Coryton Power Station ACC

Operation, Performance & Engineering

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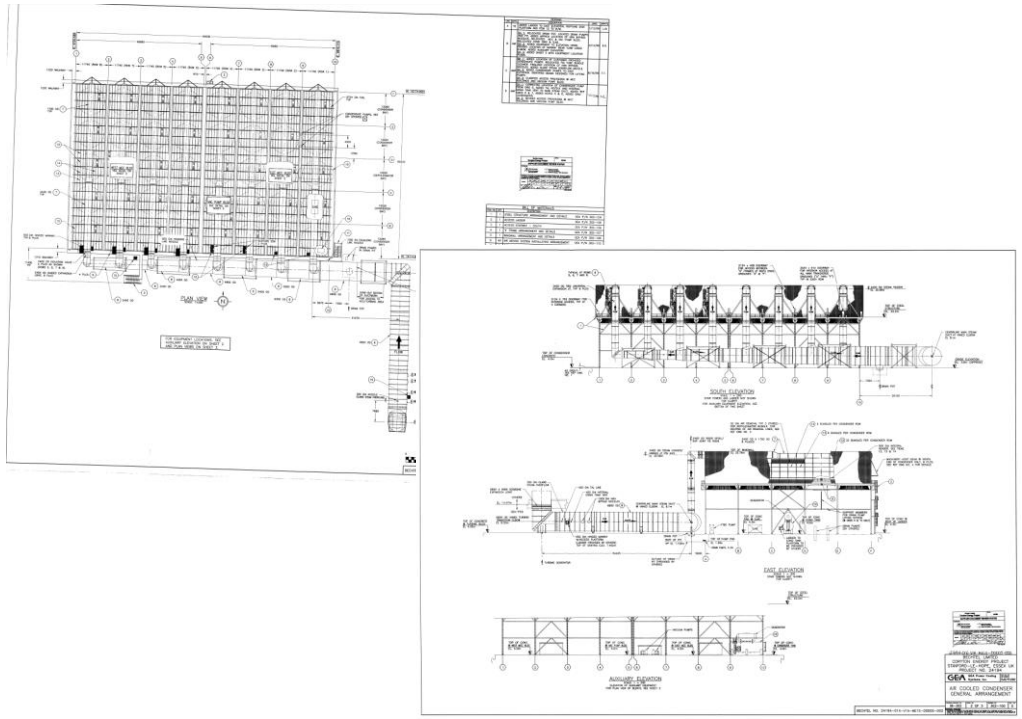
GEA Power Cooling Systems Air Cooled Condenser

Equipment Construction 1999

Commissioning and Commercial Operation 2002



Air Cooled Condenser Specification

Thermal Design Exhaust Steam Flow:

Turbine Design Exhaust Steam Flow	742,680	Kg/hr
Turbine Exhaust Pressure	0.0845	Bar(a)
Exhaust Enthalpy	2407	Kj/kg
Ambient Air Temperature	10	°C

Equipment Data:

Bays:	40 Arranged in 8 Rows of 5 Fan Bays
Tube Bundles:	A Frame Construction: 32 off bays parallel flow K type (256 bundles), 8 off counter flow D type (64 bundles)
Fans:	32 off rows Single Speed 8 off Dual Speed on counter flow D bays
Air Extraction:	2 off Liquid Ring Vacuum Pumps 1 off Hogging Ejector 2 off 2 Stage Holding Ejectors with Interstage and after condensing unit

Operation of Coryton's ACC

Operation of Coryton's ACC

- **Basic specification**
  - 4 x always open rows, with 4 x selectable rows
  - Fully manual control
  - 2 x liquid ring vacuum pumps for initial draw-down
  - 2 x two-stage SJAE sets (duty & standby) for normal running conditions
  - 2 x SJAE sets for Deaerator NCG extraction
  - 1 x hogging ejector for turbine start-up and ACC sweeping
  - Vacuum maintained 24/365 in the operational range of 70 mbar to 230 mbar

Operation of Coryton's ACC

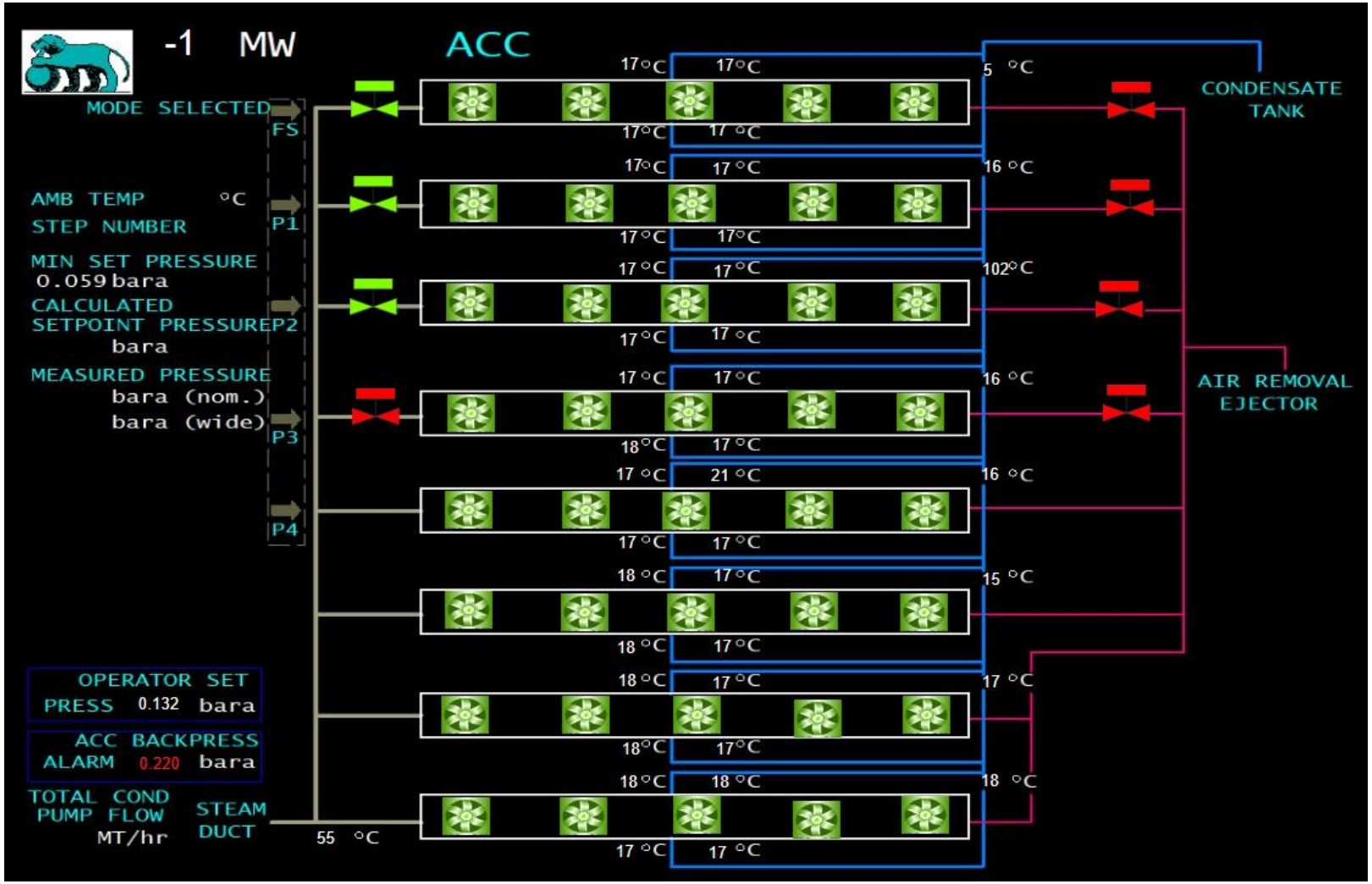
- **Commercial Operation**
  - Fully merchant plant
  - Operates on Selling-out to market and Balancing Mechanism to support National Grid
  - Originally designed as a base-load plant, now exclusively 2-shifting operation with peak or extended peak commercial revenue

Operation of Coryton's ACC

- **System start**
  - Steam systems lined-out correctly
  - Auxiliary steam from 2 x package boilers established
  - ST glands packed
  - DA SJAE in service
  - Vacuum breaker closed & water seal established
  - 2 x liquid ring vacuum pumps started – approximately 3 to 4 hours to draw vacuum to 130 mbar
  - Backpressure maintained cyclically with vacuum pumps
  - NCG lines are kept open to ensure full evacuation of the ACC to prevent cold spots or air pockets, allowing more effective sweeping during plant start-up.

