Towards a broad-spectrum approach to testing modern Air-Cooled Condensers

Air-Cooled Condenser User Group 2025

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Content

01 Early ACC Tech vs New

A perspective on how ACC designs have changed:

- Older ACCs were big, bulky, over-designed and rigid
- Newer designs are smaller, seem to have smaller margins, be structurally more flexible and cost effective

Why would this be the case?

- Market competitiveness
- Higher material, labour and construction costs
- Suppliers being more cost effective to be more competitive

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02 Air Inleakage Testing

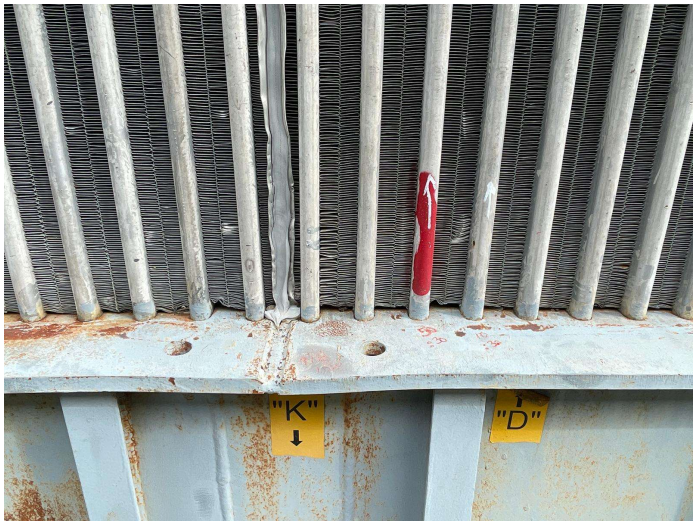
Most common inleakage areas:

Older ACCs:

- Top and Bottom tube welds on Primary heat exchanger
- Top & Bottom Tube welds between Primary heat exchanger and dephlegmator

Newer ACCs:

- Rupture discs
- Expansion joints
- Glands, shaft seals (Turbine, Vac pumps etc.)
- Flange connections



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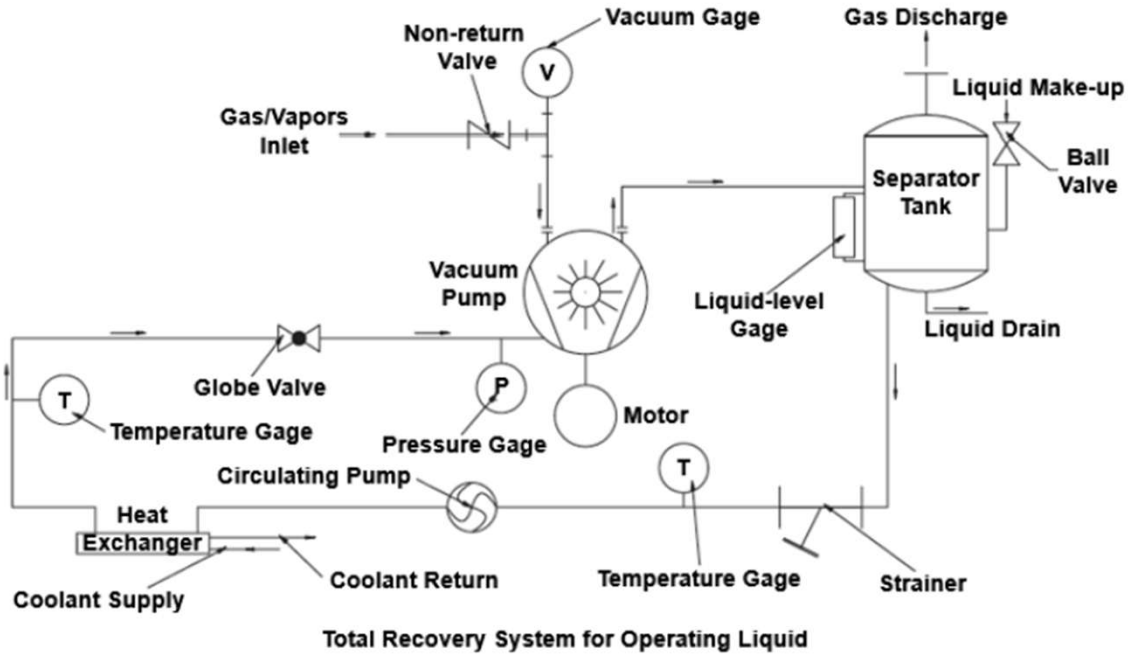
03 Liquid Ring Vacuum Pump (LRVP) Challenges

