HVDC OUTAGES 2020

WELCOME, INTRODUCTIONS AND SAFETY
AGENDA

1. Welcome, introductions and safety  
   Katherine Moore
2. Outage Programme  
   Gavin Murray
3. Reconductoring Works  
   Gavin Murray
4. Pole 2 VBE Upgrade  
   Greg Spence
5. Maintenance works  
   Mario Feraru
6. Outage programme – SO Assessment  
   Angela Houston & David Katz
7. Pole 2 system testing requirements  
   Greg Spence
8. SO Response to testing requirements  
   Richard Sherry
9. Monitoring System Conditions  
   Angela Houston
10. Summary and steps going forward  
    Katherine Moore
## OUTAGE PROGRAMME

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**GAVIN MURRAY**
RECONDUCTORING WORKS

- This project replaces the MOA conductor on each pole, and on the earth return, on the Churton Park section of the HVDC Line, OTB-HAY A Line
- 9.5 km, $25.5m
- The conductor installed on this Churton Park section in 1992 needs to be replaced.
  - Inspections show significant corrosion and obvious bulges.
  - The rest of the NI section of this line was replaced in 2011.
- Two contractors, Broadspectrum and Electrix, deploying approximately 60 linemen.
- The project is vulnerable to the weather, is being planned to be resilient to that.
- Emergency recall time is 7 days for a system emergency.
POLE 2 VBE UPGRADE OVERVIEW

Scope Summary
Pole 2 Valve Base Electronics (VBE) at HAY and BEN. End of life replacement.
- Converts Pole Control firing pulses (electrical) to light pulses for distribution to valve stacks.
- Valve stack (Quadravalve) snubber capacitor replacement.
- Fire mitigation. Replacing end of life oil filled capacitors with dry type capacitors.
- Fibreoptic lightguide replacement. Distribute firing pulses to valve stacks.
- Very reliable but expected to be too brittle for handling during VBE and Capacitor replacement.

Project Status
Project value approx $17M. Contract with ABB.
Manufacture and testing of equipment currently in progress.
Equipment delivery to site HAY and BEN early December.

Installation Requirements
HAY and BEN installation work concurrent. Multiple work crews. ABB supervision.
Remove existing equipment, install new, installation and pre-commissioning tests, system tests.
Recall time 20+ days for VBE and Lightguides.
Scheduled / annual maintenance
Routine visual inspection and electrical testing of primary plant at HVDC Converter Stations with focus on;
- Thyristor Valve inspection
- Valve cooling inspections including grading electrodes and couplings checks
- Converter Transformer Electrical testing
- Wall bushing Electrical testing – Transformer Delta
- Transmission line Maintenance – Insulator and hardware replacements
- HVDC Neutral/Common Equipment inspection
- Routine fire system inspections and checks
- Control system enhancements/changes

This work forms part of Transpower’s Routine preventative maintenance plan. This work ensures the ongoing service performance and reliability of HVDC

Investigations and opportune work
- Pole 2 Converter Transformer Electrical Testing – Further testing outside of routine maintenance
- Visual inspection of other primary plant – Condition assessments for asset future planning
- Pole 2 HVAC refurbishment – Heating, Ventilation and Air-conditioning system overhaul after 28 years of operation
- Oteranga Bay HVDC Gantry replacement – Replacement of termination gantry at OTB
- Benmore Pole 3 Tap Changer refurbishment – Operations based replacement
- Pole 3 Converter Transformer paint repairs
# OUTAGE PROGRAMME - SO ASSESSMENT

1. HVDC Outage Assessment (NZGB)
2. Scenarios studied

## HVDC Outages 2020

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- **Jan**: Pole 2 outage 780 MW transfer limit, Bipole 406 MW transfer limit, Pole 2 + 1 electrode outage 406 MW transfer limit
- **Feb**: Pole 2 outage 780 MW transfer limit, Pole 2 testing 780 MW transfer limit, Pole 3 500 MW
- **Mar**: Pole 3 outage 500 MW transfer limit, Bipole, Pole 3 + 1 electrode outage 406 MW transfer limit, Pole 3 outage 500 MW transfer limit
- **Apr**: Pole 3 outage 500 MW transfer limit
WEEKEND BIPOLE OUTAGES

Scenarios considered:
1. base case
2. reduced gas
3. reduced gas and no wind

Analysis of generation balance shows adequate margins when bipole outages are scheduled during weekends.
Generation balance (N-1-G) is satisfactory for single pole outages.

Low generation margins currently or shortfalls may result during the bipole outages (if scheduled on weekdays) if there is reduced gas and no wind.

