meridian

Condition Assessment Criteria

And the Data Required for Hydropower Generating Units

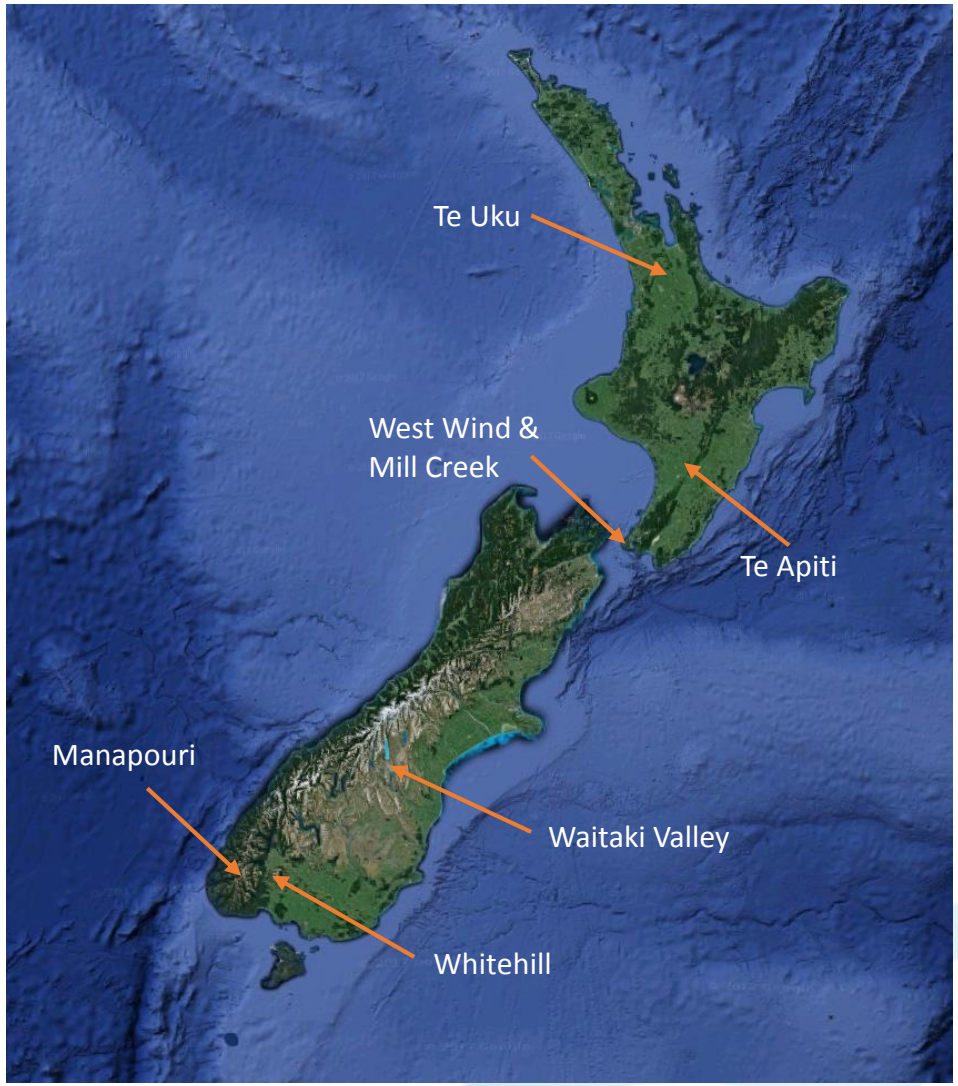
APEX 2017

"Powered by Data"