The following are typical LRVP challenges

- Inadequate vacuum levels
- High seal water temperatures
- Air or non–condensable ingress
- Cavitation
- Mechanical Damage
- Improper pump operation



Total Recovery System for Operating Liquid

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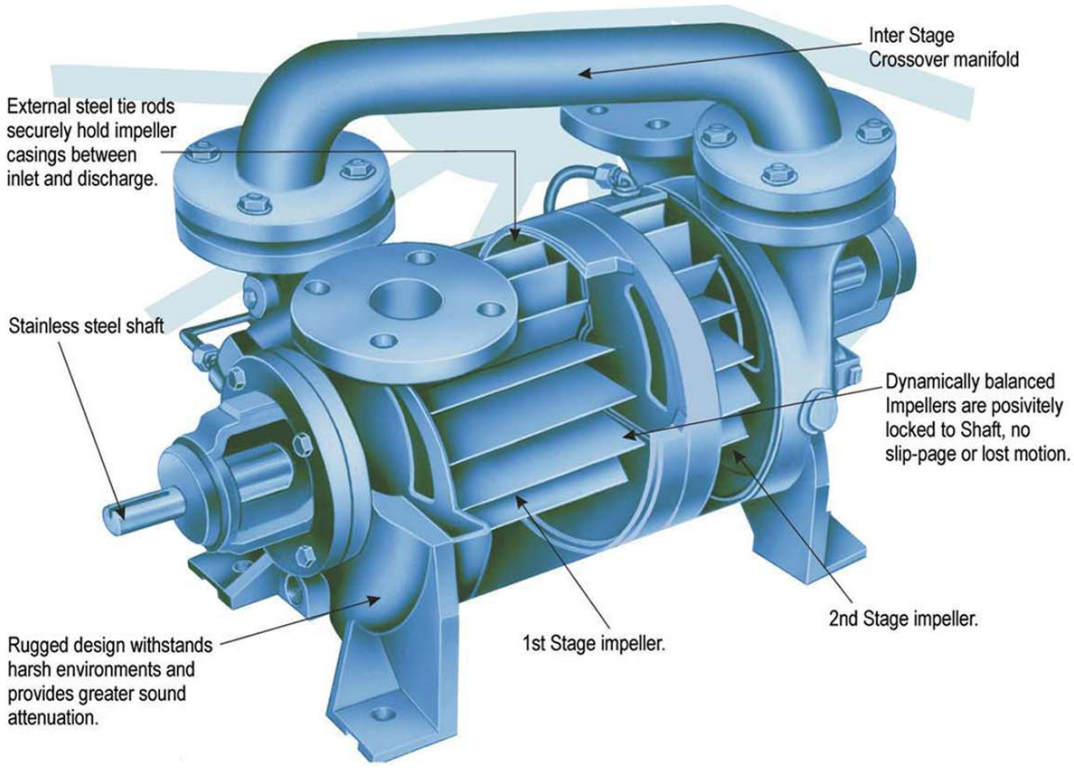
03 Liquid Ring Vacuum pump (LRVP) Challenges:

- Mechanical Challenges
- QA/QC Challenges
- LRVP Protection Effectiveness
  - Spray water protection
  - Anti-cavitation Protection



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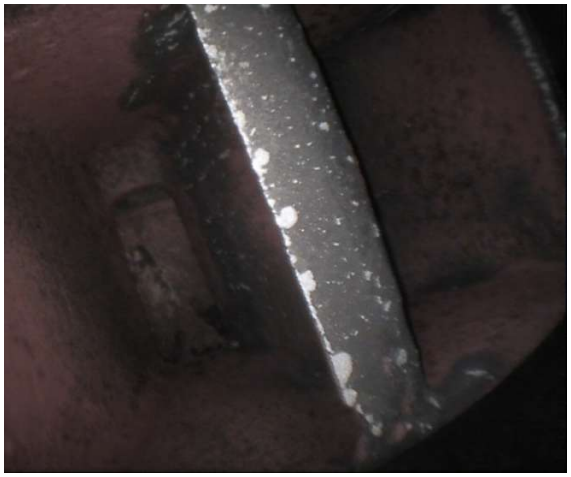
03 Liquid Ring Vacuum pump (LRVP) Challenges: Case Study 1

