RISK BASED DAM PORTFOLIO MANAGEMENT IN AUSTRALIA

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Entura, Hydro Tasmania

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WE OPERATE
WE CONSULT
Outline

Dam Portfolio Management – Australian Context
Hydro Tasmania’s Dam Portfolio Management
• Introduction to Hydro Tasmania Business
• Hydro Tasmania’s Dam Portfolio

Dam Safety Management & the use of Risk
• Guidelines and Standards which inform the Dam Safety Programme
• Programme Arrangement
• Risk Acceptance Criteria & Assessment
• Risk Mitigation - CAPEX
• Risk Management - OPEX
• Program Performance Assessment

Examples of Risk Mitigation Projects

Conclusion
Dam Portfolio Management in Australia

Australia experienced a major dam building era in the 1900’s

- Oldest dams late 1800’s, rapid expansion post WW2
- Large portfolio’s predominantly publicly owned
- Moved towards multiple use recognition
- New dams / redevelopments commonly using PPP

Current situation characterised by

- Ageing & deteriorating infrastructure
- Increasing community expectations & risk awareness
- New understanding & changing standards
- Shifting societal priorities → Reduced public funding
- Centralised management, fewer diversified skilled resources

Difficult to continue to manage as historically

→ risk based instead of standards based
Dam Safety Management & Regulation

State based oversight – no National Legislation
Responsibilities remain with the owner
4 states/territ have DS Legislation & Regulation, 3 states/territ don’t
Peak body providing leadership and guidance is ANCOLD
ANCOLD is an active member of the International body ICOLD
Key ANCOLD Guidelines
**Basic DS Programme Process**

**Context**
- Internal - Business priorities, Nature of portfolio
- External - Regulation, Public expectations

**Dam Management Activities**
- Surveillance – Inspection, Monitoring, Reviews
- Operations & maintenance
- Capability, Information, Preparedness

**Risk Assessments**

**Rectification Activities**
- Undertake maintenance, or
- Investigate, design & undertake major works

**Flowchart**

- Is There a Deficit? [No]
- Is it tolerable? [Yes]
- Yes
- No [Rectification Activities]

- Is There a Deficit? [Yes]
- Yes

**Logo and Slogan**
- Kentura: The power of natural thinking
- WE OWN. WE OPERATE. WE CONSULT.
Hydro Tasmania owns, operates and maintains

- 29 hydropower stations
- 55 major dams + 150 smaller dams
- 188 headwork gates and valves
- 22 canals
- 19 tunnels
- 43 pipelines
- 58 machines

System configuration
- 2 large inter-annual storages
- 5 seasonal storages
- Run-of-river

Australia’s largest clean energy producer
Australia’s largest water manager
Our history starts


Major Tasmania industrialisation


Multiple projects developed

Anthony scheme completed (last major)

Start of external consulting

Internat. consulting expansion

Australian Offices established

Retail (Momentum)

Entura Brand launched

Entura India Opened

Entura JV
Hydro Tasmania’s 55 Prescribed Dams

- 12 Concr Faced Rock Fill
- 14 Concrete Gravity
- 23 Earth fill
- 2 Gravity Arch
- 2 Thin Arch
- 2 Bitumen Faced Rock Fill
Cethana Dam – 110m High CFRD
## Hydro Tasmania’s Dams

Portfolio by ANCOLD Hazard Category – 204 Dams in total

<table>
<thead>
<tr>
<th>Population at Risk</th>
<th>Severity of Damage &amp; Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Negligible</td>
</tr>
<tr>
<td>0</td>
<td>142 Very Low</td>
</tr>
<tr>
<td>1-10</td>
<td>Low</td>
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<tr>
<td>11-100</td>
<td>x</td>
</tr>
<tr>
<td>101-1,000</td>
<td>x</td>
</tr>
<tr>
<td>&gt;1,000</td>
<td>x</td>
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</table>
ISO 31000 (figure 3) Risk Management Process

Communication and consultation (5.2)

- Establishing the context (5.3)
- Risk assessment (5.4)
  - Risk identification (5.4.2)
- Risk analysis (5.4.3)
- Risk evaluation (5.4.4)
- Risk treatment (5.5)

Monitoring and review (5.6)
# Business Risk Framework

<table>
<thead>
<tr>
<th>Likelihood</th>
<th>Impact (Consequences)</th>
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<tr>
<td></td>
<td>Insignificant 1</td>
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<tr>
<td>A. Almost Certain</td>
<td>L</td>
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<tr>
<td>B. Likely</td>
<td>L</td>
</tr>
<tr>
<td>C. Possible</td>
<td>L</td>
</tr>
<tr>
<td>D. Unlikely</td>
<td>L</td>
</tr>
<tr>
<td>E. Rare</td>
<td>L</td>
</tr>
<tr>
<td>F. Extremely Rare</td>
<td>L</td>
</tr>
</tbody>
</table>

- **Extreme Risk** – Risk threatens business sustainability
- **High Risk** – Risk poses significant threat to corporation business strategies and objectives
- **Moderate Risk** – Risk poses moderate threat to corporation business strategies and objectives and must be incorporated into project or business risk management programs.
- **Low Risk** – Risk poses minimal threat to corporation business strategies and objectives.

