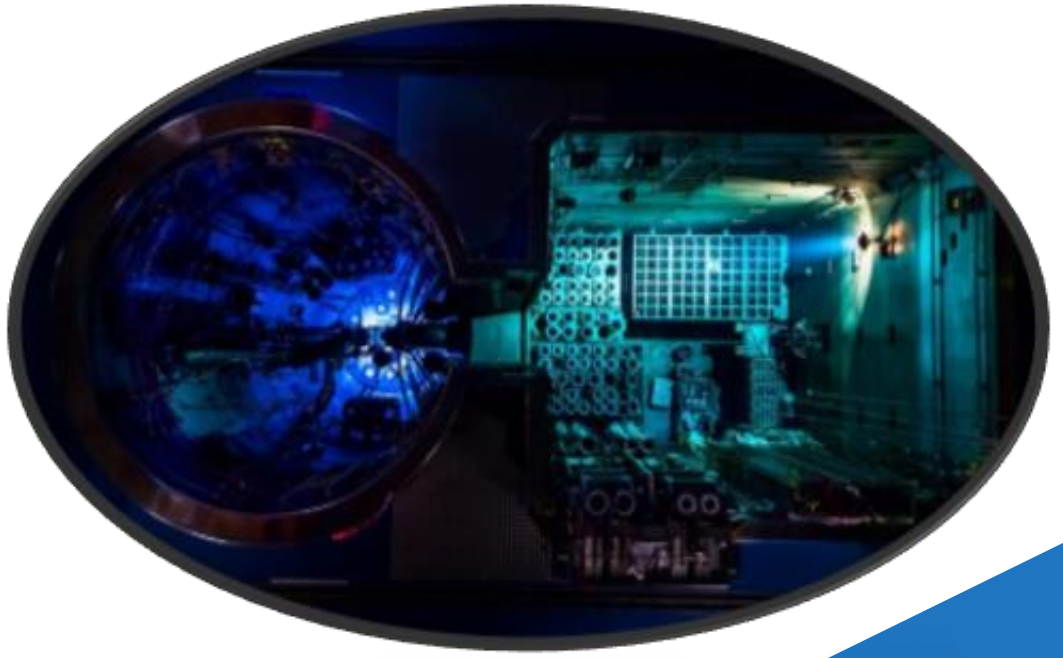
Australian Government | ANSTO

Secondary Cooling System Ageing Management and Refurbishment Activities at the OPAL Reactor



IAEA: Technical Meeting on Research Reactor Ageing Management, Refurbishment and Modernisation