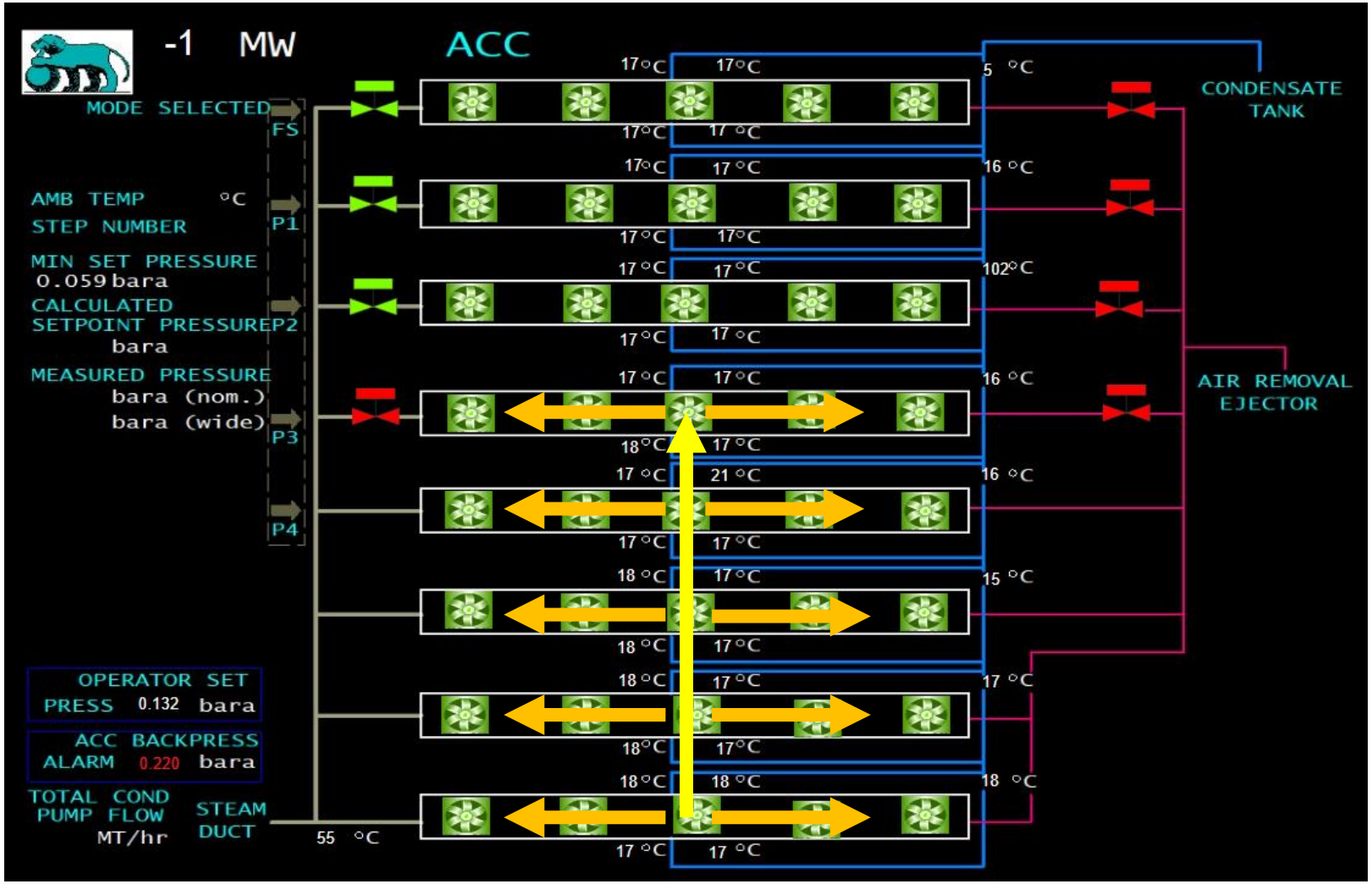
Operation of Coryton's ACC

- **Plant start**
  - Vacuum pumps running prior to plant start
  - Gas Turbines started & steam from HRSGs passed to steam duct via cascade bypass system – HRH bypasses exhaust into steam duct
  - Steam is allowed to warm the first 5 ACC rows



