

ACCUG Guidelines Documents

ACCUG 2021

Andy Howell
October 14, 2021



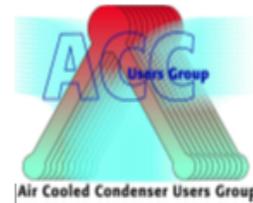
Air-Cooled Condenser Users Group

- Grass-roots organization, originated ~2007 to promote technical exchange among interested persons
- Initiated annual meetings in 2009 with NV Energy support
 - Las Vegas – San Francisco – Pueblo, CO – Gillette, WY – Summerlin, NV – San Diego – Gettysburg, PA – Dallas – (Xi'an, China) – Las Vegas – Colorado Springs – Queretaro, Mexico
 - presentations / discussion
 - ACC site visit / tour connected to each meeting
 - user/operators, OEMs, vendors, consultants
- Website developed with support from Combined Cycle Journal and SV Events: <https://acc-usersgroup.org/>
 - email Forum – Q&A
 - presentations from past meetings
 - registration information for current meeting
 - other technical information
- Technical guidance documents
 - steam-side inspection 2015
 - finned-tube cleaning 2018
 - air inleakage (in-progress)



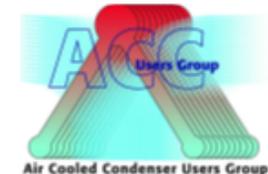
Air Cooled Condenser Users Group

<http://acc-usersgroup.org/>



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ACC.01: Guidelines for Internal Inspection of Air-Cooled Condensers

Original Issue: May 12, 2015
Revision due: May 12, 2018

Publication in whole or in part is allowed provided that attribution is given to the Air Cooled Condenser Users Group

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ACC.02: Guidelines for Finned Tube Cleaning in Air-Cooled Condensers

Original Issue: October 12, 2018
Revision due: October 12, 2021

Publication in whole or in part is allowed provided that attribution is given to the Air Cooled Condenser Users Group

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ACC.03: Guidelines for Air In-leakage in Air-Cooled Condensers

Original Issue: xxx
Revision due: xxx

Publication in whole or in part is allowed provided that attribution is given to the Air-Cooled Condenser Users Group

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Internal ACC Inspection Guidelines

Objectives:

- provide guidance to ensure a comprehensive inspection
- provide a focal point for the ACC community to optimize steamside inspections
- employ the use of a quantifiable index to allow comparison between ACCs

Input:

- ACC users, consultants, OEMs

Product:

- technical information and examples
- itemized inspection worksheet
- corrosion index (DHACI)

Introduction

- ACCs are very large structures with large surface area of iron
- Corrosion results in iron transport and potentially air inleakage, which can cause major challenges
- Effectiveness of steam cycle chemistry treatment is confirmed with internal inspection

Document Contents

- Introduction
- Plant Configuration
- ACC Configuration
- Operation
- Frequency of Inspection
- Preparation for Inspection
- Safety
- Physical (Visual) Inspection for Corrosion
 - DHACI Criteria for Quantifying Corrosion
 - Upper Section
 - Lower Section
 - Inspection Regions

(continued...)

Document Contents

(continued...)

- Other Internal Components
- References
- Photos
- Definitions
- ACC Visual Inspection Worksheet
- ACC Inspection Worksheet: Background Information

Plant Configuration

- Once through boiler
 - no contamination allowed
 - condensate polisher and filter likely
 - high pH limits polisher effectiveness
- Heat Recovery Steam Generators / Drum Boilers
 - can remove contaminants in boiler but often not in preboiler system
 - can use amines instead of ammonia if no polisher

ACC Configuration

- Factors influencing internal corrosion:
 - support structures / turbulence
 - cooling tube length / entry shape (weld ridge)
 - number of rows / isolation of risers
 - number of fans / operational flexibility
 - condensate drainage
 - condensate deaerator
 - parallel cooling – steam velocity

ACC Operation

- Higher pH reduces iron transport
- Neutralizing / filming amines generally reduce corrosion better than ammonia
- Historical data on chemistry control, iron transport, unit operation are important
- ACC condition when off-line