Mechanical Challenges



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03 Liquid Ring Vacuum pump (LRVP) Challenges: Case Study 1

QA/QC Challenges

Observations:

- Inadequate Quality Management System (QMS)
- Inadequate failure investigation reports
- Inadequate pump strip down records
- Unnecessary replacement of pump components

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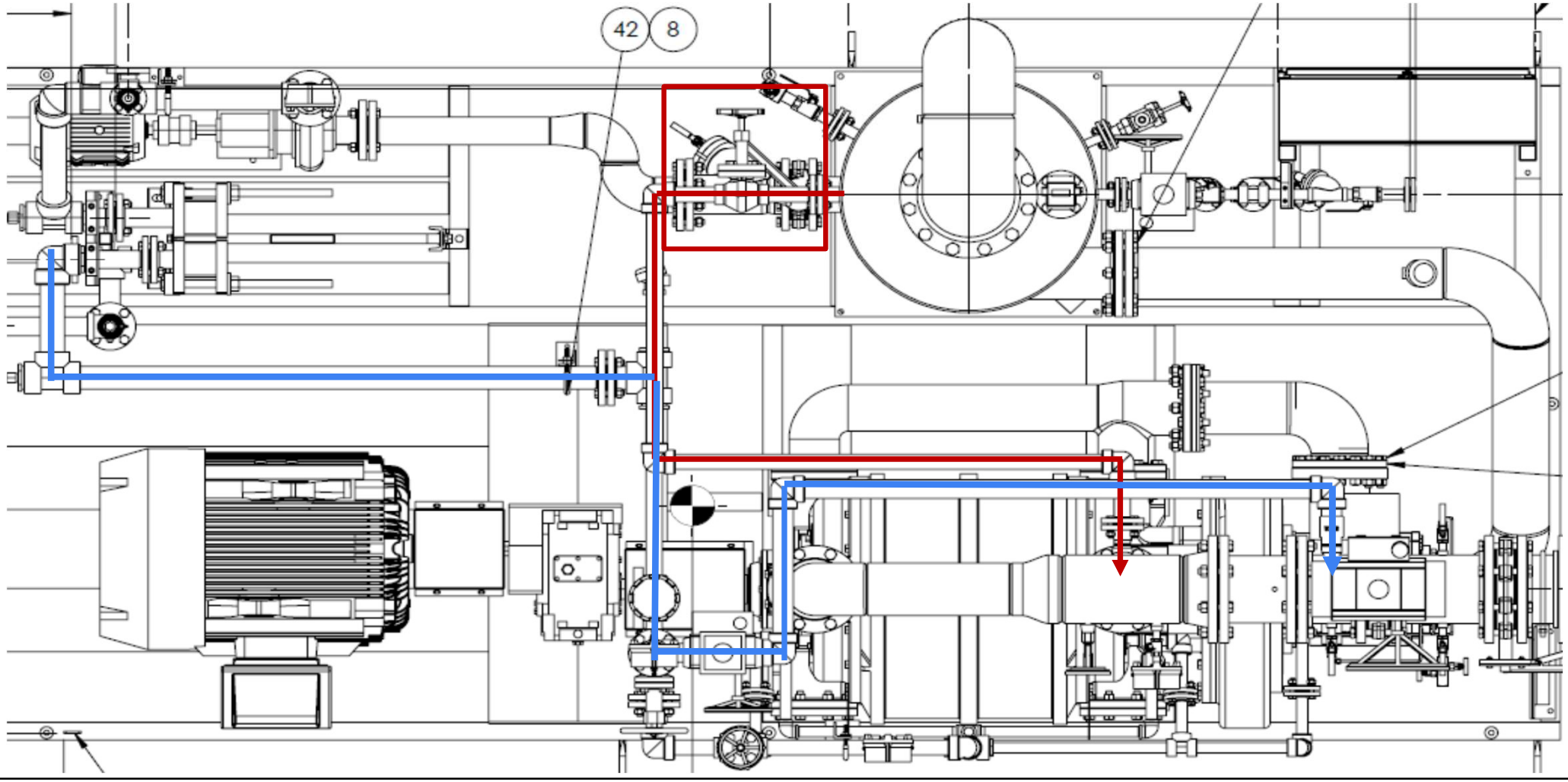
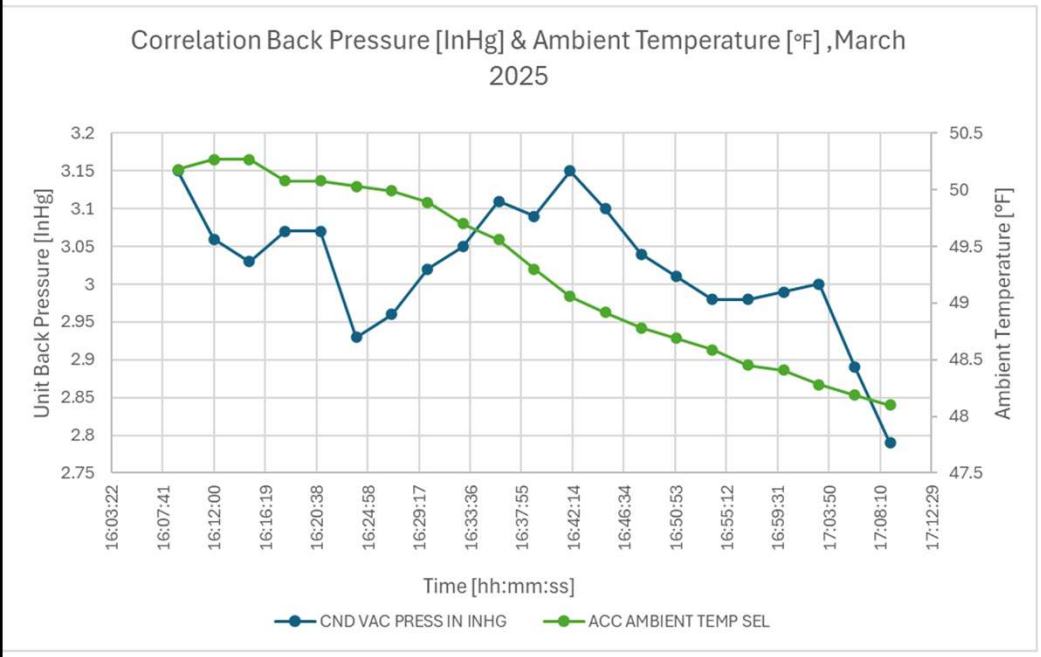
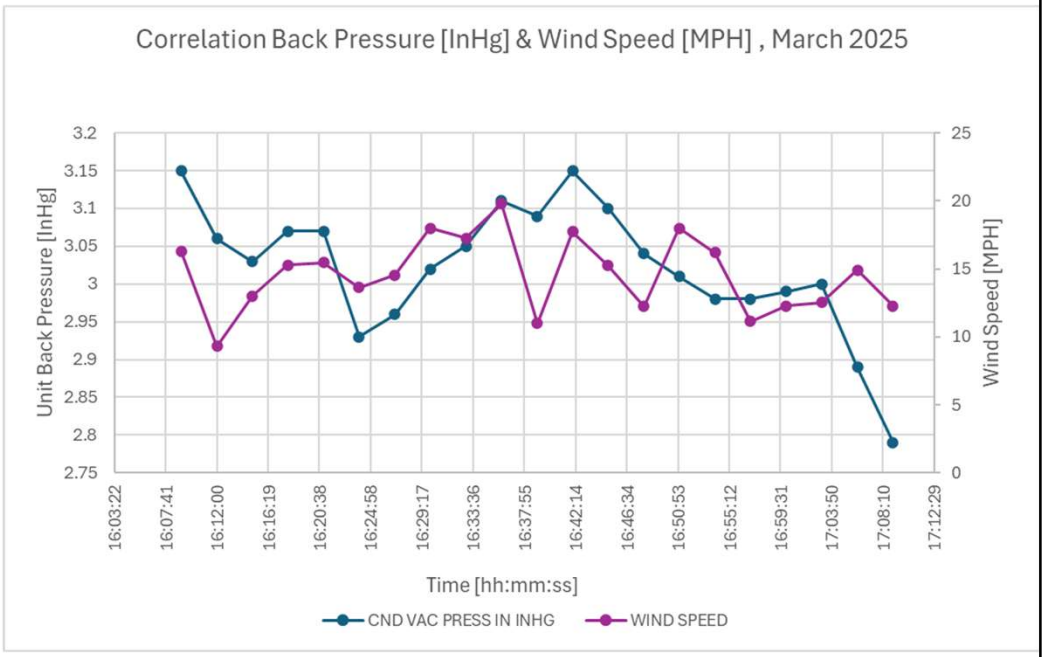
03 Liquid Ring Vacuum pump (LRVP) Challenges: Case Study 2