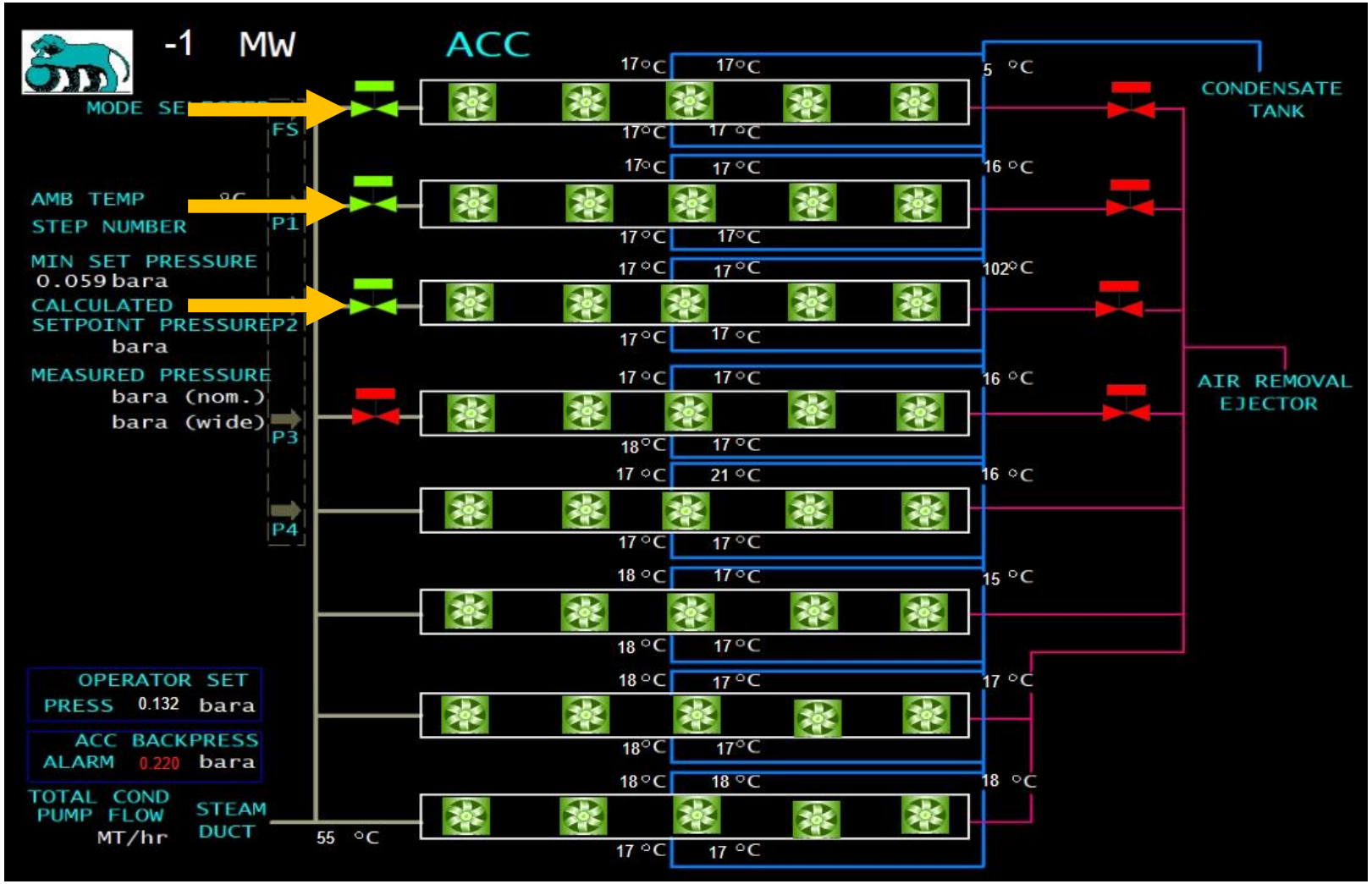
Operation of Coryton's ACC

- **Plant start**
  - Hogging ejector takes over from vacuum pumps when CRH pressure reaches 12 bar
  - Cells allowed to heat to around 55'C before starting fans – promotes good sweeping
  - Dephleg fans started in low speed initially
  - Fans either side are then started in turn at no less than 40 second intervals



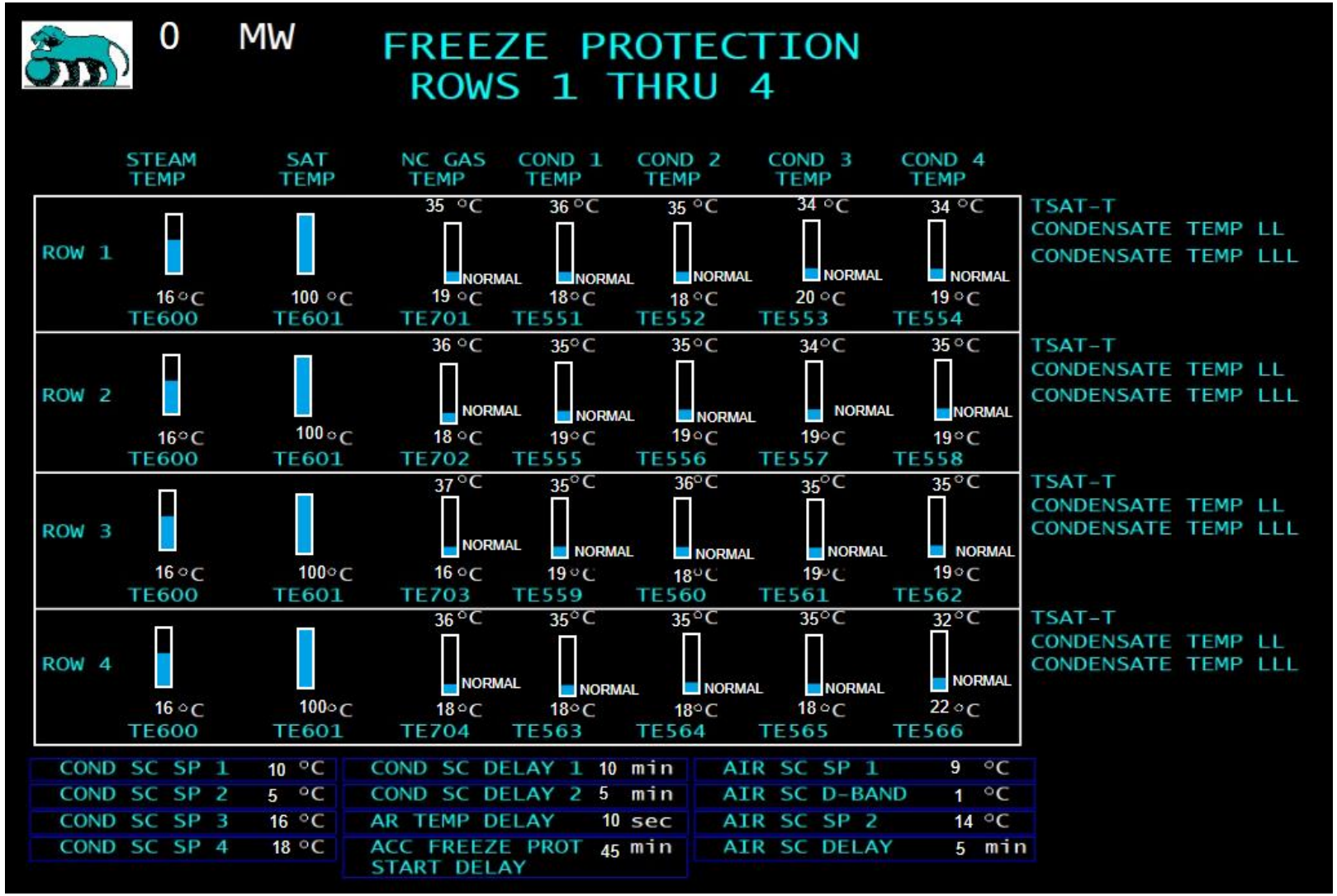
Operation of Coryton's ACC

- **Plant start**
  - Additional rows are opened one at a time, as needed, to ensure backpressure is maintained below ST start criteria of 200 mbar
  - Sweeping of the ACC then takes place, if needed, by cycling fans in the cold spots or adjacent cells
  - Once sweeping is complete, the SJAE ejectors take over from the Hogging ejector