Jarrod Wyatt

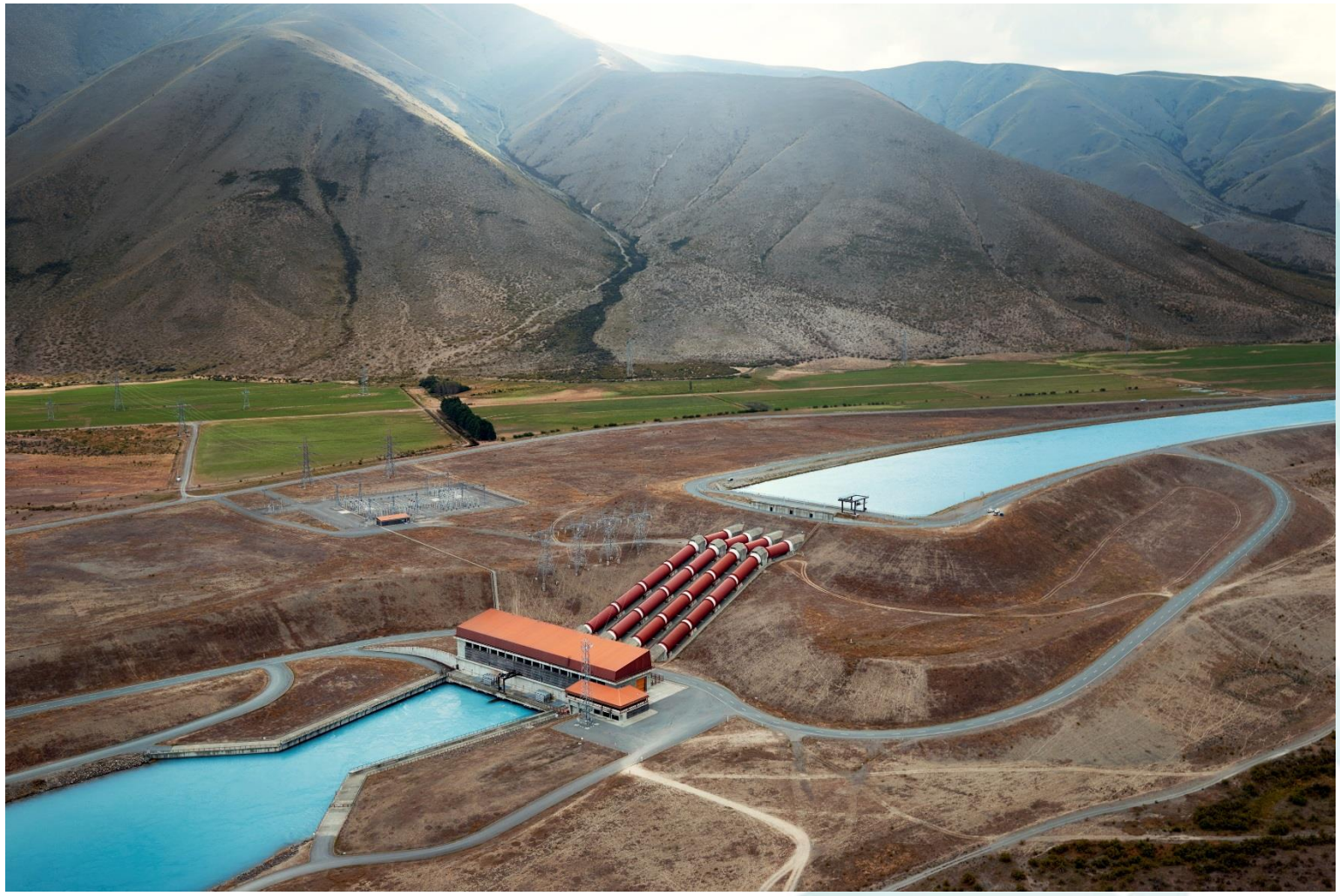
Meridian at a Glance

- 100% renewable electricity generator and retailer
- 7 hydro stations
  - Manapouri, Ohau A, Ohau B, Ohau C, Benmore, Aviemore & Waitaki
- 7 wind farms
  - Te Apiti, Te Uku, West Wind, Mill Creek, Whitehill, Mt Mercer & Mt Miller



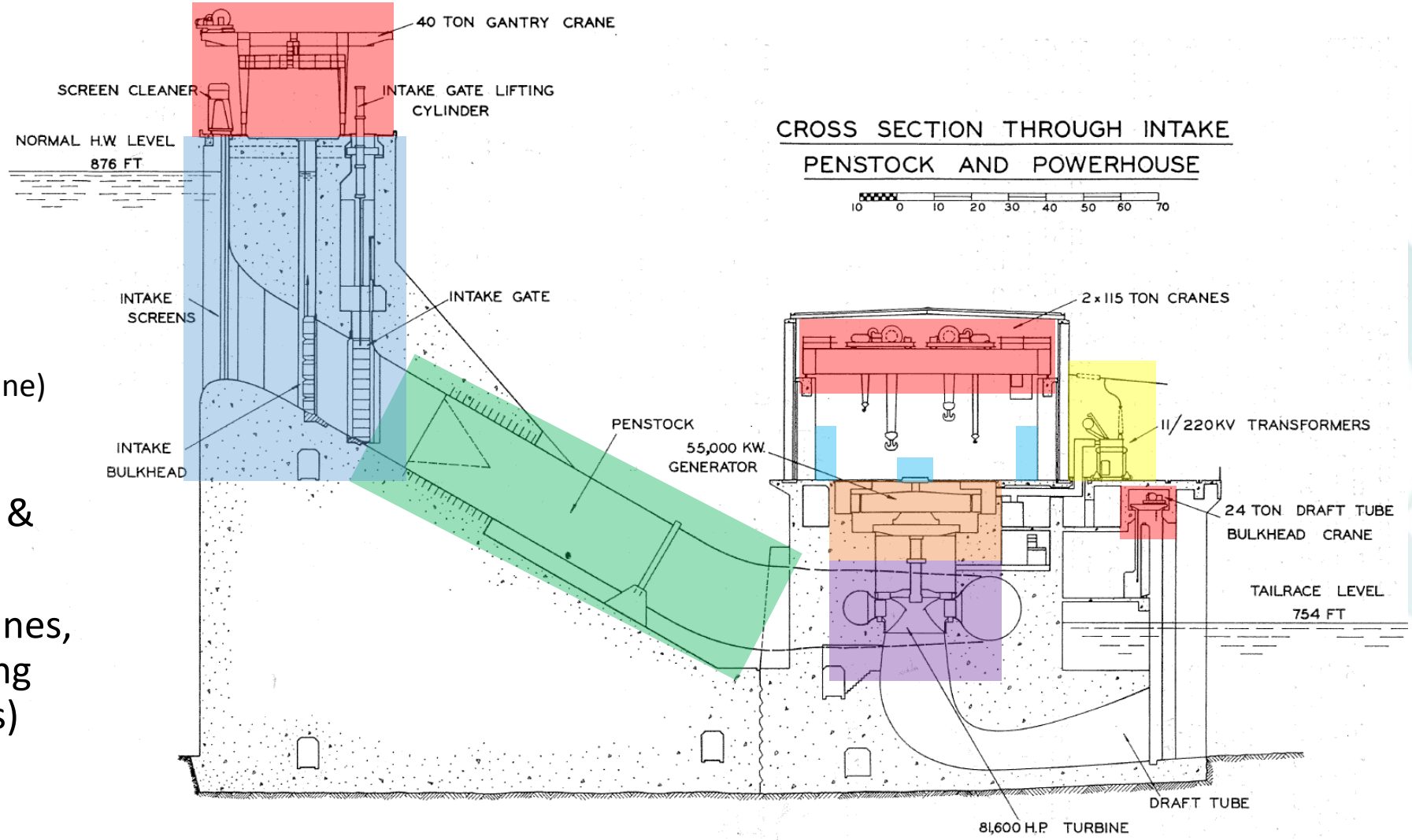
Overview

- Condition data
  - What?
  - How?
  - Why?
- Detailed main unit condition assessments
  - Development
  - Implementation
- Future Works