Due to higher loads, the weekday scheduling of the bipole outages creates tighter margins than if they are scheduled during weekends.
HVDC OUTAGE IMPLICATIONS

The HVDC is a major piece of the power system. Removing a pole from service will:

1. Decrease physical capability of the HVDC.
2. Increase the amount of reserves required to facilitate a given level of energy transfer.
3. 1 & 2 could place a greater dependency on North Island generation.

This could impact the spot price of electricity.

We encourage all participants (buying and selling) to review their risk profiles, adopt appropriate mitigation strategies for your business.
FREQUENCY KEEPING CONTROL (FKC)

Current process when in Monopole:
• FKC is modelled on or off depending on HVDC transfer levels.
• Turing it off changes the frequency band procured, reserve sharing, and modulation risk,
• Details of process and modelling are available on the System Operator website.

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<th>HVDC transfer levels</th>
<th>FKC status</th>
<th>Changes to Modelling (Process available on the system operators website)</th>
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| When HVDC forecast **below** 70MW | FKC stays off | 1. **Modulation Risk** changes from 30MW to 0MW.  
2. **FIR** Sharing limits increase 30MW  
3. **SIR** Sharing is removed  
4. **Frequency keeping bands** increase from 15MW to 25MW in each island |

• Because this is a manual change forward indications of whether FKC is on or off are not always perfect ahead of gate closure.
• This impacts certainty of forward price signals around the transition into and out of 70MW of HVDC transfer.

**Question was asked,** *can we leave it off 100% of time to improve forward price signals?*
The SO has reviewed modelling FKC off for the duration of the outages to improve certainty. We compared May 11-12 monopole outage with FKC off for the whole outage. The outcome is highly dependant on offers/hydrology/demand at the time, but we have not found sufficient reason to move away from our current processes.

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<th>Value driver</th>
<th>Value of FKC off for whole of 11-12 May Monopole outage</th>
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<td>Production Cost (NZ inc value)</td>
<td>+ $9k</td>
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<td>Frequency Keeping</td>
<td>- $30 – 50k</td>
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<td>Price difference (as indicator of FKC on price certainty)</td>
<td>96% of the time price impact was less than $10. Max impact $19</td>
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POLE 2 SYSTEM TESTING

Test Planning

- Test window Mon 17th – Wed 26th Feb (10 days).
- Schedule tests to fit with naturally occurring HVDC transfer (on Pole 3 – up to 780MW).
- Pole 2 to operate for defined periods under test plan conditions, within 780MW transfer limit (additional capacity of P2 not offered).
- Test schedule published to the market with confirmation via CAN.

Test Requirements

- Verify VBE functionality. Pole control unaltered by VBE work.
- Pole 2 not a secondary risk to AC events (voltage or frequency). GO test report with SO for review.

Test Outline

- 14 tests to complete (some concurrently. HVDC transfer range North up to 400MW, or South up to 200MW.
- P2 trip tests, power ramping tests, staged line faults DC (2) and AC (2).
- Comparison of Pole 2 performance before and after VBE change (qualification tests).
- Complete tests as soon as possible.
POLE 2 SYSTEM TESTING

- Historic HVDC transfers show typical weekday profile with north upward pressure.

- Pole 3 monopole limit (780MW) unlikely to constrain transfer – typically limited by NI reserve requirement.

- For Pole 3 monopole transfer NI reserve requirements will determine transfer value.

- Target test range up to 400MW North (or 200 MW South).

- Timing of tests will be scheduled to align with desired system conditions.
1. Draft System Test Requirements submitted by Grid Owner
   • Process for System Operator to agree the test requirements

2. Expected outcome for treatment of system risk and secondary risk:
   • P2 secondary DC risk (i.e. for a P3 trip) until testing completed
   • Means that Bipole capability offered would be treated as a CE risk
   • No additional risk identified for AC CE events
   • Bipole capability offered will be P3 capability (i.e. self-cover of P2 under test)
   • P2 not a secondary risk when in monopole operation after tests completed

3. System Operator has sought independent review of the scope of testing required, the potential system risks and this proposed approach to secondary risks

4. Final Decision from system operator expected end of August

5. Formal test plan process will be followed to agree test plan (PR_EA_010)
The System Operator will continue to assess system conditions and risks to system security with respect to these outages.

Areas of monitoring include:
- Hydro storage
- Concurrent transmission and generation outages
- Generation balance shortfalls
- Gas supply

Any concerns or changes to the work with respect to the associated outages will be advised to all stakeholders following the usual channels.
SUMMARY AND STEPS GOING FORWARD

1. On going monitoring, and updates as required
2. Follow up industry meeting early Nov to review system conditions and preparations.

Information sources and contact points:

2. POCP information on HVDC outages for 2020: POCP outages
3. NZGB: https://nzgb.redspider.co.nz
4. System Operator mailbox for queries relating to outages and NZGB assessments: System.Operator@transpower.co.nz
THANK YOU FOR YOUR ATTENDANCE