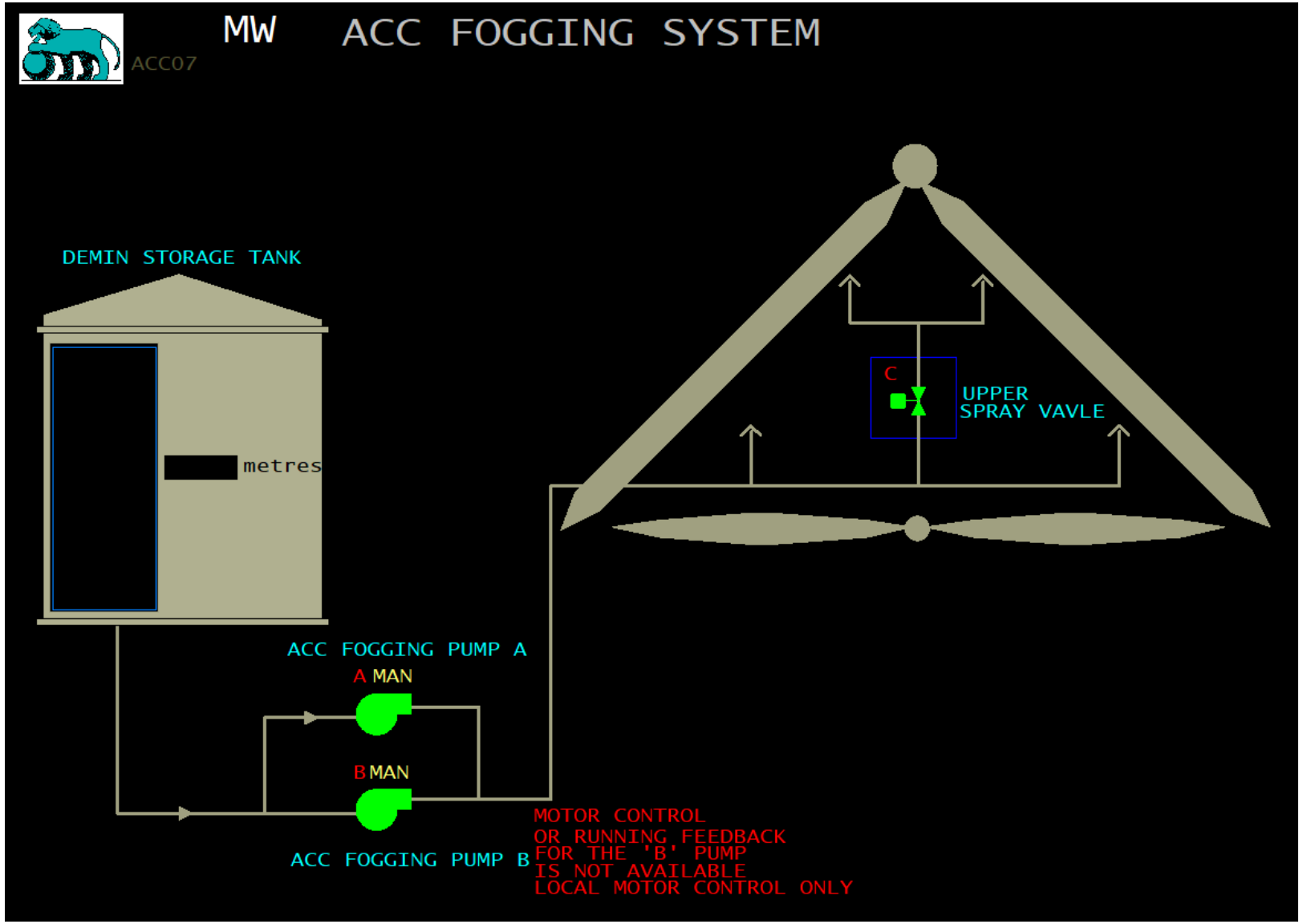
Operation of Coryton's ACC

- **Freeze protection**
  - Condensate and NCG temperatures are monitored and compared to the steam temperature and saturation temperature
  - Fans are automatically taken out of, and put back into, service when the cell and/or NCG temperatures approach saturation temperature
  - Not used



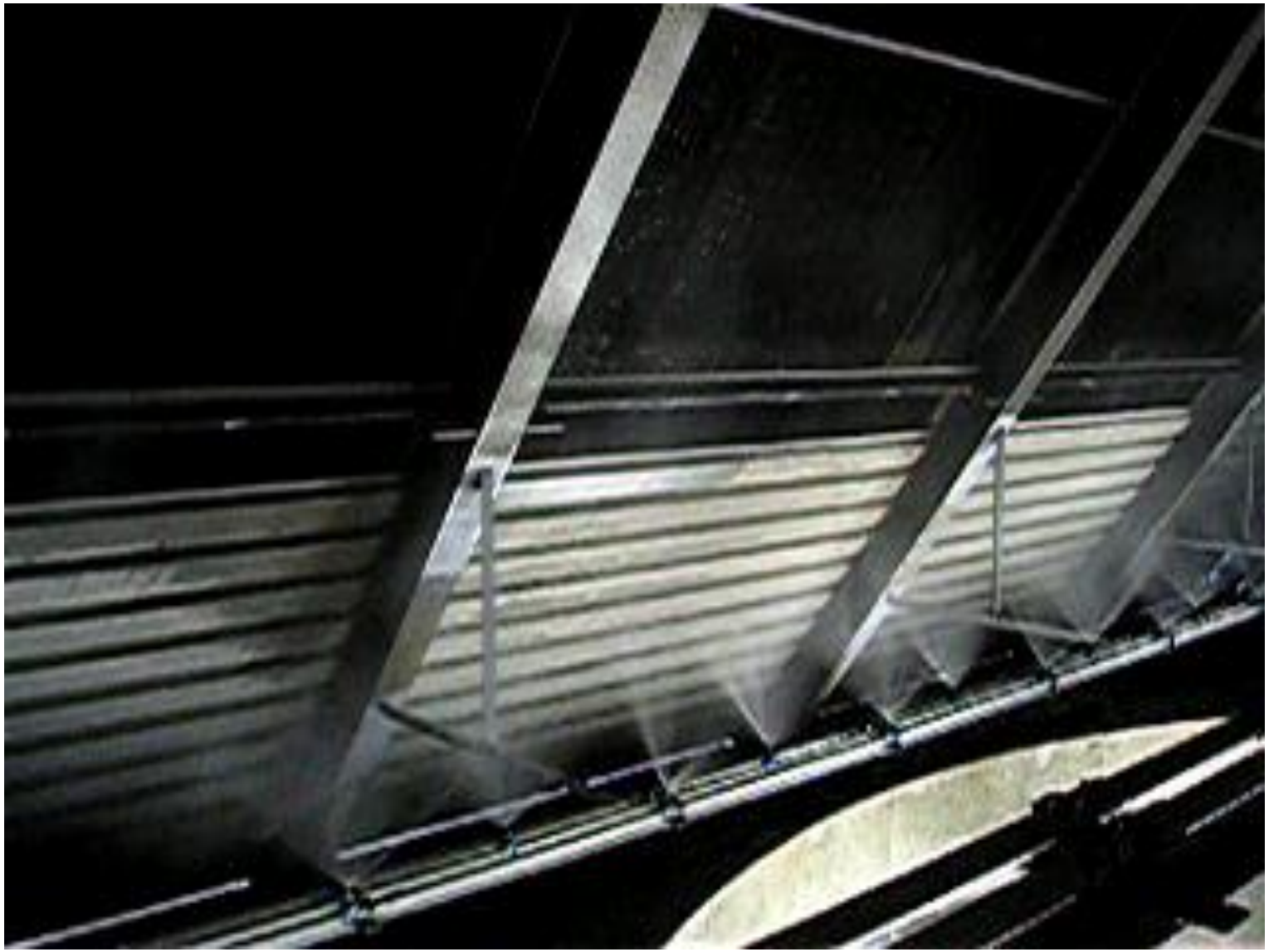
Operation of Coryton's ACC

- **Fogging**
  - Demineralised water used to spray a "fog" to the underside of each radiator, giving a more efficient cooling medium in periods of extreme hot weather – typically greater than 33'C
  - The sprays are in 2 sections, lower and upper. Lower are always in service, upper are selected in hotter temperatures
  - Not currently used



Operation of Coryton's ACC

- **Fogging**
  - Improves backpressure – approximately 50 to 100 mbar, depending on conditions. Net gain of between 10 and 30 MW
  - Huge use of Demin water

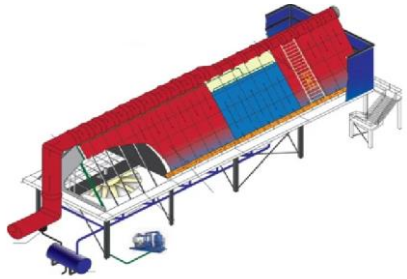


Coryton ACC performance

Contents

ACC performance

ACCs are critical in industrial cooling applications. Their performance significantly drops in hot weather, impacting efficiency due to:



Reduced heat transfer capacity

- system must work harder to achieve the same cooling effect
- higher operational costs and more strain on the power generation system.