03 Liquid Ring Vacuum pump (LRVP) Challenges: Case Study 2





The effect of wind speed, ambient conditions on ACC Performance

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03 Liquid Ring Vacuum pump (LRVP) Challenges: Case Study 2

What are the requirements for optimal operation of LRVP during all seasons?

Requirement	Cold Conditions (<50F°)	Warm Conditions (>95F°)
Seal Liquid Temp Control	Heating or circulation	Cooling via HX or chiller
Freeze Protection	Drainage, insulation, heaters	Not required
Cavitation Risk	Low	High — requires cooling
Material Suitability	Freeze-resistant materials	Heat-resistant materials
Startup/Shut-down Handling	Warm-up, prevent freezing	Avoid hot restart with hot liquid

Optimal control and protection especially during the summer months:

- Ensure effective operation of glycol cooling system to prevent high seal water temperature.
- Ensure effective control of anti-cavitation control valves:
  - Temperature differential between seal water temperature and ambient temperature (Under investigation)
  - Using the LRVP suction pressure to control the modulating anti-cavitation valve to prevent vapour pressure conditions that would result in cavitation. (Under Investigation)

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04 Air-Cooled Condenser Dephlegmators

The Whiskey distillery of the energy Industry:

- Both rely on phase change and effective heat transfer
- Both require tight temperature and pressure control
- Cooling is central to both processes