Frequency of Inspection

- Thoroughly during construction





Frequency of Inspection

- Thoroughly during construction
- Within first few months after commissioning, if possible



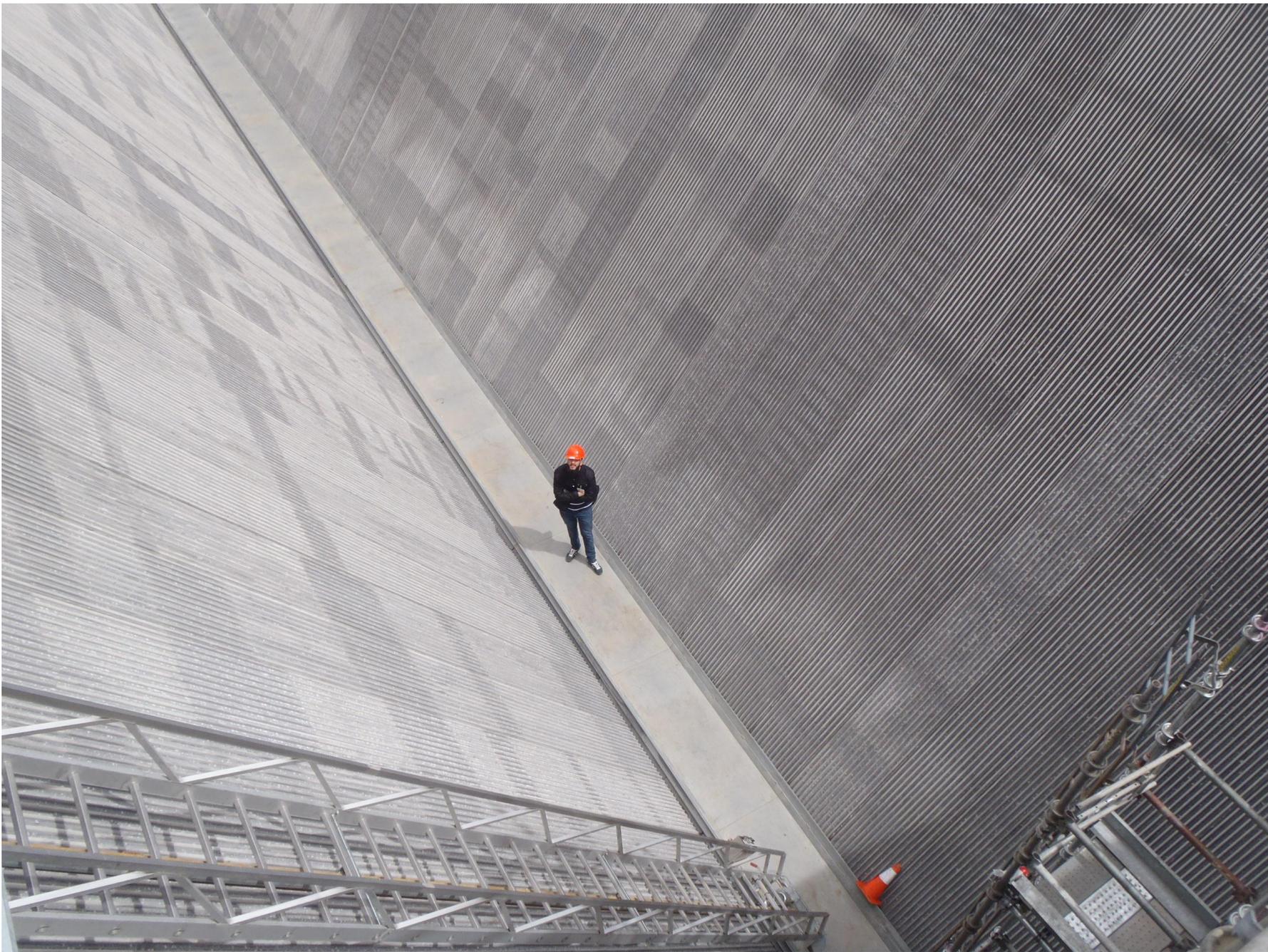
Frequency of Inspection

- Thoroughly during construction
- Within first few months after commissioning, if possible
- Annually; select at least one duct for repeat examination, rotate others
 - If no problems observed after 3 or 4 years, may change inspection to alternate years