Increased backpressure
reduced vacuum efficiency

- more steam remains in the turbine exhaust.
- reduced differential pressure across the turbine could lead to a 1-2% drop in turbine efficiency.

Potential for overheating
Increased maintenance needs

- the capacity to maintain optimal operating temperatures is significantly impaired.
- Overheating increases the thermal stress on ACC components, leading to material fatigue and potential failures.

Data monitoring and evaluation

Comprehensive data collection and analysis enable us to make informed decisions on optimising performance and implement targeted improvements that enhance efficiency and reliability.

PI Data
collection process

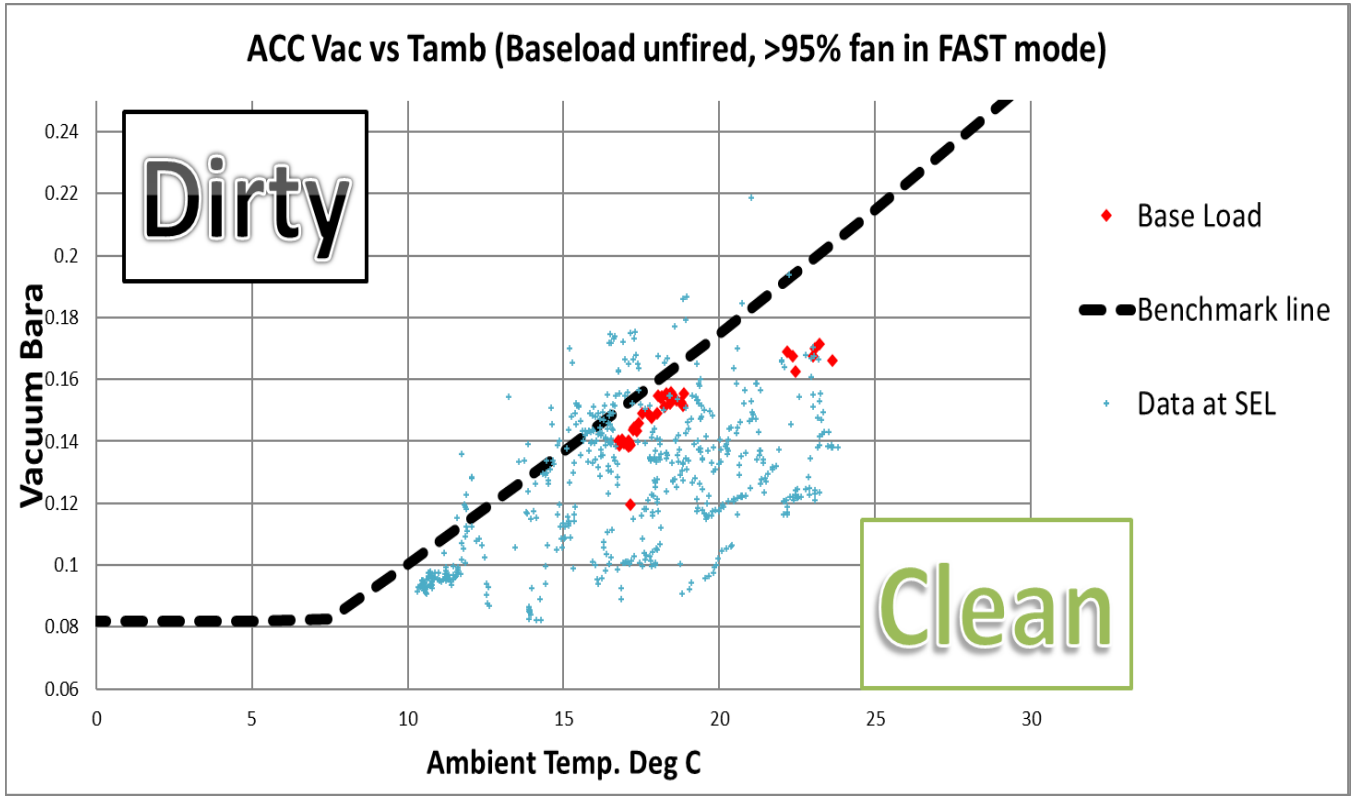
Plant load, Amb. Tep, Vacuum press, Running fans.

Application of filters
cleaning process

Collection on data either at Base load or SEL.

Evaluation
Analysis

Understand how the ACC is performing and if any action is required.

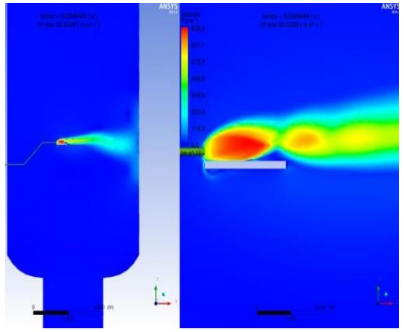


ACC performance:

When ACC performance declines, thorough analysis of potential causes is crucial. Based on this analysis, the following solutions can be implemented

ACC wash

- To remove accumulated dirt, debris, and scale buildup from the condenser fins and tubes.
- Regular cleaning prevents corrosion and deterioration, extending the lifespan of ACC components



Air ingress survey

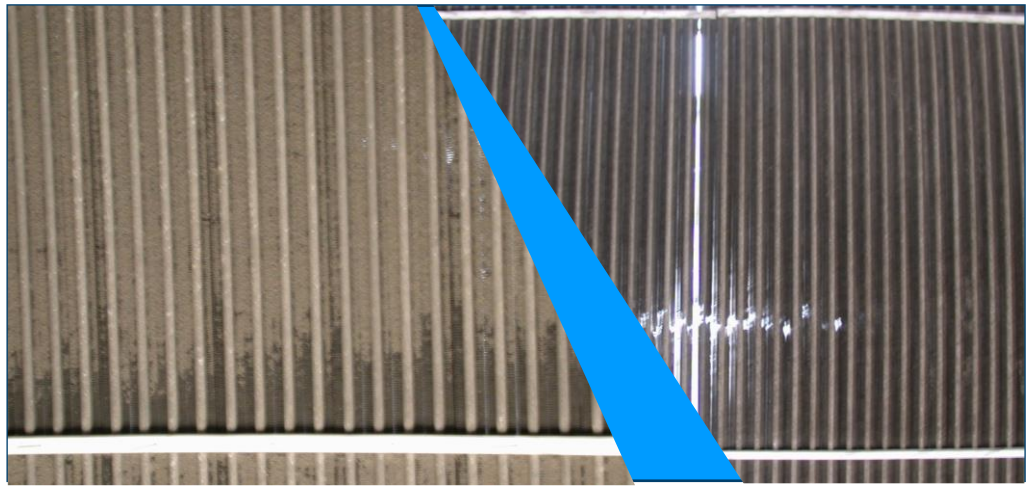
- To detect and quantify air leaks within the ACC system.
- The presence of air reduces the temperature differential needed for effective heat.