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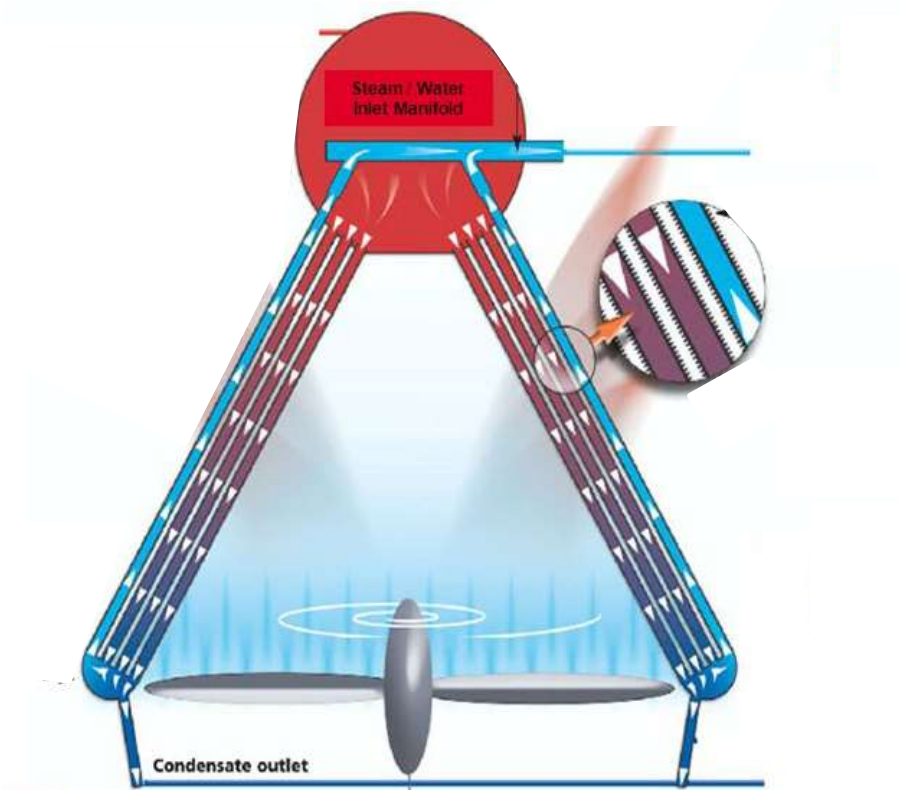
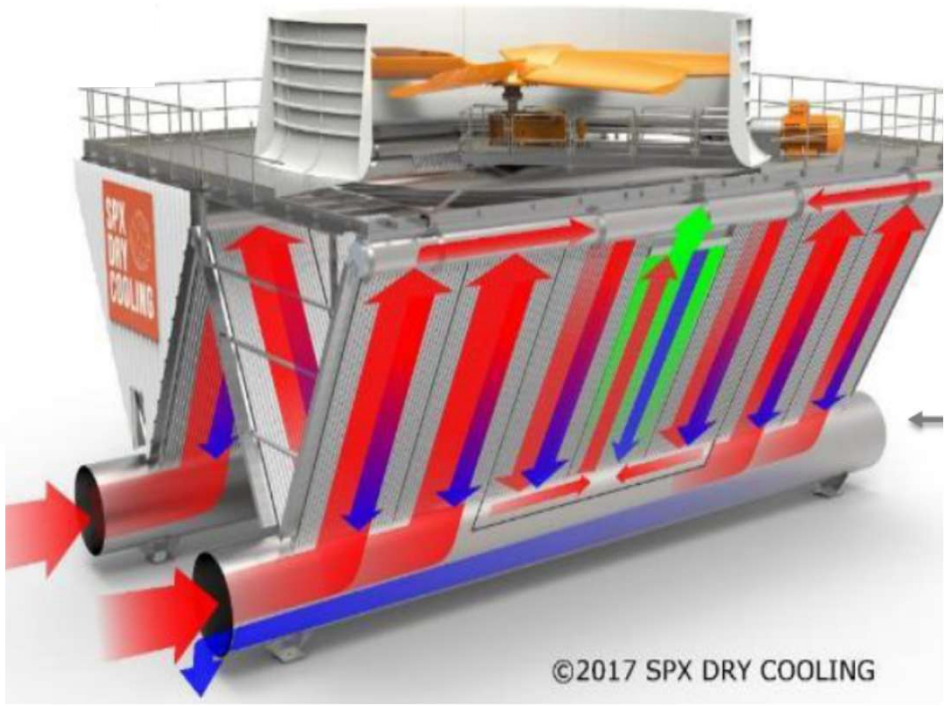
04 Air-Cooled Condenser Dephlegmators





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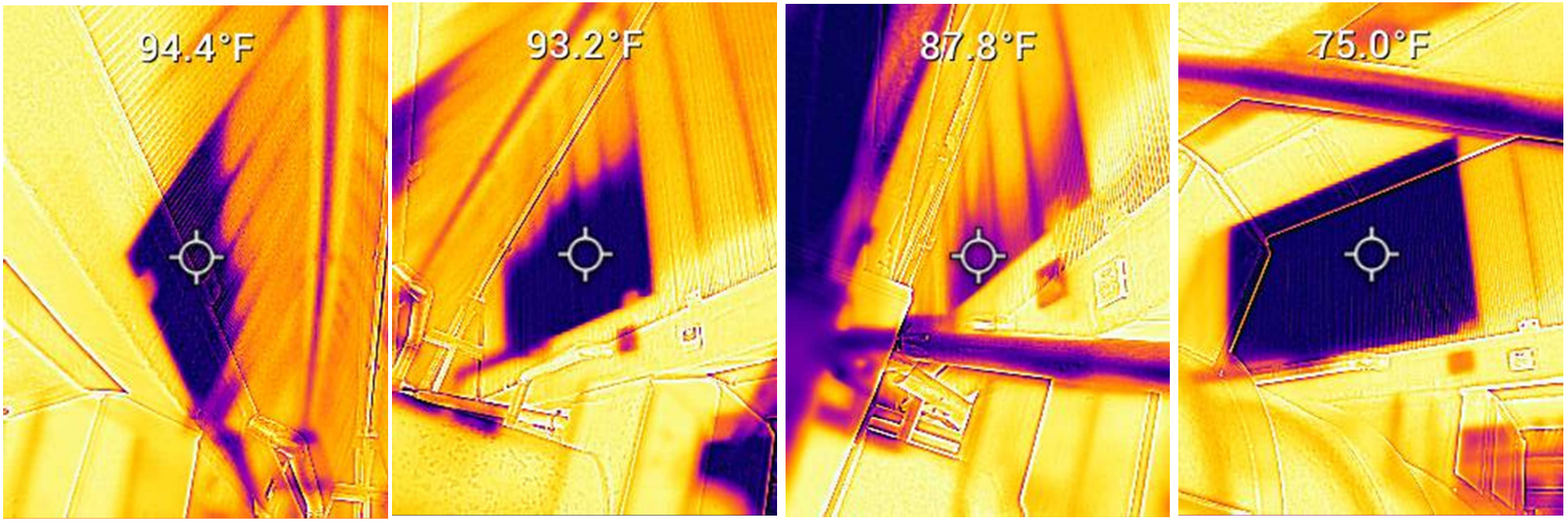
04 Air-Cooled Condenser Dephlegmators