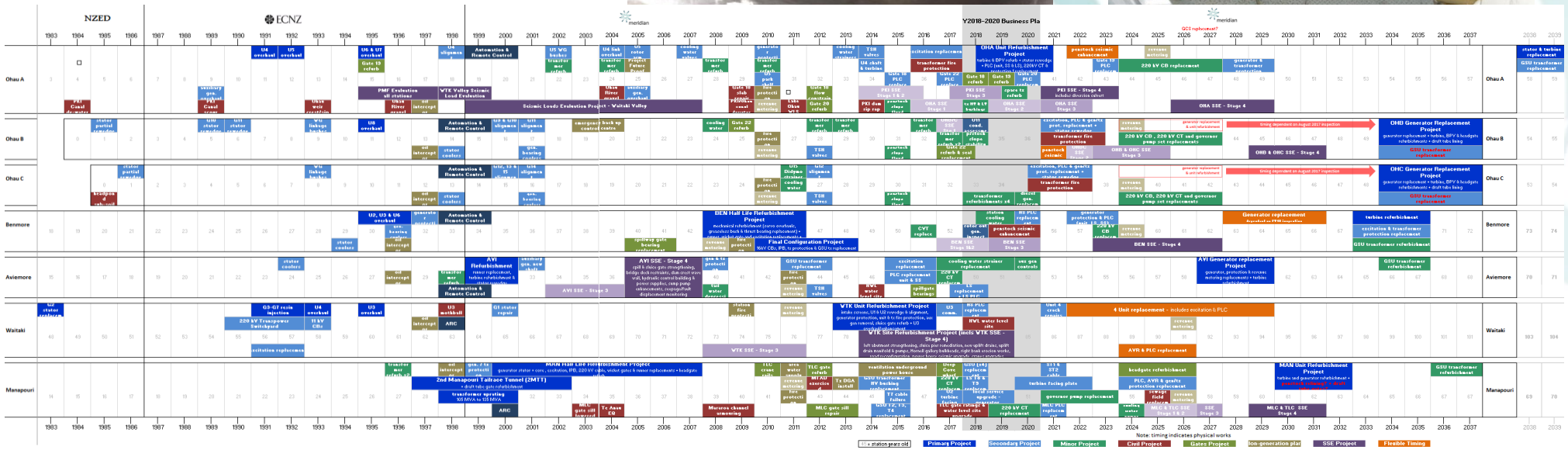
A Typical Hydro Station

- Headgates and Intake Structure
- Penstock
- Main unit
  - Above coupling (Generator)
  - Below coupling (Turbine)
- Transformers
- Excitation, Protection & Control/Governor
- Auxiliary Services (cranes, compressed air, cooling water, AC/DC supplies)



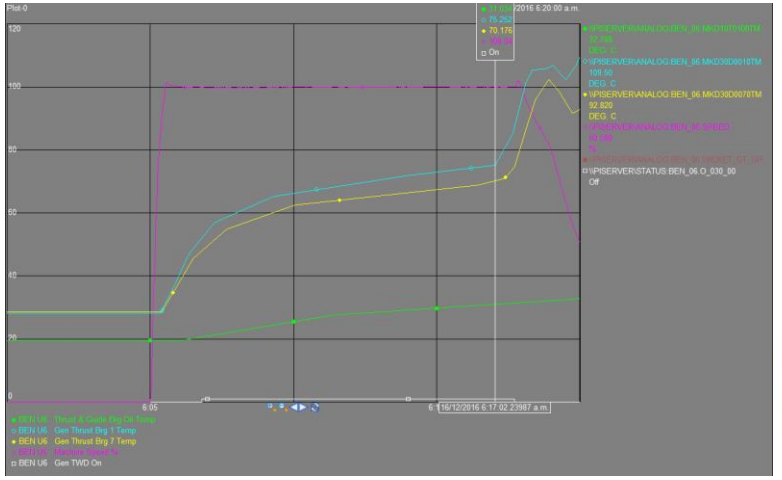
Condition Data

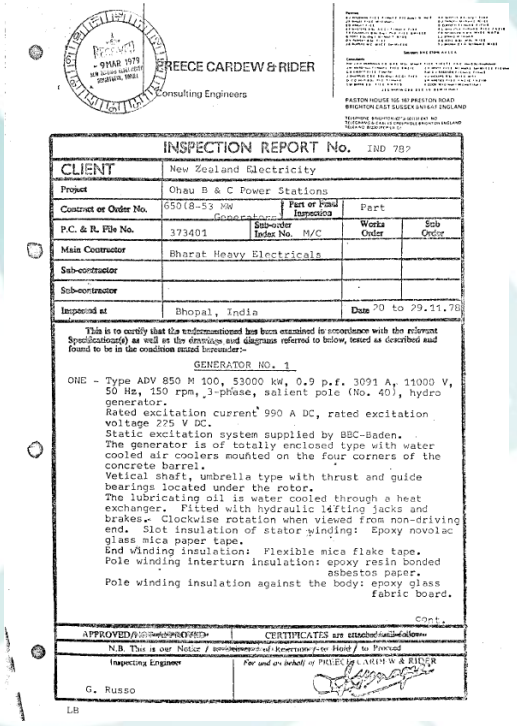
- Drives operational parameters & restrictions
- Drives Asset Maintenance Plan (AMP) process
  - Minor projects
  - Major projects & refurbishments/replacements
- Objective & subjective
- Photos
- Reports
- Tests



Gathering Condition Data

- Scheduled maintenance
- Route marches
- Real time operation of units
- Analysis of operation data
- Forced Outages
- Desktop Investigations
- Review of historical data





REECE CARDEW & RIDER
Consulting Engineers

INSPECTION REPORT No. IND 782

CLIENT	New Zealand Electricity		
Project	Ohau B & C Power Stations		
Contract or Order No.	650(8-53 MW Generators	Part or Final Inspection	Part
P.C. & R. File No.	373401	Sub-order Index No. M/C	Works Order / Sub Order
Main Contractor	Bharat Heavy Electricals		
Sub-contractor			
Sub-contractor			
Inspected at	Bhopal, India	Date	20 to 29.11.78

This is to certify that the undermentioned has been examined in accordance with the relevant Specification(s) as well as the drawings and diagrams referred to below, tested as described and found to be in the condition stated hereunder:-

GENERATOR NO. 1

ONE - Type ADV 850 M 100, 53000 kW, 0.9 p.f. 3091 A, 11000 V, 50 Hz, 150 rpm, 3-phase, salient pole (No. 40), hydro generator.
Rated excitation current 990 A DC, rated excitation voltage 225 V DC.
Static excitation system supplied by BBC-Baden.
The generator is of totally enclosed type with water cooled air coolers mounted on the four corners of the concrete barrel.
Vetical shaft, umbrella type with thrust and guide bearings located under the rotor.
The lubricating oil is water cooled through a heat exchanger. Fitted with hydraulic lifting jacks and brakes. Clockwise rotation when viewed from non-driving end. Slot insulation of stator winding: Epoxy novolac glass mica paper tape.
End winding insulation: Flexible mica flake tape.
Pole winding interturn insulation: epoxy resin bonded asbestos paper.
Pole winding insulation against the body: epoxy glass fabric board.

Cont.