Virtual: 31 May – 4 June 2021

Chris Humphrey
OPAL Engineering

Science. Ingenu

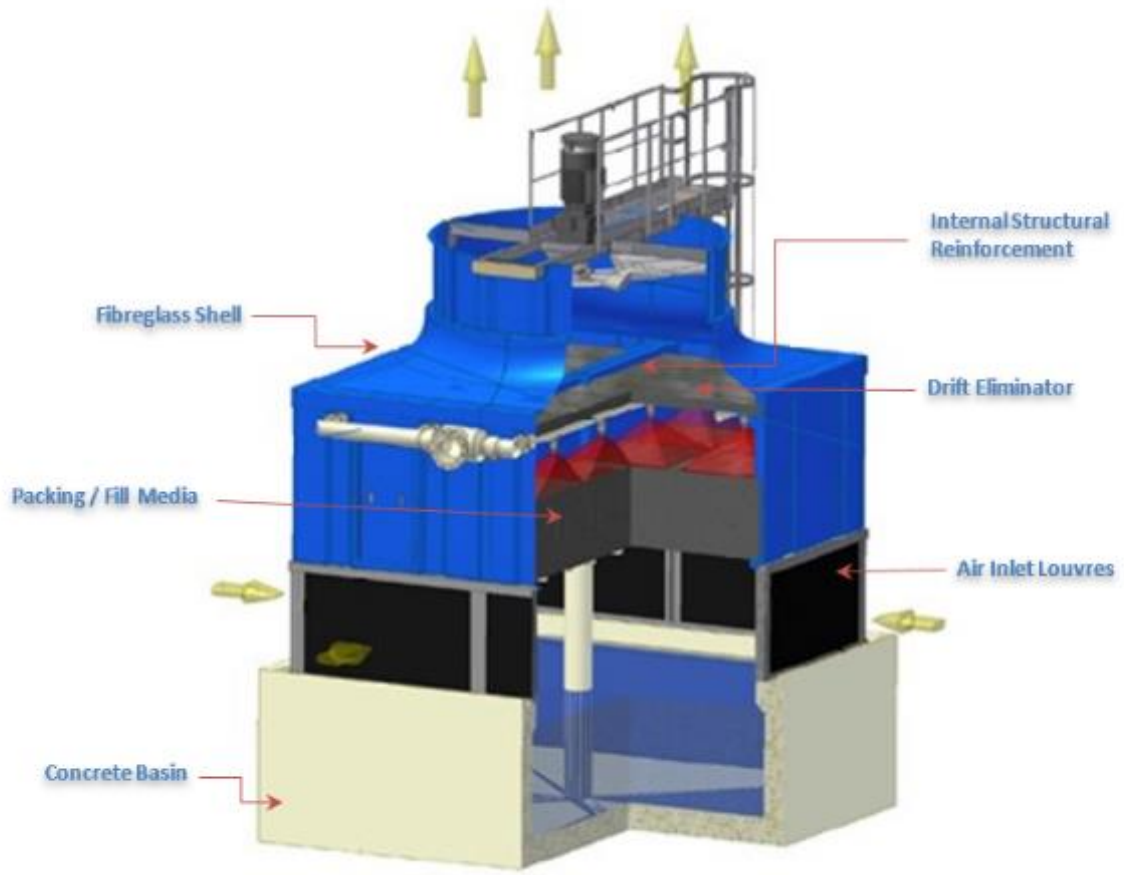
Introduction

- The OPAL Reactor in Sydney Australia was commissioned in 2006
- Heat load of 26 MW_t is removed via Secondary Cooling System (SCS) to the atmosphere
- Maintenance Strategy prepared for SCS based upon RCM-2 approach identified ageing mechanisms:
  - UV damage to fibreglass structure, vibration (fatigue)
  - Atmospheric weathering (temperature, humidity)
  - Corrosion of structures systems and components
  - Fouling due to chemically treated water, dust and debris
- Obsolescence of parts and supplier has also presented a challenge to managing the asset
- After 15 years of service life a number of refurbishment activities are now being undertaken to address the ageing management

SCS Five module Cooling Tower

Refurbishment Activities

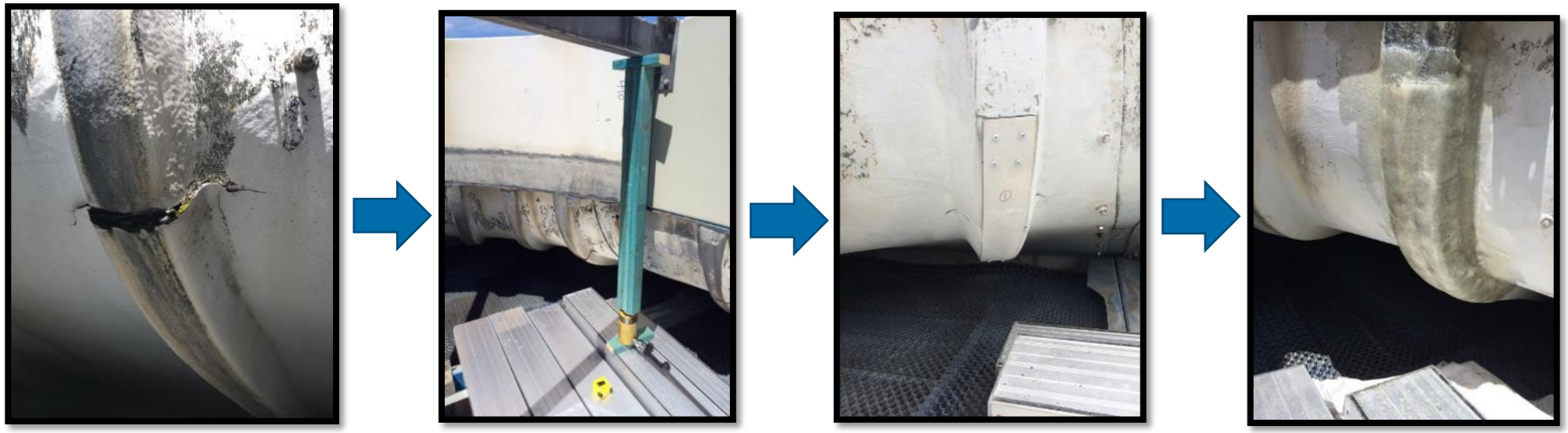
1. Cooling Tower Structural Reinforcement (completed May 2018)
2. Cooling Tower Drift Eliminator Replacement (completed May 2018)
3. Cooling Tower Packing Replacement (Aug 2019, Mar 2021, ongoing)
4. Cooling Tower Air Inlet Louvre Replacement (commenced Mar 2021)
5. Cooling Tower Fibreglass Coating Upgrade (commenced April 2021)
6. Cooling Tower Concrete Basin Relining (planned June 2021)