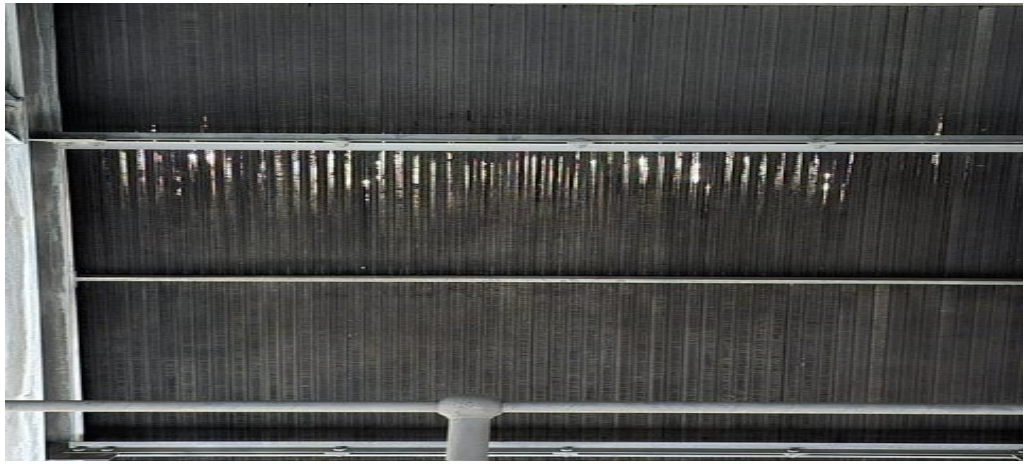
Fogging system

- To spray fine mist or fog into the air entering the ACC.
- The process enhances the heat transfer efficiency of the condenser.

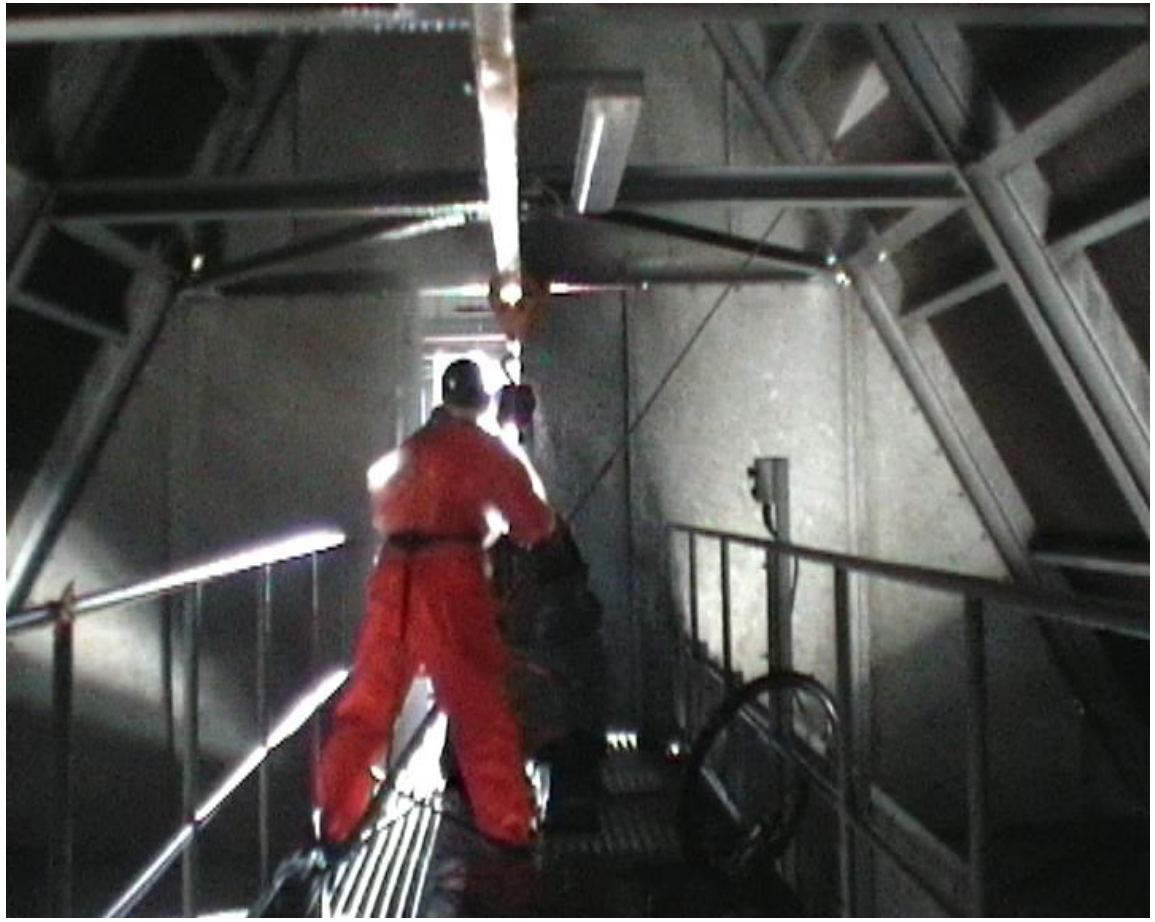
ACC Wash

- Clean surfaces allow for more effective cooling
- Use of appropriate cleaning agents and techniques to effectively remove contaminants
- The frequency of washing depends on the operating environment and the level of contamination





ACC Wash



Air ingress survey

Essential for maintaining the efficiency and reliability of ACC systems. Can enhance condensation efficiency, reduce back pressure, and improve overall performance.

Quantifying air flow inside vacuum pipework

Air flow in pipework can be measured by using helium dilution technique.

Leaks can be found almost anywhere.

Air leaks on steam ejectors
assessment steam ejector performance

Understanding of how exactly the ejectors are removing air from the system and whether this is in line with their design capacity.

Improving efficiency
Reducing back pressure

Detecting and sealing these leaks can significantly reduce the overall back pressure.

Allows the plant to continue without increased operational costs and inefficiencies.

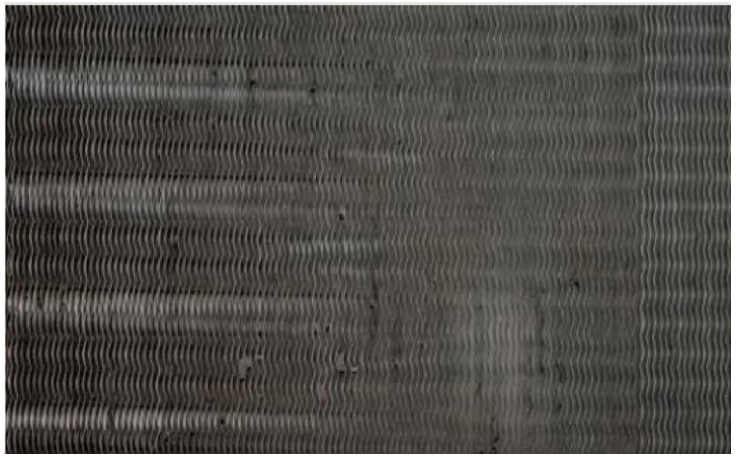
Fogging system

The intention was to fit a system which allowed the operators to maintain predicted output at temperatures above 25c.

- A physical drop in steam turbine back pressure.
- A temperature drop on the condensate return on row 1.
- A minimal 1 MW increase on the steam turbine.

Fogging system

If the ACC is to be used annually on a regular basis at lower than designed temperatures, then consideration needs to be given to the following



Corrosion
Obstruction of the fins

Knock on effect that will reduce the condenser performance.

Water treatment plant upgrade
Iron exchange plant

Consideration to either restore the E-Cells or invest in an iron exchange plant.

Water collection
Cleaning process required

A combination of water collection drains / gulleys / sumps etc would also be required.

Fogging system

If the ACC is to be used annually on a regular basis at lower than designed temperatures, then consideration needs to be given to the following

Electrical equipment improvement
Water protection

Determine if electrical equipment needs to be up rated to IP53 or better.

Environmental Agency
Increased use of water

Excessive use of water may require revision of environmental permit .

Energy market
Baseload demand has decreased

Due to renewable sources, Baseload run are less frequent in hot weather.