Safety

- Falling – appropriate railing, walkways, elevators if possible





Safety

- Falling – appropriate railing, walkways, elevators if possible
- Upper distribution ducts – permanent ladders and platforms best





Safety

- Falling – appropriate railing, walkways, elevators if possible
- Upper distribution ducts – permanent ladders and platforms best
- Insure adequate air inside ducts
- Lighting
- Floor drain ports
- Plan for removal of personnel during injury

Inspection

- Record “normal” and “abnormal” surface appearance with photographs
 - shiny metal
 - different colors of iron oxide
 - deposition

Rating: DHACI (1 – 5)

Upper Section: duct, cooling tube entries

- 1 - Good condition: no corrosion found



Rating: DHACI (1 – 5)

Upper Section: duct, cooling tube entries

- 1 - Good condition: no corrosion found
- 2 - Minor corrosion: no bare metal, but black deposits at tube entries



Rating: DHACI (1 – 5)

Upper Section: duct, cooling tube entries

- 1 - Good condition: no corrosion found
- 2 - Minor corrosion: no bare metal, but black deposits at tube entries
- 3 – Moderate corrosion: scattered spots of bare metal, black deposits





Rating: DHACI (1 – 5)

Upper Section: duct, cooling tube entries

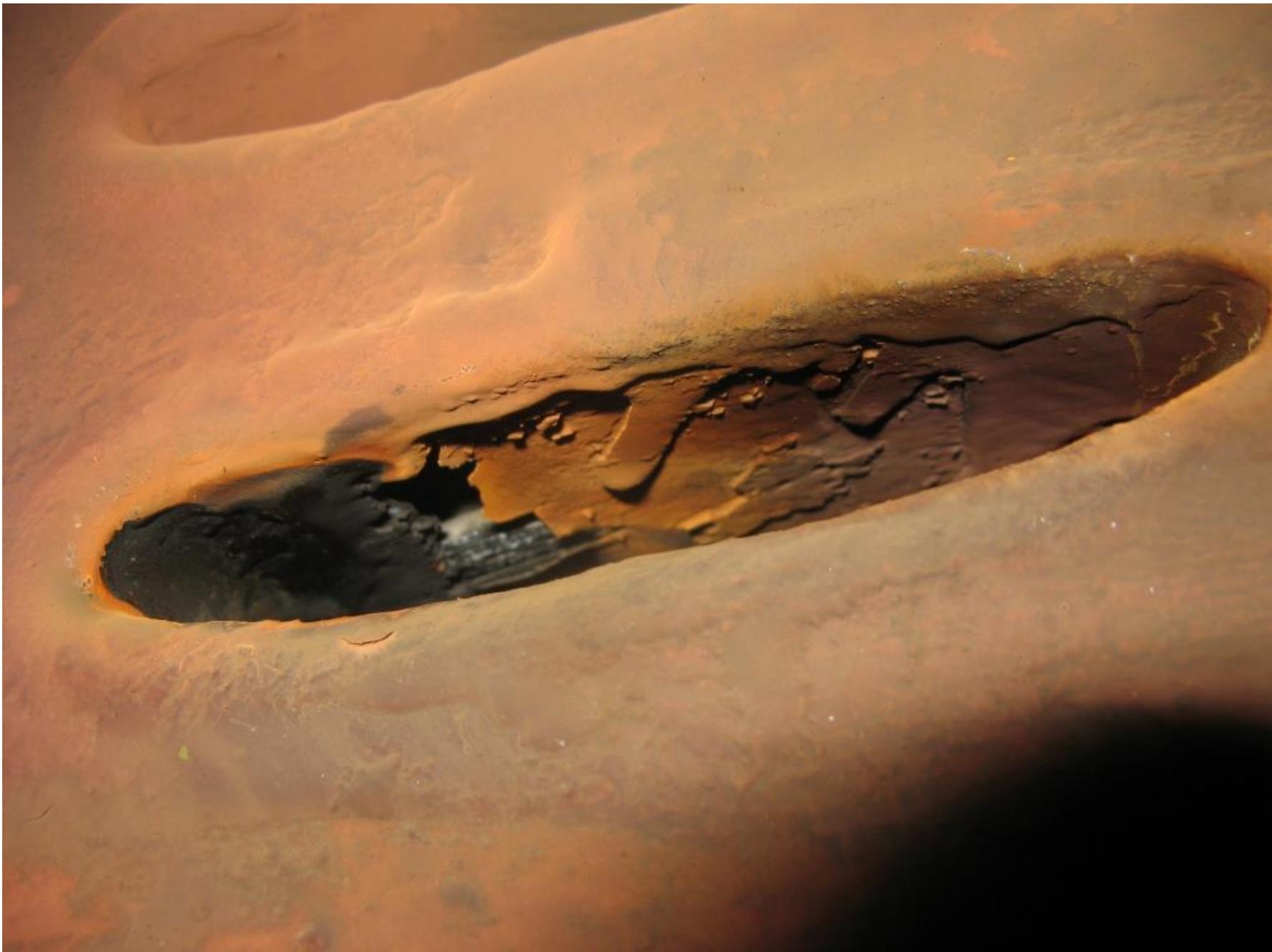
- 1 - Good condition: no corrosion found
- 2 - Minor corrosion: no bare metal, but black deposits at tube entries
- 3 – Moderate corrosion: scattered spots of bare metal, black deposits
- 4 – Serious corrosion: widespread bare metal at tube entries along with widespread black deposits