APPROVED/~~NOT APPROVED~~ CERTIFICATES are attached/~~not attached~~ hereto

N.B. This is our Notice / ~~permission~~ to Proceed

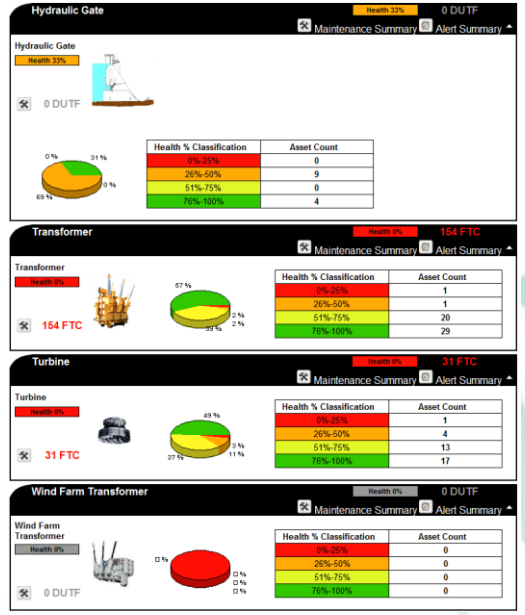
Inspecting Engineer: G. Russo

For and on behalf of REECE CARDEW & RIDER

LB

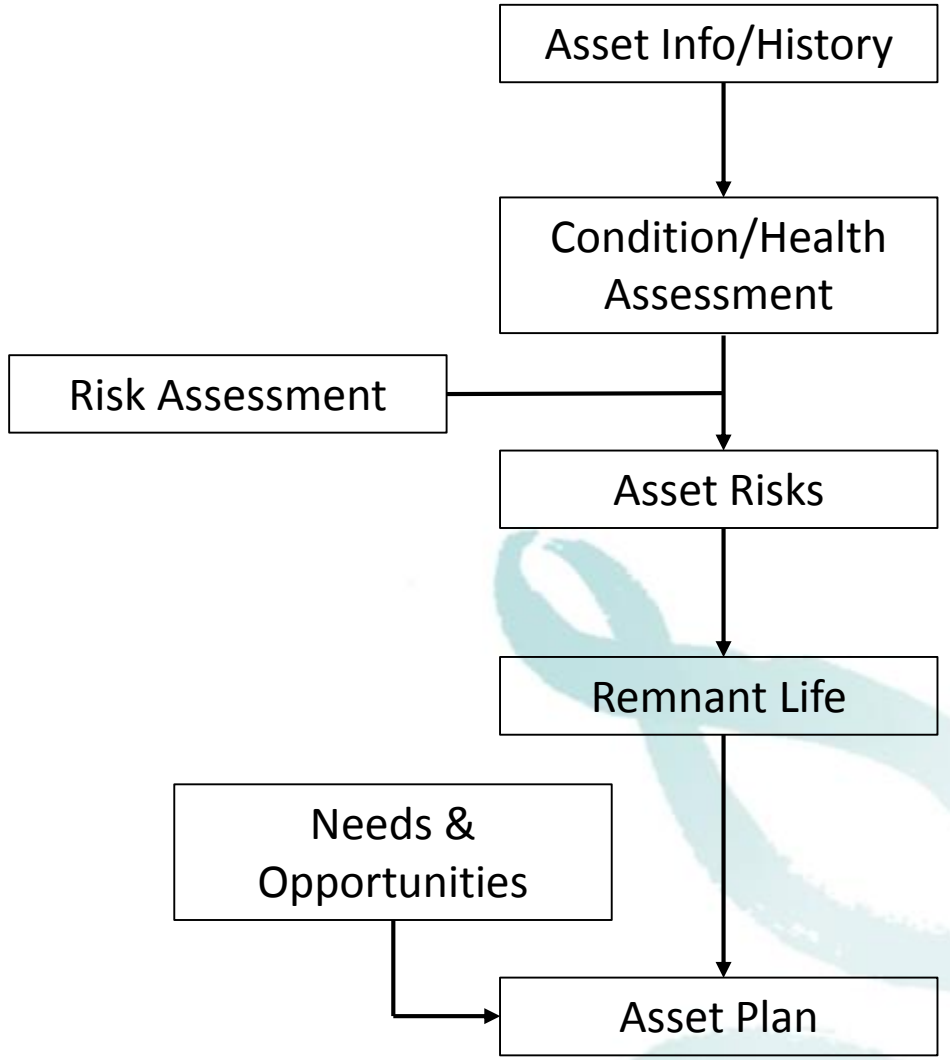
Condition Data Storage

- Maximo
- M drive and Filesite
- Plantdocs
- PI Historian
- PAM (undergoing replacement)
- Personal drives & peoples heads