- $150M+  
- $750M+
ANCOLD Public Safety Risk To Life Criteria

- **Increasingly Tolerable**
  - Low
  - Increasingly Tolerable
  - New Dams

- **ANCOLD Risk Tolerance Limit - New Dams**
  - Moderate
  - Increasingly Tolerable
  - Existing Dams

- **ANCOLD Risk Tolerance Limit - Existing Dams**
  - High
  - Increasingly Intolerable
  - Extreme

- **Probable Loss Of Life**
  - 0.1
  - 1
  - 10
  - 100
  - 1000

- **Annual Probability of Dam Failure**
  - 1:10^2
  - 1:10^3
  - 1:10^4
  - 1:10^5
  - 1:10^6
Public Safety - High Risk Since PRA Completed

Probable Loss Of Life

Prior to Mitigation
Current Assessment
Probable Loss Of Life

0.1 1 10 100

1:10

6

1:10

5

1:10

4

1:10

3

1:10

2

1:10

1

Public Safety - High Risk Since PRA Completed

Prior to Mitigation

Current Assessment

Extreme

High

Moderate

Low

Annual Probability of Dam Failure

0.1 1 10 100 1000

Probable Loss Of Life

Public Safety - High Risk Since PRA Completed
Public Safety - High Risk Since PRA Completed

- Probable Loss Of Life
- Current High Risks

- High
- Extreme
- Moderate
- Low

- Dam 2

Diagram showing the relationship between annual probability of dam failure and probable loss of life, with areas marked as High, Moderate, Low, and Extreme risks.
Hypothetical Risk Reduction Pathways Over Time

- **Alternative #1** – defer program
- **Alternative #2** – defer program

- **Quick Wins Complete**
- **Dam #1 complete**
- **Dam #2 complete**
- **Dam #3 complete**
- **Dam #4 imminent**

**Past 10 years plan (complete)**

**Potential range of risk variance over 10 year plan period**
Reece Dam – 122m High CFRD
Catagunya Dam – 49m High Post Tensioned Concr
Rowallan Dam – 43m High Earth & Rockfill
Hydro Tasmania Financial Risk Criteria

What drives action here?
<table>
<thead>
<tr>
<th>Ancold Hazard Category</th>
<th>Very Low</th>
<th>Low</th>
<th>Significant</th>
<th>High C</th>
<th>High B</th>
<th>High A</th>
<th>Extreme</th>
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<td>DSRdb Consequence Rating</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
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<tr>
<td>Deficiency Category</td>
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<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
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<td>Sustain Score</td>
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<tr>
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<td>6</td>
<td>6</td>
<td>6</td>
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</tr>
</tbody>
</table>

**Dam Sustainability Rating**
DS Risk Management “Balancing Act”

**High Risk**

- Deficiencies

**Surveil. O&M**

- Heightened Awareness

- Increased Scrutiny
  - Monitoring
  - Investigation
  - Reporting
  - Priority works

**Response**

- Major Intervention

**Increased focus on**
- routine inspections
- monitoring installations
- quick wins
- addressing outstanding issues
- flood warning system
- emergency preparedness
- use of contractors
- training of field staff
# DS Program Performance Assessment Example

<table>
<thead>
<tr>
<th>Issue</th>
<th>Compliance Status</th>
<th>Management Status</th>
<th>Previous Report Status</th>
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<tbody>
<tr>
<td>Dam Surveillance</td>
<td>B</td>
<td>☐</td>
<td>B</td>
</tr>
<tr>
<td>Dam Operations and Maintenance</td>
<td>B</td>
<td>✓</td>
<td>B</td>
</tr>
<tr>
<td>Regular Reporting</td>
<td>A</td>
<td>✓</td>
<td>A</td>
</tr>
<tr>
<td>Audits and Reviews</td>
<td>A</td>
<td>✓</td>
<td>A</td>
</tr>
<tr>
<td>Performance of Dams with Heightened Safety Awareness</td>
<td>A</td>
<td>✓</td>
<td>A</td>
</tr>
<tr>
<td>Investigation and Resolution of Dam Safety Deficiencies</td>
<td>A</td>
<td>✓</td>
<td>B</td>
</tr>
<tr>
<td>Emergency Preparedness</td>
<td>A</td>
<td>✓</td>
<td>B</td>
</tr>
<tr>
<td>Maintaining Personnel Capability &amp; Access to Key Technical Information</td>
<td>A</td>
<td>✓</td>
<td>A</td>
</tr>
<tr>
<td>Communication with External Stakeholders</td>
<td>A</td>
<td>✓</td>
<td>A</td>
</tr>
</tbody>
</table>
Echo Dam Filter Upgrade
Echo Dam Filter Upgrade

- Embankment Core
- Zone 2A Sand Filter
- Zone 2C Drainage
- Zone 3 Rockfill
Cethana Dam – Spillway Upgrade
Catagunya Dam Restoration
Catagunya Dam Restoration
Rowallan Dam Embankment Upgrade

- Embankment Reconstruction
- Strengthen Spillway Walls
- Investigate Foundation
- Monitor Spillway Erosion
- Penstock Bypass Valve
- Turbine Relief Valve
Rowallan Dam Embankment Upgrade
Conclusions

Establish the context of portfolio management – this is critical

- Regulatory environment
- External stakeholders
- Shareholder demands & risk appetite
- Business capacity & priorities

Establish goals, objectives & measures

- Financial
- Risk
- Program delivery & performance

Review and monitor performance of the above, incl changes

Report outcomes, identify areas for improvement and reset targets
Questions
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