Rating: DHACI (1 – 5)

Upper Section: duct, cooling tube entries

- 1 - Good condition: no corrosion found
- 2 - Minor corrosion: no bare metal, but black deposits at tube entries
- 3 – Moderate corrosion: scattered spots of bare metal, black deposits
- 4 – Serious corrosion: widespread bare metal at tube entries along with widespread black deposits
- 5 – Very serious corrosion: holes in tubes or welds, widespread corrosion in other tubes





Rating: DHACI (A – C)

Lower Section: turbine exhaust, lower duct, risers

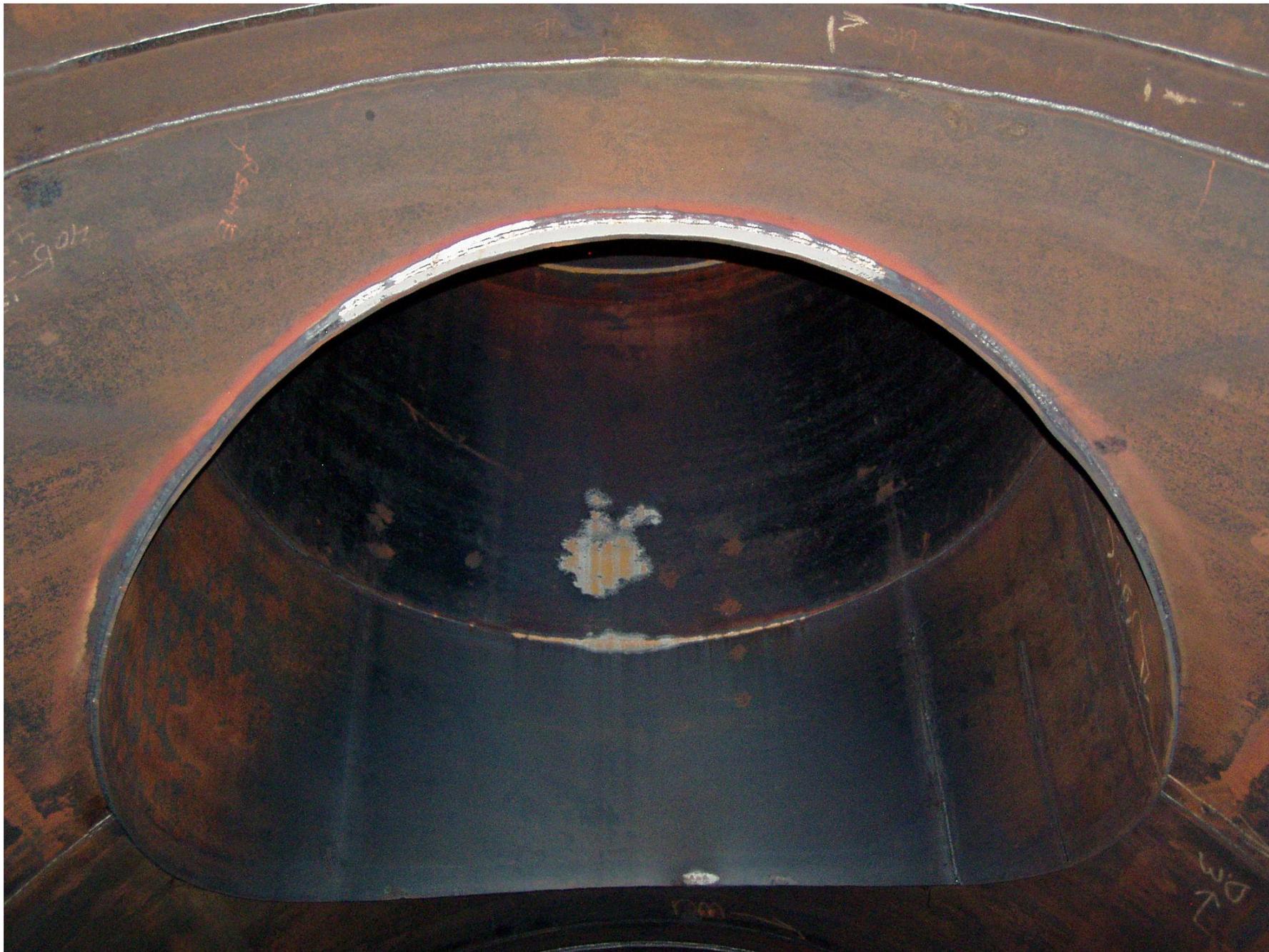
- A - Good condition: no corrosion found



Rating: DHACI (A – C)

Lower Section: turbine exhaust, lower duct, risers

- A - Good condition: no corrosion found
- B - Minor corrosion: some scattered spots of bare metal



Rating: DHACI (A – C)

Lower Section: turbine exhaust, lower duct, risers

- A - Good condition: no corrosion found
- B - Minor corrosion: some scattered spots of bare metal
- C – Serious corrosion: multiple, widespread areas of bare metal scattered spots of bare metal, black deposits



Rating: DHACI (A – C)

Lower Section: turbine exhaust, lower duct, risers

- A - Good condition: no corrosion found
- B - Minor corrosion: some scattered spots of bare metal
- C – Serious corrosion: multiple, widespread areas of bare metal scattered spots of bare metal, black deposits

The DHACI is used to compare between units, or to track changes with operating changes in a unit

The lower duct area is generally not a major concern, since the walls are thick compared with cooling tube walls.

Inspection Worksheets

ACC Inspection Worksheet: Background Information

Unit name	
Date inspected	
Inspector	
Plant contact	
Unit design (general / MW capacity)	
ACC design	
Tube type	
ACC manufacturer & startup year	
Condensate T (seasonal)	
Design steam flow	
Condensate polishing? (describe)	
Condensate filtration? (describe)	
Condensate Fe levels: startup	
Condensate Fe levels: routine	
Condensate pH control range	

ACC Inspection Worksheet: Locations

LP turbine blades, last stage(s)	
LP turbine exhaust, direct impact and vicinity	
Large steam exhaust duct	
•general surface	
•flow-related corrosion areas	
Lower distribution duct	
•flow-related corrosion areas	
•riser entries	
•other comments	
Lower Duct DHACI rating: A, B or C	
Upper distribution duct (which one?)	
•entry louvers	
•entry duct region	
•general duct	
•tubesheet and cross-supports	