Wind walls

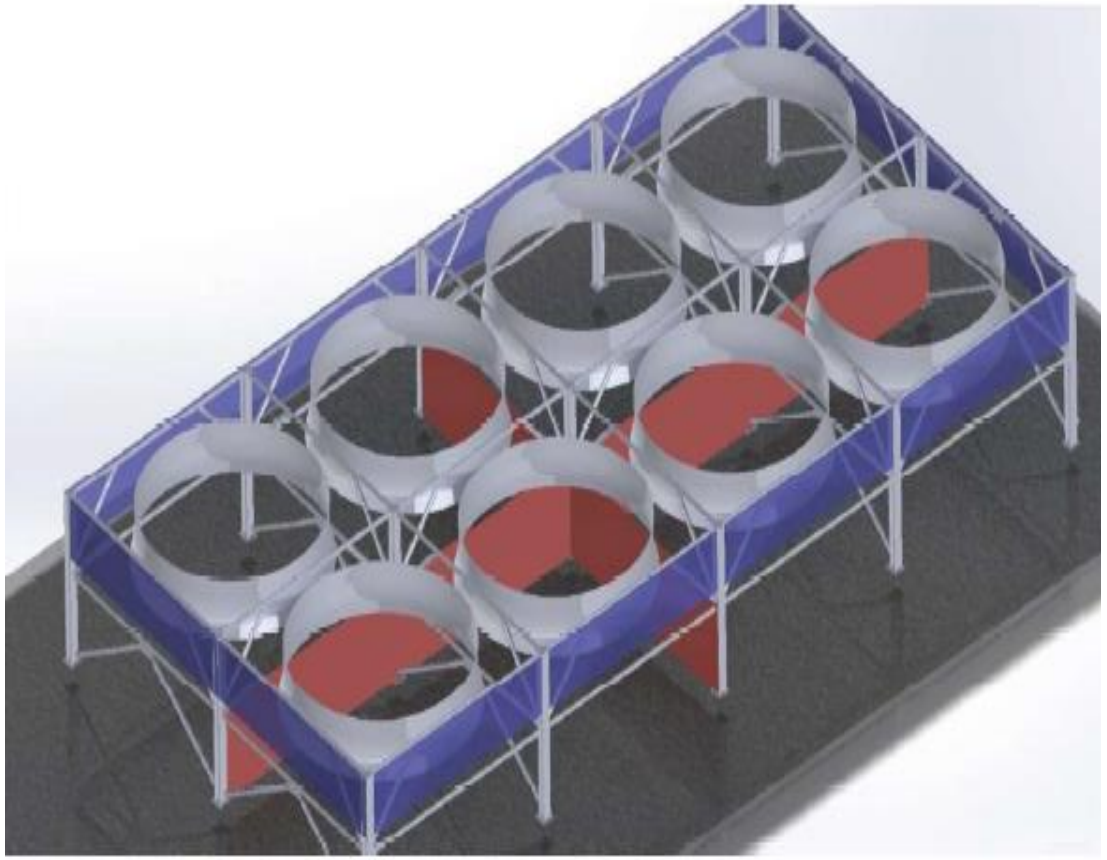
Perimeter walls are installed around the underside of the fixed wind wall, which are approximately 33% of the ACC height from the fan deck downwards, to reduce high level wind shear.

These screens are typically manufactured from a 50% open mesh, which will still allow air to flow to pass through, but will reduce the wind speed under the perimeter of the ACC.

Cruciform

- Wind screen running down the middle of the unit
- One side to the other
- Located in the central bays

The slight porosity will allow air to pass from one side to another with its main function being to turn the low level air flow up into the fans.



InterGen Coryton Power Station Air Cooled Condenser Equipment Introduction and End User Experience

Date

Common Maintenance

The Air Cooled Condenser has provided reliable service with relatively low maintenance. Common Equipment Maintenance Items below

Motor Changes:

- Initial failures due to over greasing bearings.
- 3 to 4 motor changes per annum due to age and cyclic use

Gear Box:

- Annual Oil and Breather Changes
- Only three gearbox changes from original

Non Condensable Gas Extraction Equipment Servicing:

- Vacuum Pump Repair and Servicing
- Ejector Skid Repairs and Servicing:
- Steam Leaks
- Air Ingress

Equipment Improvements to Date

Primarily Improvements have been focused around air ingress and reliable cyclic plant operation

Ejector Skid Poor Performance:

- Complete unit overhaul in 2017 and full Steam Jet Air Ejector and Valve replacement.
- Gasketed joint upgrades to improve tolerance to cyclic operation

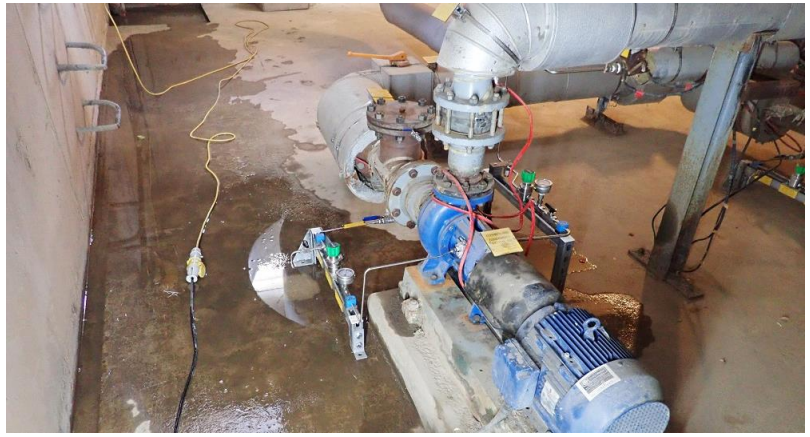
Hot Well Pumps Air Ingress:

- Mechanical Seal Upgrade from original to double seal with flush water to prevent air ingress
- Seal Water to Mechanical Seal Upgrade for reliable sealing

Dog Bone Seal LP Steam Turbine to Exhaust Duct:

- Material Change from EPDM to Neoprene for oil resistance due to LP Turbine Bearing Leaks
- Temperature monitoring for overheating during unit startup.
- 230°F / 110°C Continuous
- 280°F / 138°C Intermittent

Equipment Improvements to Date



Equipment Improvements Future Considerations

Condenser Performance and Reliability Optimisation

Equipment Automation:

- Fan System Automation for realisable start current management and prevention of Fan Trip on Strat up
- Condenser performance optimisation based condenser temperatures

Ejector Skid Redundancy:

- Full plant required out of service to allow for repairs due to venting to atmosphere.
- Dual system would allow maintenance repairs without plant out of service.

Vacuum Pump Cooling:

- Inlet cooling for Vacuum Pumps
- Improved draw down for unit starts
- Avoidance of vacuum pump trip from increasing temperature leading to delayed start up


QUESTIONS?