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04 Air-Cooled Condenser Dephlegmators

How do we go about resolving this?

Step 1: Air in leakage testing

Step 2: Effective LRVP or Ejector system testing

Step 3: Investigate the possibility of ACC draw down balancing

- Possibility of installing appropriately sized orifices on all down coming air extraction lines (Design dependent)
- Possibility of using NCG temperatures to control motorised valves to balance the extraction across the dephlegmators (Under investigation)

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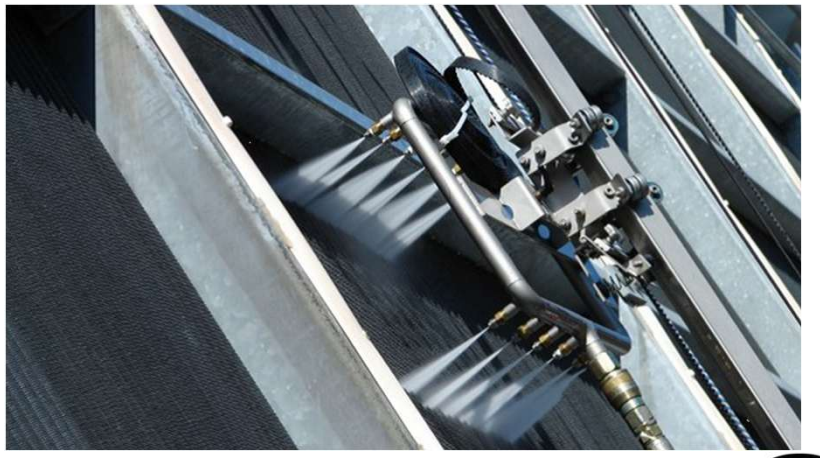
05 Air-Cooled Condenser Operation

Additional Means of Effective Operation:

- Effective ACC Cleaning
- Optimize Fan Cycling
  - PID or MPC control
  - Dynamic load following control
  - Staggered fan start/stop logic
  - Ambient compensated control
  - Fan Zoning/grouping



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06 Dissolved Oxygen

Dissolved Oxygen:

What are the typical misconceptions when it comes to DO levels?

- “if the vacuum is good, we do not have high DOs”
- “If the vacuum is bad , we must have high DOs” but,

What is good industry practices when it comes to managing high DO levels?

- Monitor both Vacuum and DO concentration
- Use partial pressure analysis to verify how much of the vacuum consists of air.
- Ensure effectiveness of air removal system
- Conduct regular Air Inleakage testing

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07 Broad Spectrum Approach

What do we mean with a “Broad Spectrum Approach”?

”Adopting a strategy or methodology that addresses a wide range of conditions, variables, risks or scenarios in stead of focusing on one specific case, issue or solution”

Proposed Broad Spectrum Approach:

- Increase involvement of equipment owners on ACC design
- Investigate all associated equipment sets with a direct performance impact on the ACCs
- Consult with highly qualified air-inleakage specialists in conjunction with plant optimization specialists from the start to provide an informed view of the ACC and associated equipment performance

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