Cooling Tower Cross-section

1. Cooling Tower Structural Reinforcement

- In 2017, CT-A blades came into contact with fibreglass
- RCA found five tower support ribs were cracked and the tower was collapsing due to the 2 tonne mass of the fan assembly
- Modification Approved (Engineering Deviation Report):
  - Repairs were made to cracks and CT-A was returned to service
- Engineering commenced investigating a permanent solution



Cracked Rib | Jacking Alignment | Repair #1 | Repair #2

1. Cooling Tower Structural Reinforcement

- Original supplier: Superchill Australia (no-longer trading), new company Breezewater Pty Ltd identified to propose design solution.
- In May 2018 a stainless steel load transfer frame was installed inside each tower to provide long-term reinforcement
- Modifications approved (Change Control Submissions):
  - Reclassification of seismic class of fibreglass structure from Seismic Class 2 ⇒ Seismic Class 3
  - Design, fabricate and install frame to withhold the mass of the fan/motor/gearbox. Redirect load on the fibreglass fan casing to the main FRP support frame and concrete pillars

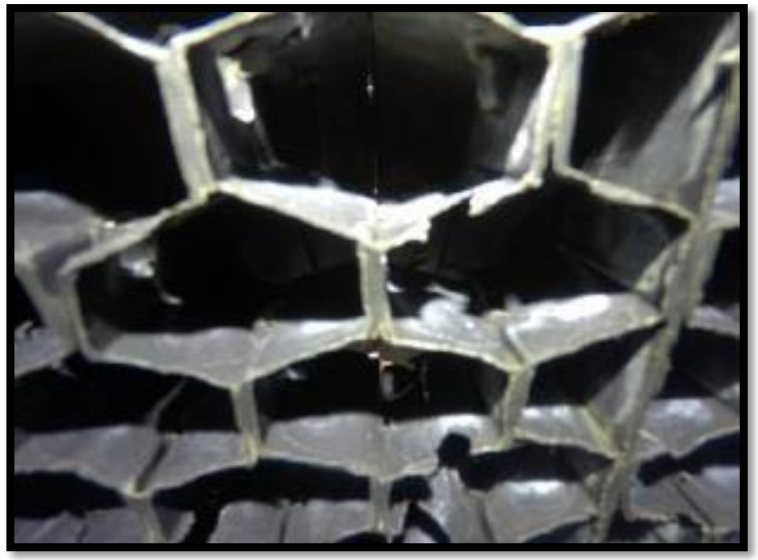
Breezewater
Innovative Process Cooling Solutions

SS Frame, Parts

SS Frame, Installed

2. Drift Eliminator Replacement

- Original drift eliminators were identified as in poor condition in 2017 and replacement prioritised due to:
  - UV damage, cracking and scale build-up, sagging due to loss of elasticity
- Australian standards required maximum drift loss of 0.002%, a safety barrier for prevention of exposure of people to legionella in water droplets
- In May 2018 new Brentwood CF80MAx drift eliminators were installed on all towers during installation of the 'load transfer frame'
- Modification approved (Component Replacement Evaluation):
  - Change to material (PVC from PP) with lower inherent flammability, stronger, improved drift loss 0.0005%