**Non-corrosion component integrity is also considered,
and expansion of this topic would be useful**



ACC Finned Tube Cleaning Guidelines

Objectives:

- provide guidance for important issues involved in finned tube cleanings
- provide an expandable document for the ACC community to input on finned tube cleaning experiences and needs
- provide an initial basis for considering options with finned tube cleaning systems
- identify the effects of blocked fins on cooling system performance

Input:

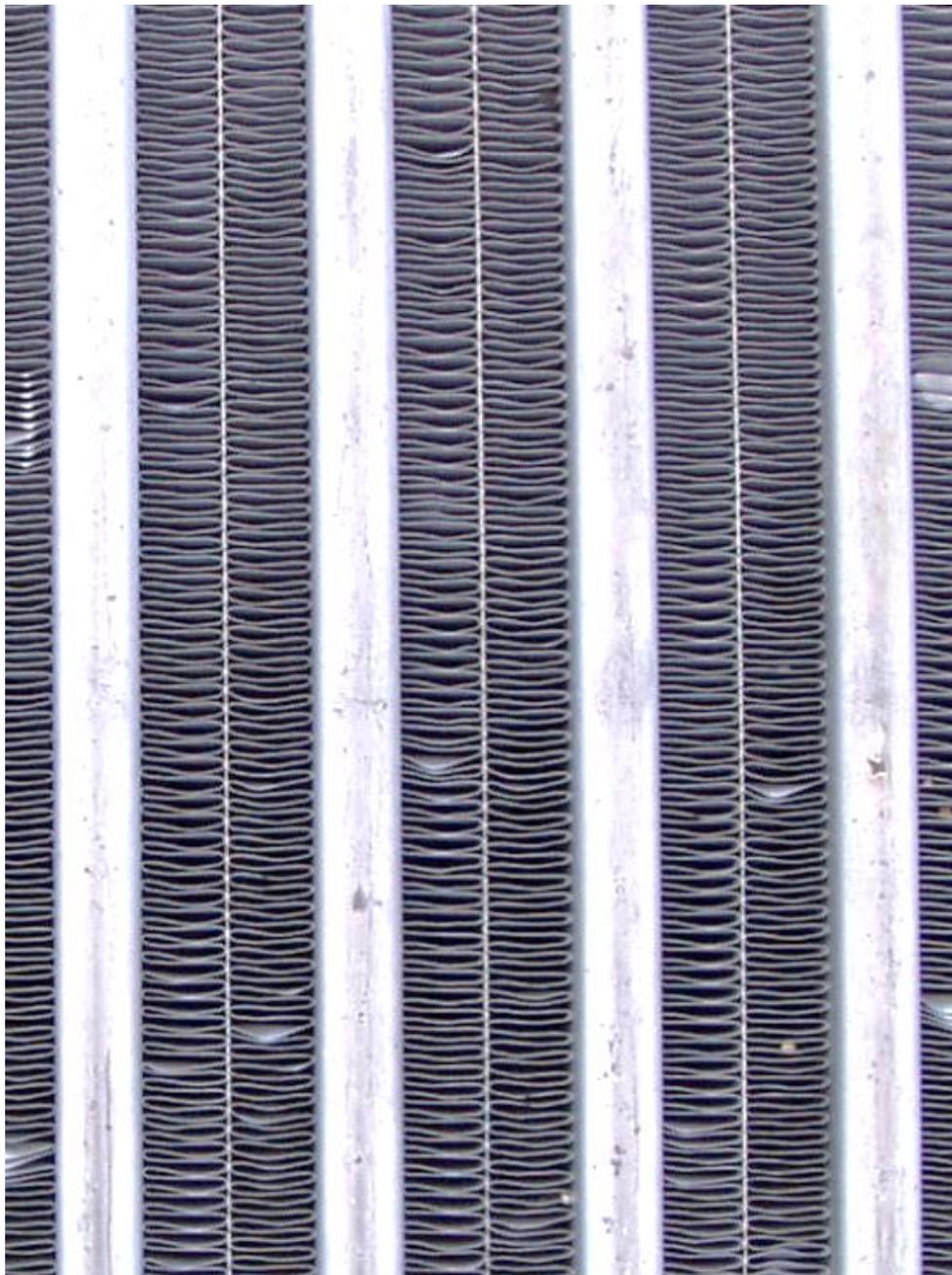
- ACC users, consultants, finned tube cleaning service companies