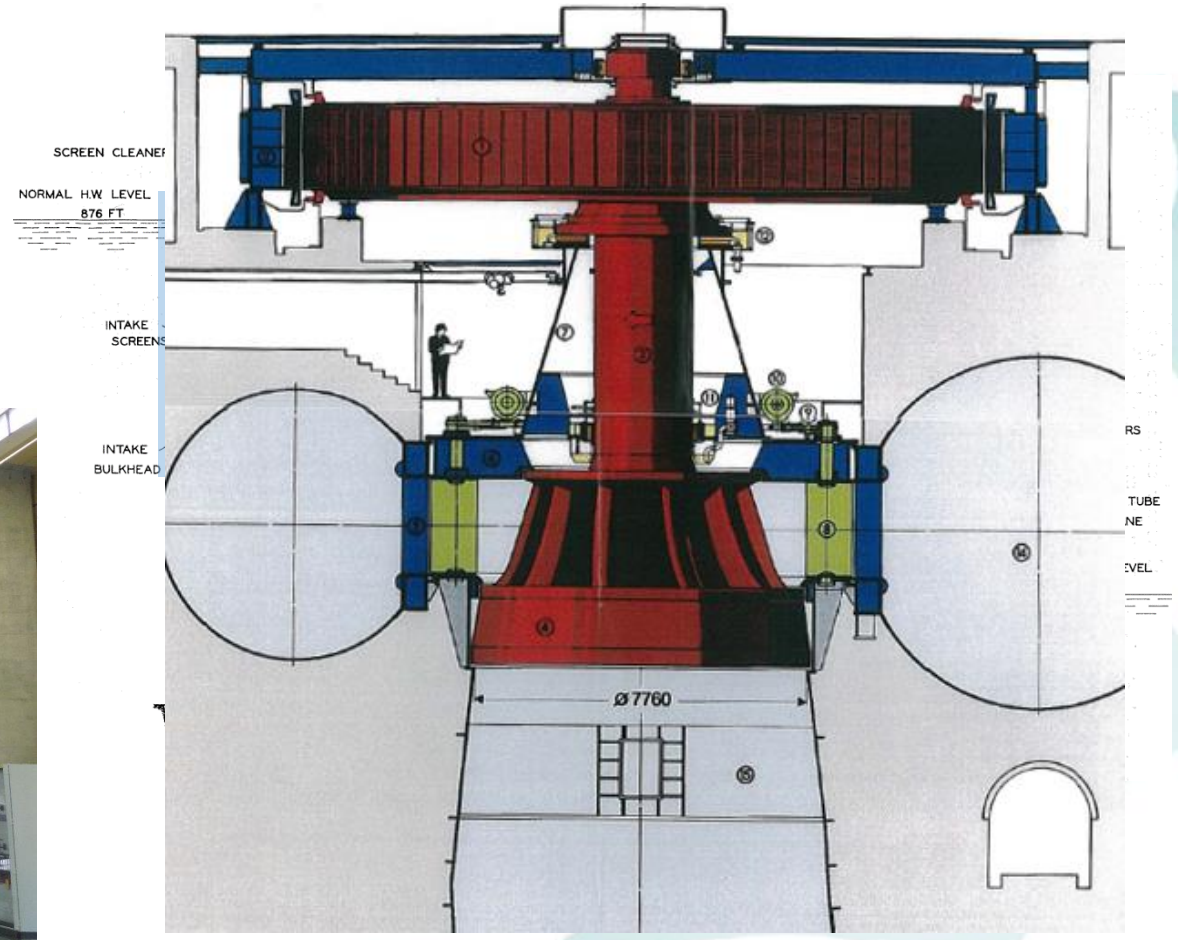
Making Decisions

- Choices for aging plant
  - Retire
  - Redevelop
  - Life extension (refurbishment)
  - Modernisation (replacement)
- Screen and prioritise
- Conduct a closer condition assessment
- Assess risks – estimate remnant life
- Prioritise H&S risks
- Make a decision!



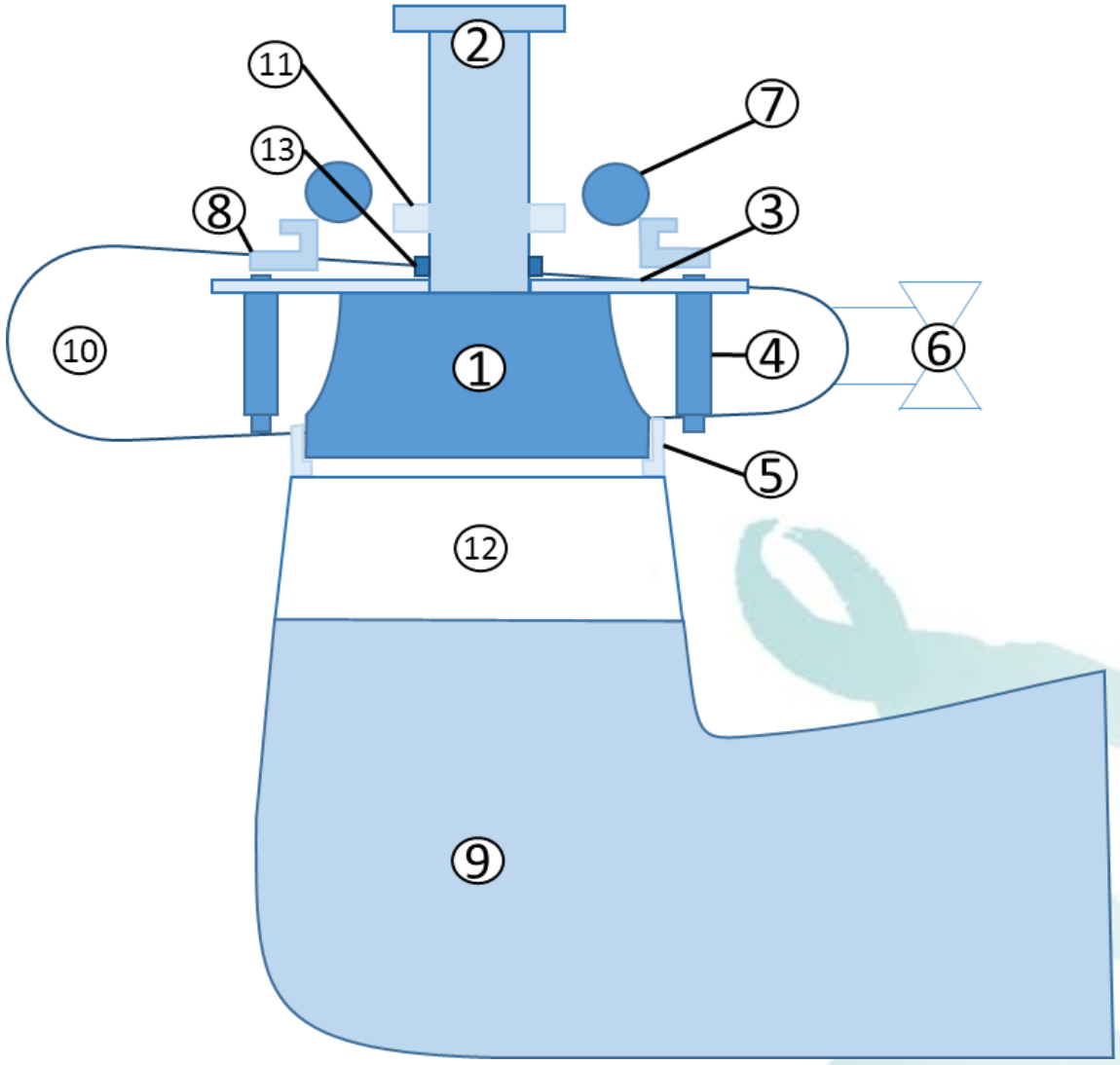
Detailed Condition Assessment

- Develop a template for main systems
- Start with the main units
- Split systems into components
- Assign weightings