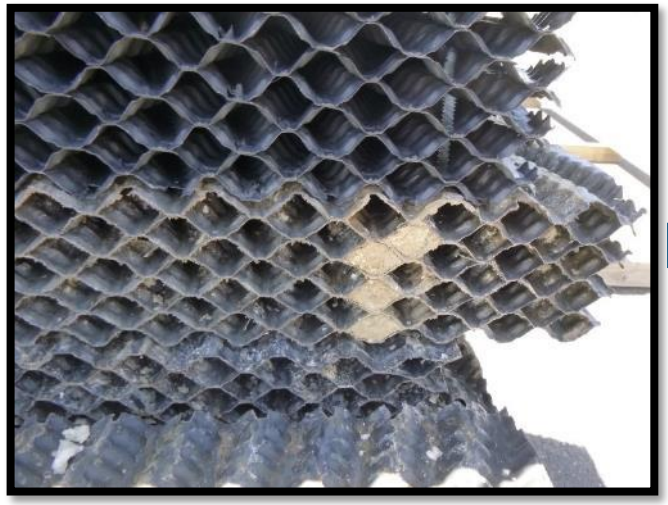
Cracking

Sagging

Replacement

3. Cooling Tower Packing Replacement

- Original internal fill or packing identified as in degrading condition in 2017 and should be replaced progressively over the next approximately 5 year period:
  - Cracking, fouling and scale build-up, sagging due to loss of elasticity, softening due to long term exposure to warm chemically treated water
- Spending is phased across financial years, so far two modules are completed with Brentwood CF1200MA:
  - Tower A: Aug 2019
  - Tower E: Mar 2021
  - Tower B, C & D: future
- Modification approved (Component Replacement Evaluation):
  - Change to material (PVC from PP) with lower inherent flammability, stronger, improved performance wettability



Fouling

One Tower Volume

Installation

4. Air Inlet Louvre Replacement

- Original air inlet louvre's were identified as in degrading condition in 2017 and should be replaced in the next 5 year period:
  - UV damage, cracking, fouling and scale build-up, sagging due to loss of elasticity
- In Mar 2021 the first 8 out of 76 removable air inlet louvres were rebuilt with Brentwood CL80, remaining panels will be replaced by the end of 2021
- Modification approved (Component Replacement Evaluation):
  - Change to thickness and material (PVC from PP) with lower inherent flammability, stronger, thinner with lower pressure drop

Old Air Inlet Louvre Panel

New Air Inlet Louvre Panel

5. Cooling Tower Fibreglass Coating Upgrade

- Original fibreglass gel-top coat has lost its lustre and begun to chalk due to prolonged atmospheric weather and UV exposure.
- An epoxy painting specification was developed with DULUX industrial coatings to extend life by 15 years.
- The contractor commenced work in April 2021 involving: surface preparation, joint sealing, undercoat, topcoat.
- Modifications approved:
  - Installation of new stainless steel access doors (Component Replacement Evaluation)
  - Application of DULUX specified coating system (Engineering Deviation Report)

Original: corroded access door

Scaffolding

Paint Application: Undercoat (Grey), Topcoat (Blue)

6. Cooling Tower Concrete Basin Relining

- Cooling tower basin is a concrete pool ~ 35m x 9m containing 700 kL of chemically treated water. The original waterproof lining inspected in 2010, 2012, 2014, 2016, 2019 has now completely failed.
- A long shutdown of 4 weeks is required to remediate (scheduled for June 2021).
- Modifications approved (change control submission):
  - Installation of a new concrete liner
  - Deployment of mobile cooling tower to enable completion with full basin empty

Basin Full

Patchwork Basin coating

Failed Coating Remnants

6. Cooling Tower Concrete Basin Relining

- In Sept 2019 submerged pipe supports (Qty 6) were replaced with corrosion resistant and maintainable design.
- Dulux Protective Coatings:
  - Provided ANSTO with a high-performance specification (Flexituff – Polyurea) to provide long term protection to an immersed substrate
  - Specification recommended: based upon that used for Australia's 'Water & Wastewater Industry – Asset Protection'

Submerged Pipe-support

Aggreko 2.5 MW Mobile CT

Polyurea Coating System


Including
Pipelines, Coatings & Linings

Q & A

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