Asset Management Workshop
Transpower & Commerce Commission

27th October 2016
This slide pack provides material on Transpower’s asset management journey.

The pack was developed to support a relatively informal workshop with Commerce Commission staff, consistent with Transpower’s “no surprises” approach to developing our RCP3 reset proposal.

We are happy for the material to be shared with interested parties, and to be used in support of the reset process. The material is consistent with Transpower’s 2016 Integrated Transmission Plan update, including our 2016 Asset Management Plan.
Topics

1. Asset management (Steve Jay)
2. Services engagement (Stephen Jones)
3. Reconductoring (Stephen Jones)
4. Enhancement & Development (Nikki Newham)
5. ICT (Cobus Nel)
6. Planning (Ross Parry)
1. Asset management journey
2. Services

- We are on a journey:
  - RCP 1 = high level measures
  - RCP 2 = categorised measures
  - RCP 3 = refined / refreshed measures that improve on RCP2 better reflecting customer value. A progression towards more customer targeted measures in the future

- Hence this engagement is about “refreshing” and improving the RCP2 measures. The engagement will not require significant resource from our customers:
  - many issues being considered in the regulatory space (TPM, Capex IM etc.)
  - We aim to cast the net wider with our engagement to include consumer groups
2. Outline of Engagement Process

- October / early November 2016: Publication of an initial engagement paper describing the process, current measures and direction of feedback so far

- Early February 2017: Focus group of customer / stakeholder representatives to test the appetite for revising current measures

- March 2017: Three regional forums to present on the process, any proposed refinements and seek feedback

- June 2017: Publish a Services Report on the measures as part of the 2017 ITP that sets the scene with proposed measures and initial targets for the RCP3 submission
3. Reconductoring

- Planning the replacement of conductors is an inherently complex science/art:
  - Challenges and expense of obtaining sufficient condition assessment data to predictably map asset health
  - Differing Spans and Sections degrade at varying rates due to location, marine environment etc
  - Manufacturing defects show up as local conductor degradation years after commissioning

Our Asset health Model is evolving to better predict life expectancy and improved aerial surveillance technology improves our chances of identifying local defects

- Urban reconductoring will increasingly challenge us in accommodating the community, safety and environmental planning horizons
3. Alternative Reconductoring Approach
4. Enhancement and Development (E&D)

- Uncertainty is the biggest challenge for the E&D portfolio
  - Both base capex and MCP’s
  - External drivers create unexpected investment needs
  - Small changes can advance or delay investment significantly
- New process to connect E&D grid problems to improved Asset Management Framework
  - Acknowledges the uncertainty inherent in the portfolio
  - Provides mechanism for commensurate analysis based on problem uncertainty, complexity, planning horizon.
4. Enhancement and Development (E&D)

- RCP submission will be a snapshot of current E&D problems and solutions.
  - process isn’t frozen in time for submission periods
- Portfolio will have both top down and bottom up aspects
- We will expand TPR to cover:
  - E&D problems (existing TPR)
  - Process and framework for assessing problems
  - Drivers of problem uncertainty and how the problems relate to each other and choice of solution
    - Solution detail commensurate with problem uncertainty and need date
5. Information & Communications Technology (ICT)

- Implementing new approach for planning with the Grid business
  - Same framework used for setting the 5 year capex plan with the System Operator for the SOSPA with the Electricity Authority
  - Will be applied to all ICT Planning prior to RCP3 submission
5. ICT – Capabilities and Outcomes

Q4: What Capability (Tech/Process/People) changes are required to enable the business change?
Q3: What business changes are required to enhance customer/stakeholder value?
Q2: What customer/stakeholder value must be enhanced to achieve those outcomes?
Q1: What strategic, efficiency or regulatory outcomes are required?

Capability Outcomes
Business Change Outcomes
Customer Value Outcomes
Final Business Outcomes

Capability Build Outcomes
Business Change Outcomes
Customer Value Outcomes
Final Business Outcomes

Capabilities that are created which on their own do not add business value but enable the business to change.
By making the required changes in the business, to make the intended use of the capabilities, desired business outcomes can be achieved.
Achieve outcomes valued by the customer [external and internal].
Realise desired business outcomes which contribute to achievement of business goals.

Keeping the energy flowing | TRANSPower
5. ICT – Spend profile

ICT Capital Investment 2016 to 2025

- Transmission 80%
- System Operator 20%
- ICT Capex = 18% of total capital programme = $2600m

ICT Investment Value Profile 2016 to 2025

- Compliance, Risk & Lifecycle 65%
- Benefits Driven 32%
- Leading 53%

Keeping the energy flowing T R A N S P O W E R
Large ICT lifecycle projects planned for RCP3 - represents 66% of our planned lifecycle expenditure

- TransGO ($60m) – Refresh of our high-capacity and highly resilient network supporting 158 sites.
- SCADA ($30m) – Refresh of our Supervisory Control And Data Acquisition system which supports the operation of the Grid.
- Cook Strait Fibres ($12m) – Lifecycle replacement of our Cook Strait submarine fibre cables.
6. Planning
6. Planning

Base and Listed (reconductoring) projects

$\text{m}


Actual Base Listed RCP2 Allowance RCP3 Target
Close

- changed operating environment
- new tools, processes, structures
- keen to share and engage
Extra Material
7. Asset Health

- We now use true Asset Health Indices (AHI) in line with international good practice
- Remaining life estimates (RLE) will play a much smaller role in future (RCP2 “AHI”)

