

Report to the Electricity Commission

**System Operator Report:
HVDC Pole 1 Unplanned Outage,
10 to 13 March 2004**

Prepared by the System Operator
26 March 2004



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Overview

HVDC Pole 1 tripped at 8:45 am on Wednesday 10 March 2004 at a time of high HVDC north transfer. This tripping resulting in an immediate 313 MW reduction in transfer into the North Island. HVDC Pole 1 was returned to service at 14:43 on 13 March following repairs to a failed conductor on the North Island section of the HVDC line. This report is intended for information only.

The HVDC link comprises two "Poles". In the present operating configuration Pole 1 and Pole 2 are capable of 540 MW and 500 MW north transfer respectively. As a result of this Pole 1 outage the north transfer capacity of the HVDC link was reduced from 1040 MW to 500 MW.

For the first two days of the outage there was little additional generation available in the North Island to compensate for the reduction in HVDC capacity. Consequently, during this outage the System Operator had to declare two Grid Emergencies.

Demand curtailment was requested on one occasion immediately after the event and instantaneous reserves were not dispatched for three periods due to insufficient instantaneous reserves being available. The absence of instantaneous reserves created a risk that widespread automatic demand shedding would be necessary if another system event such as a generation or transmission failure subsequently occurred during the original outage.

A sequence of events covering the outage is attached at the end of this Report.

Background

At the time of the outage, high levels of hydro storage and inflows meant that North Island demand was being met largely from HVDC transfer and close to maximum North Island hydro generation. Several major North Island thermal stations were not being offered for dispatch due to the abundance of hydro storage and inflows. In this situation, with North Island hydro generation and the HVDC link operating near maximum capacity and little thermal plant offered, a major generation or transmission failure could require significant demand to be shed in an interim period as thermal generating plant can take several hours to start up.

Some demand curtailment was requested immediately after the event given the immediate generation shortfall in the North Island resulting from the reduction in HVDC capacity (the reduction in HVDC capacity is equivalent to a loss of North Island generation of the same amount). This was achieved largely from controllable demand such as hot water heating control by

participants. The main impact was in having insufficient instantaneous reserves to cover a subsequent plant transmission failure.

When insufficient instantaneous reserves are available for dispatch the EGR's permit the System Operator in a Grid Emergency to rely on the emergency under frequency shedding system (AUFLS) to cover a system event, rather than immediately curtailing demand. This is not an ideal situation as a subsequent system event normally covered by instantaneous reserves, such as the failure of a large thermal generating unit or a Pole of the HVDC link, will instead result in the automatic shedding of up to 32% of North Island demand.

Following the tripping of the HVDC Pole 1 participants contacted the System Operator seeking further information on outage duration to assist decisions on committing thermal plant. The first reliable indication of the likely outage duration was not available until 1800 on the day of the event. Site conditions resulted in the outage duration subsequently being extended by a further two days.

By Friday 12th March additional thermal generation at both Huntly and New Plymouth had been made available to replace the lost HVDC capacity alleviating grid security concerns. It is understood that some generation made available later during the outage was not initially available due to maintenance work.

The System Operator issued four updates (in addition to 9 Advice Notices) explicitly covering the implications of the situation to ensure participants were aware of system security issues arising from the outage and lack of generation to meet demand in the North Island.

The issues arising from the above event, from a System Operator perspective, were as follows:

1. Lack of Fast Starting "Standby" Generation

The NZ market does not procure a "standby generation" product. Fast starting generation is usually available from undischarged hydro generation in most generation scenarios, and is able to cover system events particularly in the North Island. Reserve generation procured by the Electricity Commission for security of supply could play a role in aiding the System Operator meet its objectives without needing to resort to either demand shedding or not dispatching instantaneous reserves. The System Operator will pursue this option further with the Electricity Commission.

2. *Implications of not dispatching reserve to avoid demand curtailment in a Grid Emergency*

The System Operator purchases instantaneous reserves from both generation and interruptible load. The benefit gained from not dispatching reserves is that it allows generation previously dispatched for instantaneous reserves to be dispatched to meet energy instead, avoiding demand curtailment. However some instantaneous reserve is provided by demand as contracted interruptible load and this is still likely to be available despite no longer being dispatched.

During the periods in this outage when no instantaneous reserves were dispatched, there were insufficient reserves to cover the subsequent loss of the other HVDC Pole, but it may have been possible to cover a lesser event (such as the subsequent loss of either Otahuhu CCGT or a Huntly generation unit) with contracted interruptible load. The likelihood of widespread demand shedding after a subsequent event would be reduced if the System Operator was still able to dispatch a reduced reserve requirement that accounted for the contracted interruptible reserve still available. The outcome would be that during such a Grid Emergency some subsequent system events could be covered without widespread automatic demand shedding.

