risk in each island. As a result the quantity of reserves procured can be reduced. Competitiveness in the instantaneous reserves market will be enhanced as the lowest cost national reserves offered into the market can be considered regardless of which island contains the generation risk to be covered.

Less reserve required to be procured in a more competitive market will result in lower costs which will be passed on to the consumer.

PURPOSE OF THIS DOCUMENT

This document provides simple descriptions of the eight key NMIR project design features that have been employed to accommodate a number of HVDC control features and operating scenarios that need to be taken into account in order to accurately and securely model the amount of reserves able to be shared between the islands at any given time.

QUESTIONS AND FEEDBACK

The RFM programme can be contacted using the *rfm@transpower.co.nz* email address. This is a monitored email account that will ensure your queries and feedback will be handled efficiently.

SIMPLE EXPLANATIONS OF NMIR DESIGN FEATURES

TRANSITION THROUGH 0MW

A 4 second time delay occurs when the HVDC first transitions into Round Power Operation and passes through 0MW when power flow direction changes from north to south or vice versa. This delay will limit Reverse FIR Sharing (opposite direction to the dispatch direction) capacity.

Following assessment of costs and benefits a 'simple' solution to manage this issue was selected for the NMIR design:

- The solution includes a new constraint to limit the Reverse FIR sharing to the HVDC energy transfer minus the pole min (P_{min}) and the modulation risk (MR), where P_{min} is modelled as 35MW.
- The solution also uses the round power exit point of 52.5MW less the MR of 30MW to determine a Round Power range between 22.5MW north and south where Reverse FIR Sharing is available.

CABLE DISCHARGE TIME

The HVDC cables have a minimum five minute discharge time between blocking and de-blocking when a Pole's power direction is changed. The cable discharge time will limit Reverse SIR sharing capacity:

- Reverse SIR Sharing in real time is capped until cable discharge completes, therefore Reverse SIR Sharing <= max (0, HVDC Energy Transfer – MR – P_{min}).
- Reverse SIR Sharing is also limited by the same constraint in schedule time when in Bipole operation (above 190MW Bipole transfer).

REDUCED VOLTAGE OPERATION

Reduced voltage is a manual or automatically triggered reduction in HVDC transmission voltage.

- When BiPole or Pole 2 reduced voltage is modelled in the market the NMIR design will cap the Forward Reserve Sharing to a maximum value of 60MW (equals 'Reduced voltage P2 limit – Monopole to Bipole transition – Modulation Risk') in all the schedules, where reduced voltage P2 limit = 300MW and Monopole to Bipole transition = 190MW. This will not apply when only Pole 3 is in reduced voltage.
- Reduced voltage operation also affects the inter-island shared reserve losses (item 7 below).

SPD RESERVE PRICING

Current island reserve pricing considers the marginal cost of covering risks in the island the reserve price is being calculated for but not the marginal cost of sharing reserves to cover risks in the other island.

- Island reserve pricing will be modified so the marginal price of reserve in an island can be due to a reserve risk binding in the other island where reserves are shared to cover that risk.

EFFECTIVENESS FACTORS

Effectiveness factors are designed to account for inherent time delays in the HVDC frequency controls and changes to losses on the HVDC transmission system. The time delays in the HVDC frequency controls only apply to the FIR effectiveness factors.

- A FIR effectiveness factor accounts for the reduced effectiveness of reserves from the non-risk island and is required to be implemented to maintain a secure power system. It is likely to be initially set to 0.8.
- SIR is a slower product and an effectiveness factor for SIR is likely to initially be set to "1". The need for a SIR effectiveness factor has not been confirmed but the NMIR design will allow for future implementation if required.
- Effectiveness factors will impact the equation: FIRrequired = FIR_risk_island + effectiveness_factor * FIR_non_risk_island, affecting both cleared reserve quantity and island reserve price.

RESERVE TRANSFER DC LOSSES

Losses on shared reserves are significant at high levels of DC energy transfer.

- Reserve transfer in the same direction as DC energy transfer will incur losses of up to 10% of reserve transferred and up to 20% in reduced voltage. This reduces the reserve received in the risk island.
- Reserve transfer in the opposite direction to DC energy transfer will reduce losses by up to 10% of reserve transferred and up to 20% in reduced voltage. This increases the reserve received in the risk island.
- The NMIR design includes modelling these loss effects in SPD and RMT ensuring system security and delivering additional economic benefits.

ISLAND LOAD RESPONSE SHARED ACROSS THE HVDC LINK

Power system studies have shown that load inertia response to an under frequency event will also be shared across the HVDC link when reserve sharing is available.

Load response within an island is already modelled as part of the Net Free Reserve (NFR) values for each island. NFRs reduce the quantity of reserve required to cover modelled risks within an island.

- Under NMIR the NFRs for an island will be adjusted to include the quantity of load response that will be received from the other island when reserve sharing is available. This quantity will vary with system conditions, but will be of an order of magnitude of approximately 1% of the sending island load (excluding large inertia-less load).
- Sharing load response also uses some of the HVDC sharing capacity. The NMIR design will clear available shared load response before clearing additional shared reserve. The reserve sharing capacity constraints will apply to the sum of the shared load response and the shared reserve. This will ensure the system does not procure 'other island' FIR that exceeds the sharing capacity of the HVDC link.

CO-OPTIMISING MANUAL RISK GROUPS

Currently individual generation units identified as risk setters can be co-optimised. During the production of market schedules a choice is made to either procure reserves to cover these risks or to lower the energy cleared at these sites to reduce the requirement for reserves and procure a reduced quantity of reserve.

Other risks relating to multiple generating units exist and are modelled from time to time. Current functionality only allows these to be modelled as manual risk quantity. In market schedules manual risks are not associated with energy offers and therefore cannot be co-optimised.

- Under NMIR an opportunity exists to associate some multi-unit risks with energy offers so they can be co-optimised within market schedules. This is possible where these multi-unit risks are combinations of injection / offer nodes but is not possible where multiple risk units are only part of a single injection / offer node. This is not part of the core NMIR solution but has been included within the NMIR scope as an efficient means to deliver this market enhancement.