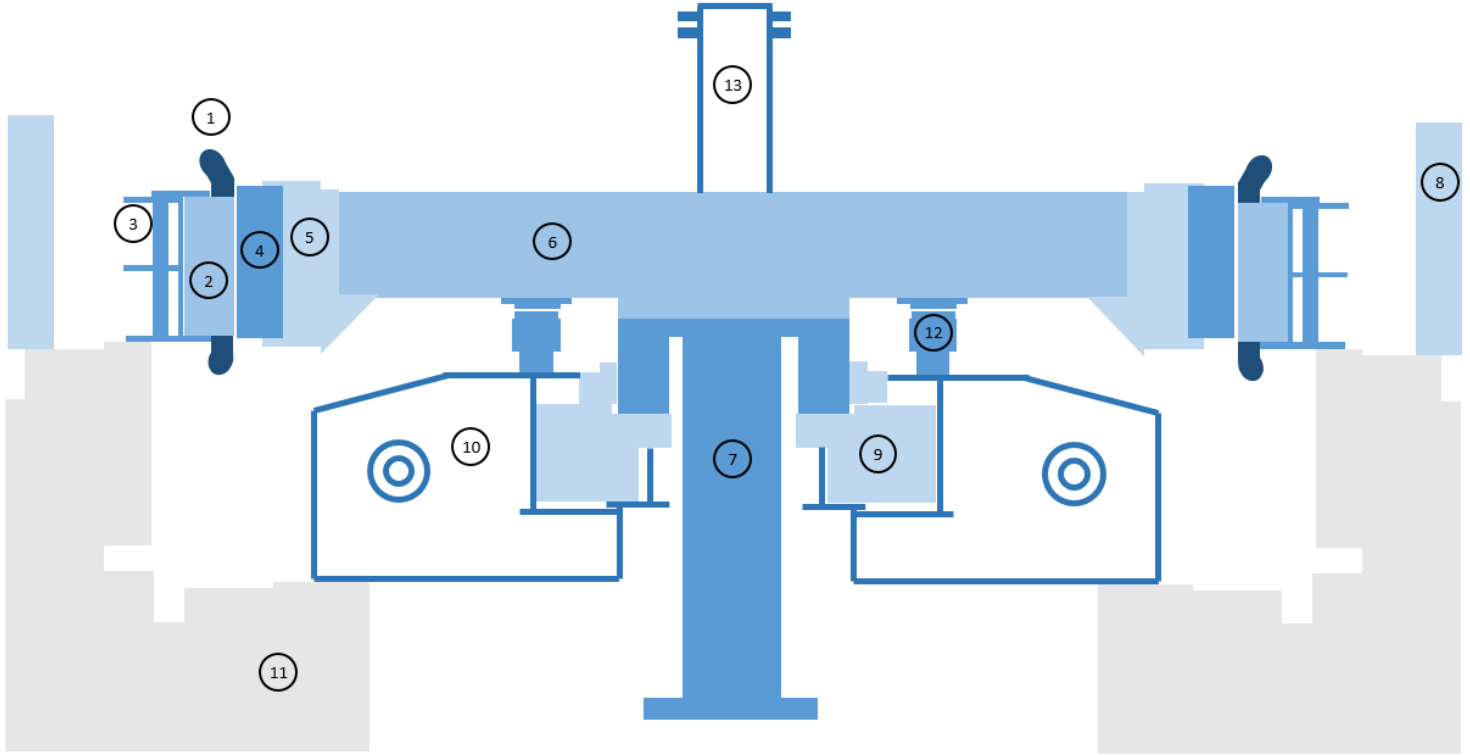
Hydroturbine

Item	Component
1	Runner
2	Shaft and Coupling
3	Head Cover
4	Wicket Gates
5	Discharge Ring
6	Bypass Valve
7	Servomotors
8	Wicket Gate Actuation Assembly
9	Draft Tube Concrete
10	Scroll Case
11	Turbine Bearing
12	Draft Tube liner
13	Shaft Seal



Hydrogenerator

Item	Component
1	Stator Winding
2	Stator Core
3	Stator Frame
4	Rotor Poles
5	Rotor Rim
6	Rotor Spider/Hub
7	Generator Shaft
8	Stator Coolers
9	Combined Bearing
10	Thrust Bracket
11	Foundations
12	Brakes and brake track
13	Excitation shaft



Template Development

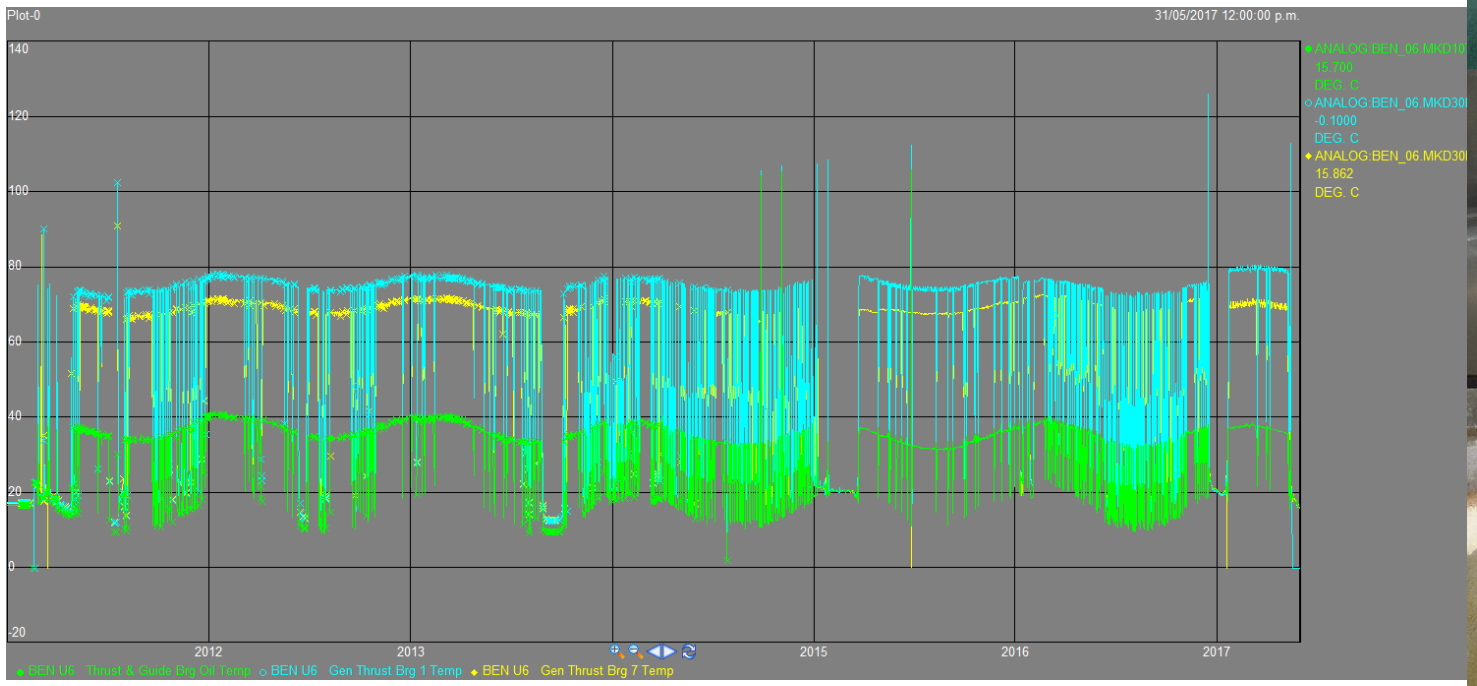
- Template based on USACE & EPRI templates and Meridian's existing templates
- Developed for Ohau B
- Assign each component condition scales
  - Cracks
  - Cavitation
  - Surface Condition
  - Wear & Deterioration
  - Component clearances
  - Oil leakage
  - Unscheduled maintenance