<table>
<thead>
<tr>
<th>Models being delivered or improved this year</th>
<th>Models planned for delivery or improvement next year (current plan is subject to change)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overhead conductor</td>
<td>Power transformers</td>
</tr>
<tr>
<td>Tower coating and tower steel</td>
<td>Circuit breakers</td>
</tr>
<tr>
<td>Tower foundations and grillages</td>
<td>Indoor switchgear</td>
</tr>
<tr>
<td>Transmission line insulators</td>
<td>Low Voltage AC supplies</td>
</tr>
<tr>
<td>Instrument transformers</td>
<td>Power cables</td>
</tr>
<tr>
<td>Power transformers</td>
<td>Disconnectors</td>
</tr>
<tr>
<td>Battery banks and chargers</td>
<td>Bus support structures and gantries</td>
</tr>
<tr>
<td>Capacitor banks and reactors</td>
<td>Buildings &amp; grounds – selected assets TBC</td>
</tr>
<tr>
<td>Buildings &amp; grounds – fencing, roofing, security</td>
<td>Further models TBC</td>
</tr>
</tbody>
</table>
7. Asset Health

Using AHI in the decision making framework:

- The models give an estimated health only
- The estimate is only a small part of the decision making process
- The importance of the asset has equal weight
- The decision is not deterministic, lots of investigation and judgement is required
7. Asset Health

The following is an example of the type of AHI reporting we expect to propose:

Asset Health Reporting

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Portfolio</td>
<td></td>
<td></td>
<td>1-4</td>
<td>&gt;4-5</td>
<td>&gt;5-6</td>
<td>&gt;6-7</td>
</tr>
<tr>
<td>Lines</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductors (km)</td>
<td>16526</td>
<td>0.05%</td>
<td>35.2%</td>
<td>14.4%</td>
<td>5.7%</td>
<td>9.3%</td>
</tr>
<tr>
<td>Tower coating</td>
<td>23729</td>
<td>0.16%</td>
<td>20.9%</td>
<td>17.7%</td>
<td>18.5%</td>
<td>7%</td>
</tr>
<tr>
<td>Tower foundations</td>
<td>23729</td>
<td>1.28%</td>
<td>66.3%</td>
<td>15.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulators</td>
<td>54715</td>
<td>0.00%</td>
<td>85.5%</td>
<td>2.8%</td>
<td>4.7%</td>
<td>1.2%</td>
</tr>
<tr>
<td>Poles</td>
<td>14579</td>
<td>0.55%</td>
<td>83.9%</td>
<td>4.7%</td>
<td></td>
<td>0.3%</td>
</tr>
<tr>
<td>Stations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instrument transformers</td>
<td>6458</td>
<td>0.55%</td>
<td>88.0%</td>
<td>4.7%</td>
<td></td>
<td>1.4%</td>
</tr>
<tr>
<td>Power transformers</td>
<td>359</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sec. Systems</td>
<td>Batteries &amp; Chargers</td>
<td>651</td>
<td>35.2%</td>
<td>5.4%</td>
<td>15.4%</td>
<td>18.6%</td>
</tr>
</tbody>
</table>

Notes:
#1 - Colours indicate the infrastructure stability of the asset class by way of measuring the ability of the current investment plan to match an approximated asset health decline.
#2 - R&R (Replacement and Refurbishment) investment information has been sourced from 2016 AMP and is for the 5 year Regulatory Control Period 2 (RCP2).
#3 - R&R rate is % of assets (number or km) planned for replacement per year compared to total population. It is the yearly average across the 5 year RCP2 period.
8. Transformers

- Case study – RCP 3-5 ‘trial’ of the decision framework including criticality
**Objective:** Trial elements of the Decision Framework on the Power transformer fleet

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**Asset criticality framework**

- **Almost Certain**
  - 300,000
  - 90,000
  - 3,000,000
  - 90,000
  - 900,000
  - 900,000
  - 300,000,000
  - 300,000,000

- **Very Likely**
  - 100,000
  - 30,000
  - 3,000,000
  - 10,000,000
  - 10,000,000
  - 300,000,000
  - 300,000,000

- **Likely**
  - 30,000
  - 90,000
  - 300,000
  - 900,000
  - 300,000
  - 300,000
  - 100,000,000
  - 300,000,000

- **Possible**
  - 10,000
  - 30,000
  - 300,000
  - 1,000,000
  - 30,000
  - 900,000
  - 100,000,000
  - 30,000,000

- **Unlikely**
  - 3,000
  - 9,000
  - 90,000
  - 900,000
  - 300,000
  - 300,000
  - 900,000
  - 900,000

- **Very Unlikely**
  - 1,000
  - 3,000
  - 30,000
  - 10,000
  - 30,000
  - 900,000
  - 900,000
  - 300,000

- **Rare**
  - 300
  - 900
  - 3,000
  - 9,000
  - 30,000
  - 90,000
  - 900,000
  - 300,000,000

- **Very Rare**
  - 100
  - 300
  - 1,000
  - 3,000
  - 10,000
  - 30,000
  - 100,000
  - 300,000

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**Objective:**

- **Trial elements of the Decision Framework on the Power transformer fleet**

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**Main contributing Teams:** Asset Planning; Commercial; Tactical Eng.
On the following results graphs, please take note of the **patterns / trends emerging only**, not the raw numbers – there are **known limitations and errors in assumptions and outputs**.

**Planned transformer replacement (Capex – R&R)**

- RCP3
- RCP4
- RCP5

**Unplanned expenditure (Capex & Opex)**

This graph provides an estimation of the unplanned remedial actions (partial or complete replacements) following unplanned unit failures. This is based on the probabilistic asset health model developed for power transformers.

**Aggregated monetised risk exposure ($m per year)**