Currently the scheduling and dispatch engine, SPD does not identify reserve as either generation sourced reserve or contracted interruptible load. In addition the reserve management calculation engine (RMT) does not permit easy manual intervention to its reserve calculation process.

The System Operator will be recommending to the Electricity Commission that the following options be considered to improve reserves dispatch during a Grid Emergency:

- Changing the SPD objective function to progressively reduce reserves requirements when required to avoid demand curtailment and obtain a feasible dispatch solution in a Grid Emergency.
- Changes to the Policy Statement and reserve calculation engine (RMT) to clearly set out the process for reducing the reserve requirement in a Grid Emergency so that lesser risks can be covered in a transparent way.

**System Operator
26 March 2004**

Appendix : Sequence of Events (from System Operator Logs)

10th March 2004

- 08:45 11th March, Pole 1, trips with a reduction in HVDC transfer of 313 MW, contracted interruptible load tripped and NI frequency fell to 49.24 Hz
- 09:09 Grid Owner advises restart of Pole 1 unsuccessful and line patrol of HVDC line underway. Advice Notice issued with for Pole 1 Outage to 12:00
- 10:06 Progressive restoration of tripped contracted interruptible load no longer possible due to insufficient generation, Grid Emergency declared and no instantaneous reserve dispatched along with request to participants to reduce demand by 4% in the North Island. The System Operator understands that this request resulted in controllable load such as water heating being shed by distributors.
- 10:25 Sufficient generation available with demand reduction to allow instantaneous reserve dispatch.
- 11:04 Revised Advice Notice issued extending Pole 1 outage to 14:00 reflecting updated information on outage received from Grid Owner.
- 12:30 to 14:30 Verbal revisions to earlier request for demand reduction, all demand restored by 14:30.
- 13:25 Revised Advice Notice issued extending Pole 1 outage to 16:00 reflecting updated information on outage received from Grid Owner.
- 15:00 Review of evening peak demand indicates demand shedding of up to 300 MW as no significant additional generation offered. Understood that some thermal generators unavailable due to maintenance while others seeking more certainty on duration of outage before committing to start up thermal plant.
- 15:47 Revised Advice Notice issued extending Pole 1 outage to 18:30 reflecting updated information on outage received from Grid Owner.
- 16:00 All available generation dispatched, insufficient instantaneous reserves without demand curtailment. No instantaneous reserves dispatched to avoid demand curtailment over evening peak.

- 17:57 Grid Owner advises cause of fault located and due to a failed conductor on the HVDC line at Kelston near Wellington. Revised Advice Notice issued extending Pole 1 outage to 16:00 11th March.
- 21:30 Sufficient generation available given demand to dispatch instantaneous reserves. Grid Emergency ended.

11th March 2004

- 4:00 Two units at New Plymouth offered and dispatched. Initial assessment was that this additional generation would avoid a Grid Emergency over the morning peak.
- 7:16 Grid Emergency declared, New Plymouth units having difficulty coming on line and demand higher than forecast by 200 MW. No instantaneous reserves dispatch to avoid demand curtailment.
- 9:35 Grid Emergency ended, instantaneous reserves able to be dispatched.
- 10:15 System Operator issues Advice Notice (Update 1) explaining the situation and highlighting the potential consequences if additional generation not made available.
- 10:17 Revised Advice Notice issued extending Pole 1 outage to 16:00, 12 March (a further day) reflecting information on outage received from Grid Owner.
- 11:25 System Operator issues Advice Notice (Update 2) noting the outage extension and requesting North Island participants to reconsider generation offers and demand bids for peak periods.
- 16:00, With demand below forecast and generation available System Operator advises Grid Emergency unlikely over evening peak.
- 17:07 Revised Advice Notice issued extending Pole 1 outage to 16:00 13 March (a further day) reflecting information on outage received from Grid Owner.
- 17:17 System Operator issues Advice Notice (Update 3) noting the extension of the outage, and that a Grid Emergency is unlikely over the evening peak given generation and demand.

12th March 2004

- Additional generation at Huntly available and dispatched. Sufficient interruptible load and fast starting generation to cover a further system event for remainder of outage.
- 17:07 System Operator issues Advice Notice (Update 4) advising that a Grid Emergency is unlikely to arise for the remainder of the advised outage and that the Grid Owner has confirmed the return time as realistic.

13th March 2004

- 10:31 Revised Advice Notice issued bringing forward end time by two hours to 14:00 reflecting information on outage received from Grid Owner.
- 11:50 Revised Advice Notice issued extending Pole 1 outage to 15:00 reflecting information on outage received from Grid Owner.
- 14:43 13th March, Pole1 returned to service full HVDC capability available