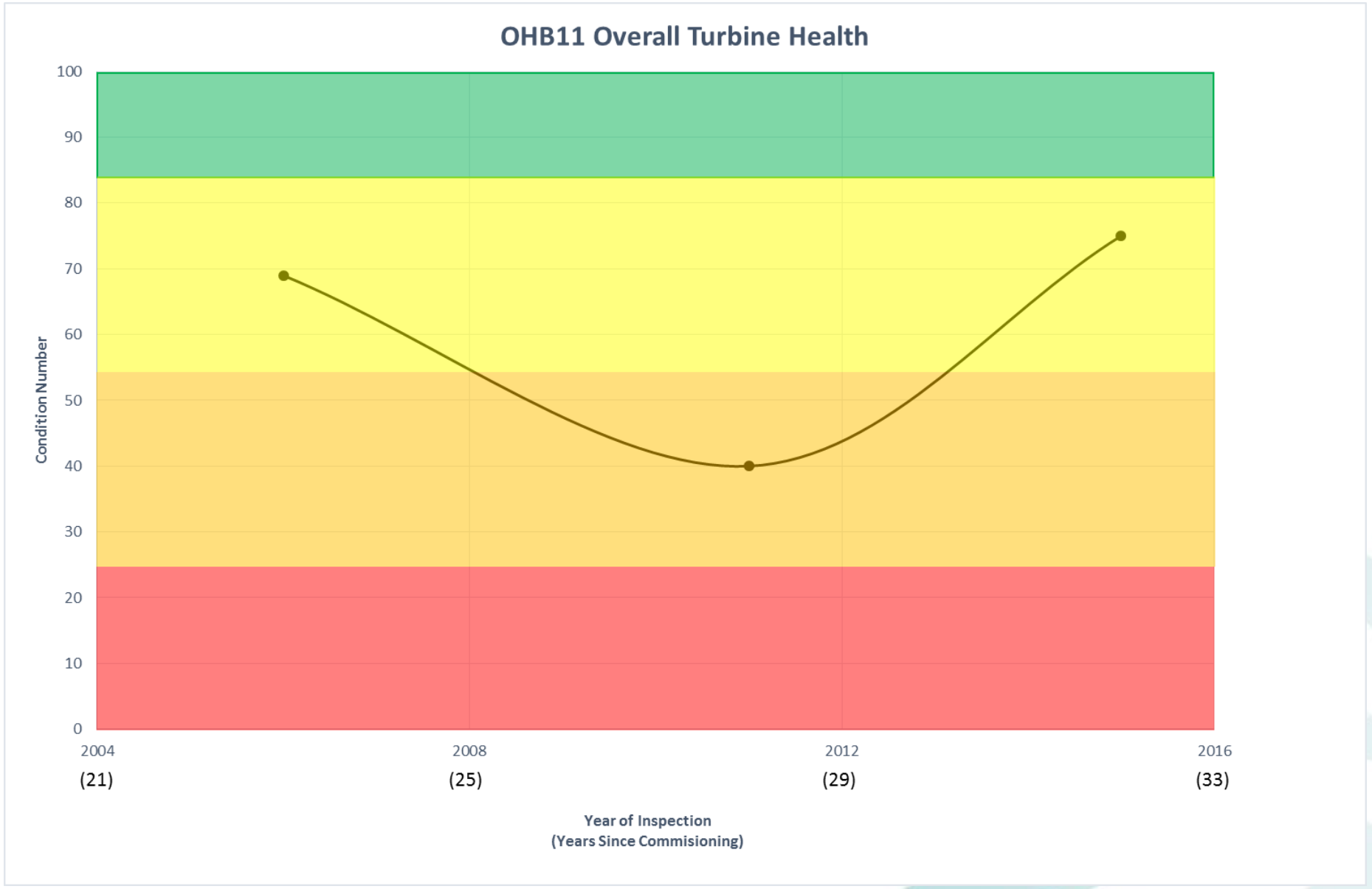
Template Development

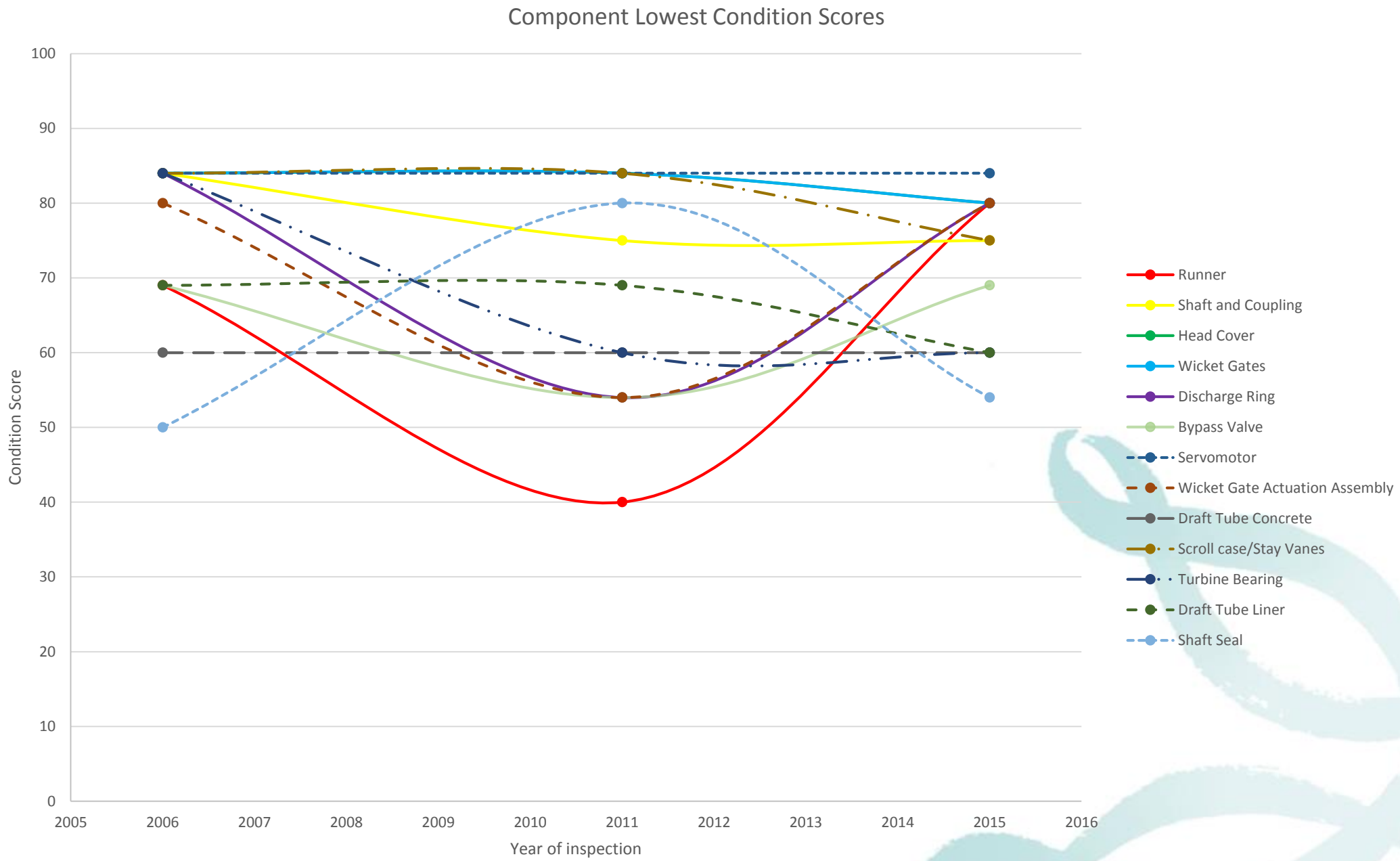
- Explicit examples
- Overall score of the system is calculated
  - Lowest condition score of each component
- Collaborative tool – input required from maintenance staff and engineers
- Mostly visual assessments
  - Some electrical tests
  - May be some NDT

Template Implementation

- Evaluate components
- Use current data and/or evaluate historical data
  - Trend condition over time




OHB11 Overall Turbine Health
100
90
80
70
60
50
40
30
20
10
0
Condition Number
2004
2008
2012
2016
(21)
(25)
(29)
(33)
Year of Inspection
(Years Since Commisioning)

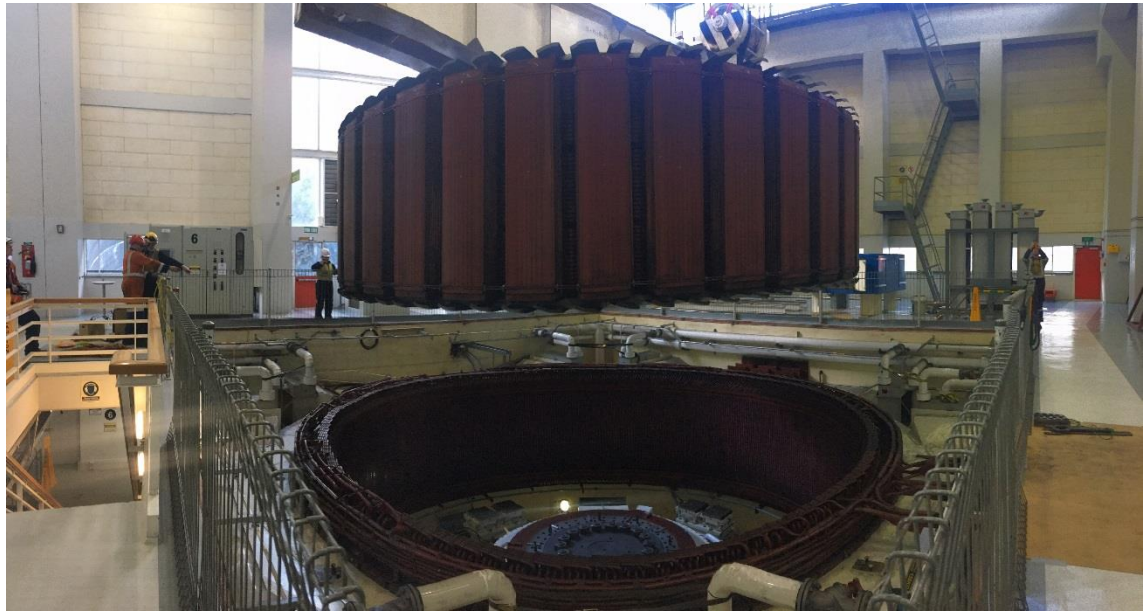

Component Lowest Condition Scores
Condition Score
100
90
80
70
60
50
40
30
20
10
0
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Year of inspection
Runner
Shaft and Coupling
Head Cover
Wicket Gates
Discharge Ring
Bypass Valve
Servomotor
Wicket Gate Actuation Assembly
Draft Tube Concrete
Scroll case/Stay Vanes
Turbine Bearing
Draft Tube Liner
Shaft Seal


L.B.


No 2.

Detailed Assessments

- In-depth assessments carried out as required
- Template collates all the required information in one place
- Work best with a disassembly



Future Works

- Develop generator template into a usable tool
- Use the templates and gather feedback
  - Ohau B Unit 11
- Develop and refine the templates
- Use templates to update job plans
- Templates feed into new PAM system

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Questions?