InterGen

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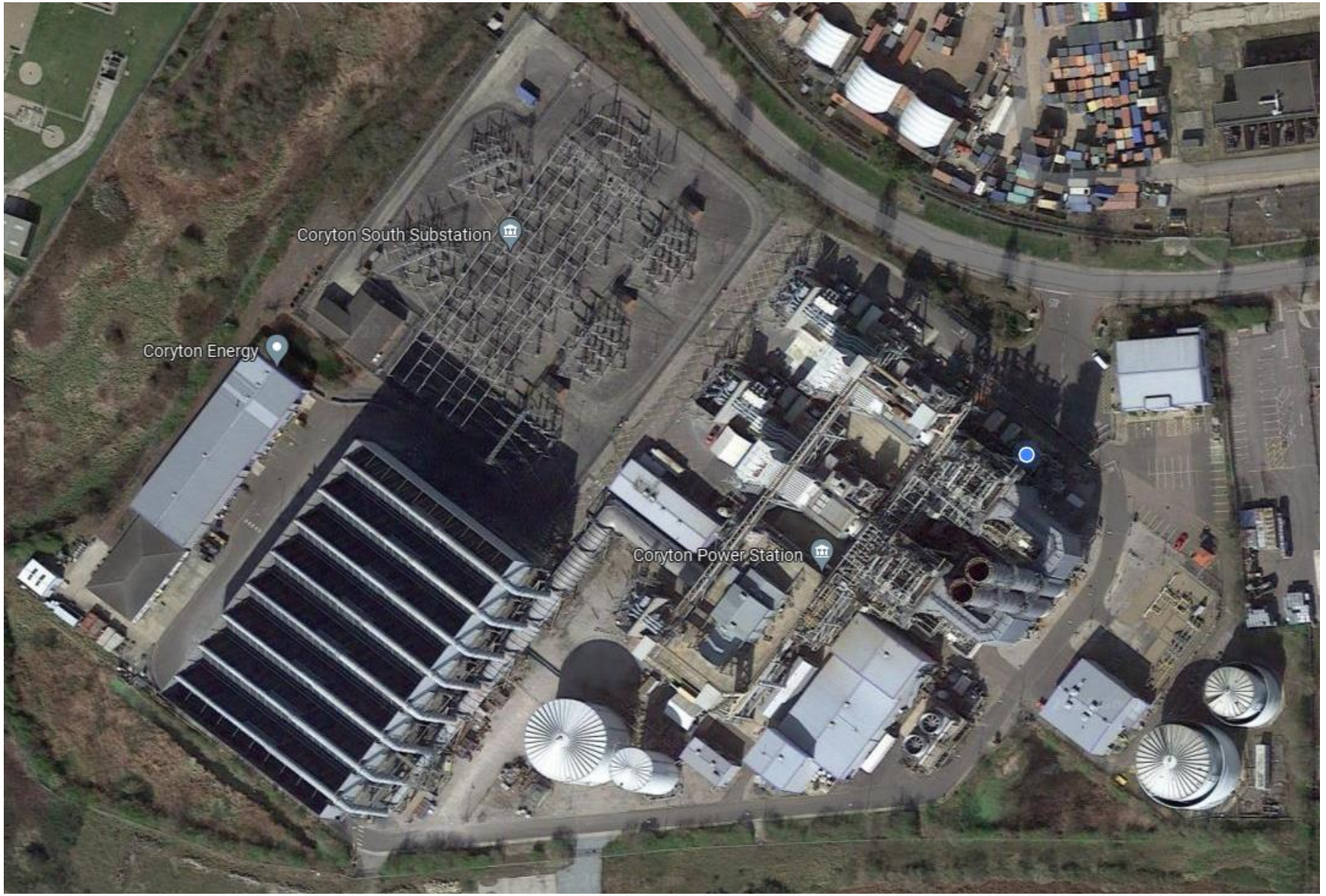
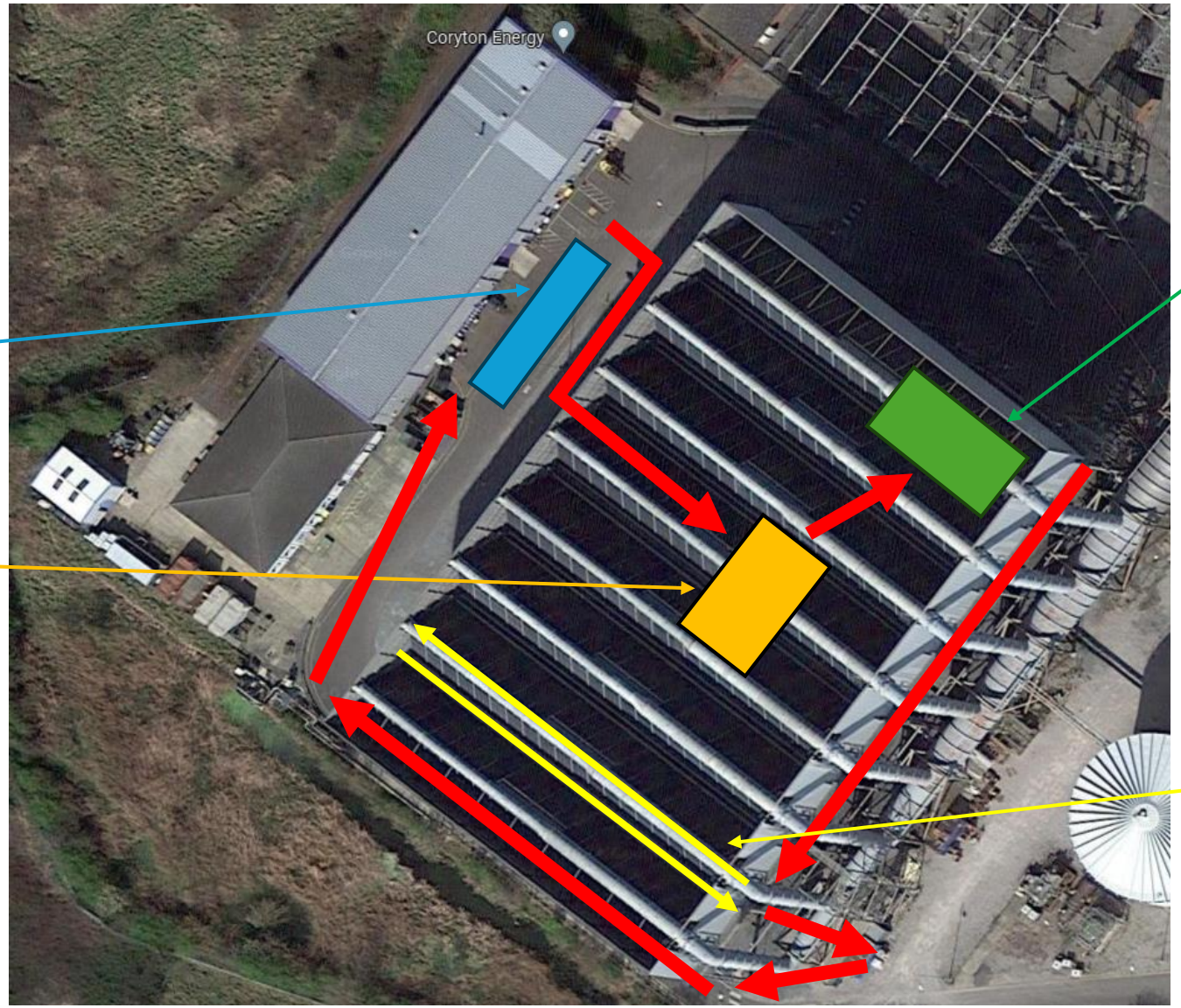
Coryton ACC tour
25th July 2024

Site Layout


Coryton South Substation
Coryton Energy
Coryton Power Station

InterGen

Tour route



General Arrangements

- On arrival
  - Stay on the coach unless directed otherwise
  - Security will board the coach and check names
  - Coach will drive on to site and park adjacent to the ACC

General Arrangements

- Demounting the bus
  - Tables will be present with disposable coveralls, hard hats and safety glasses for your use
  - There may be a small selection of safety boots
  - Water will be provided for your comfort
  - Please dispose of all water bottles & coveralls in the bags provided

General Arrangements

- The Tour
  - You will be broken into small groups (no more than 10) and will be assigned a tour guide
  - Stick with your guide at all times and cooperate with any instructions in case of emergency
  - Some of the tour will be on a gravelled surface, pay special care when walking around
  - There will be stairs and two small ladders to ascend and descend – please let your guide know of any restricted mobility issues so that we can adjust your tour as necessary
  - You may take photos, please ensure any mobile phones are in airplane mode – your guide will ask you to check

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