Product:

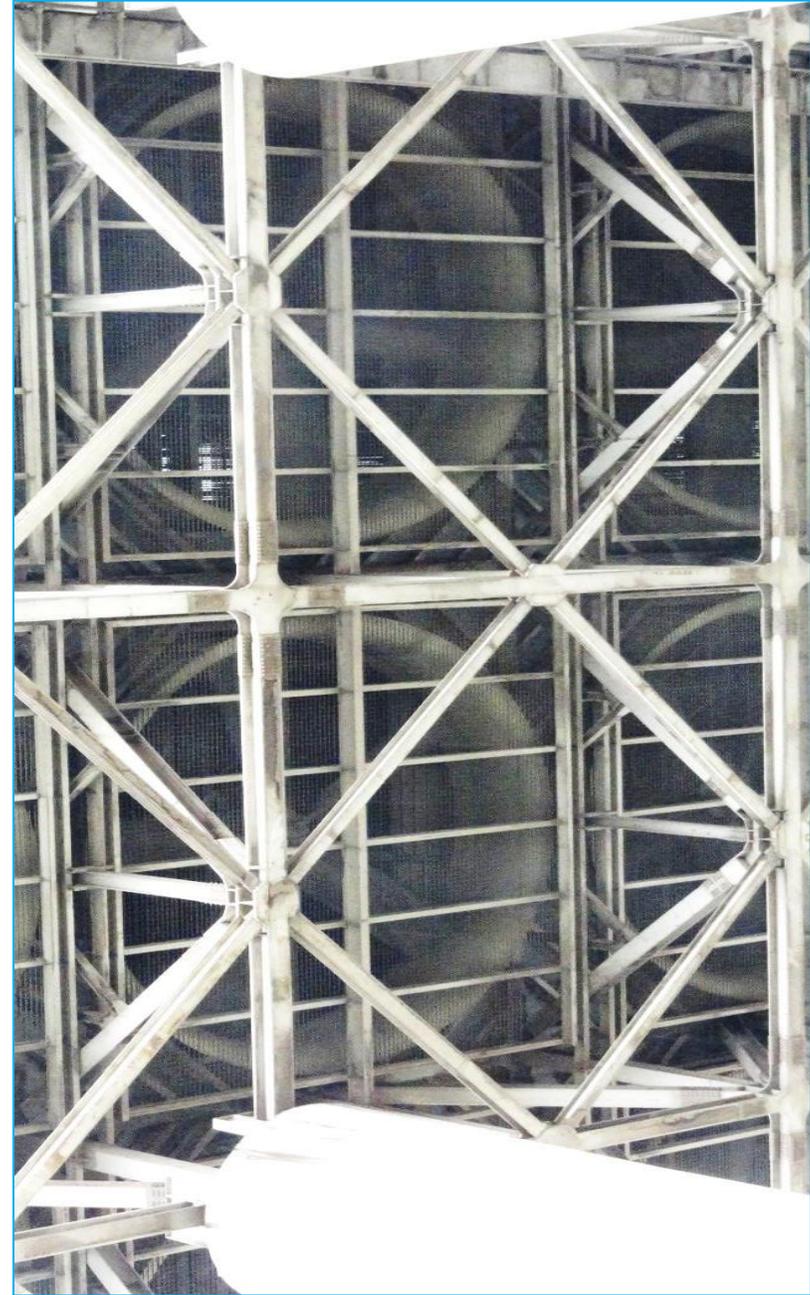
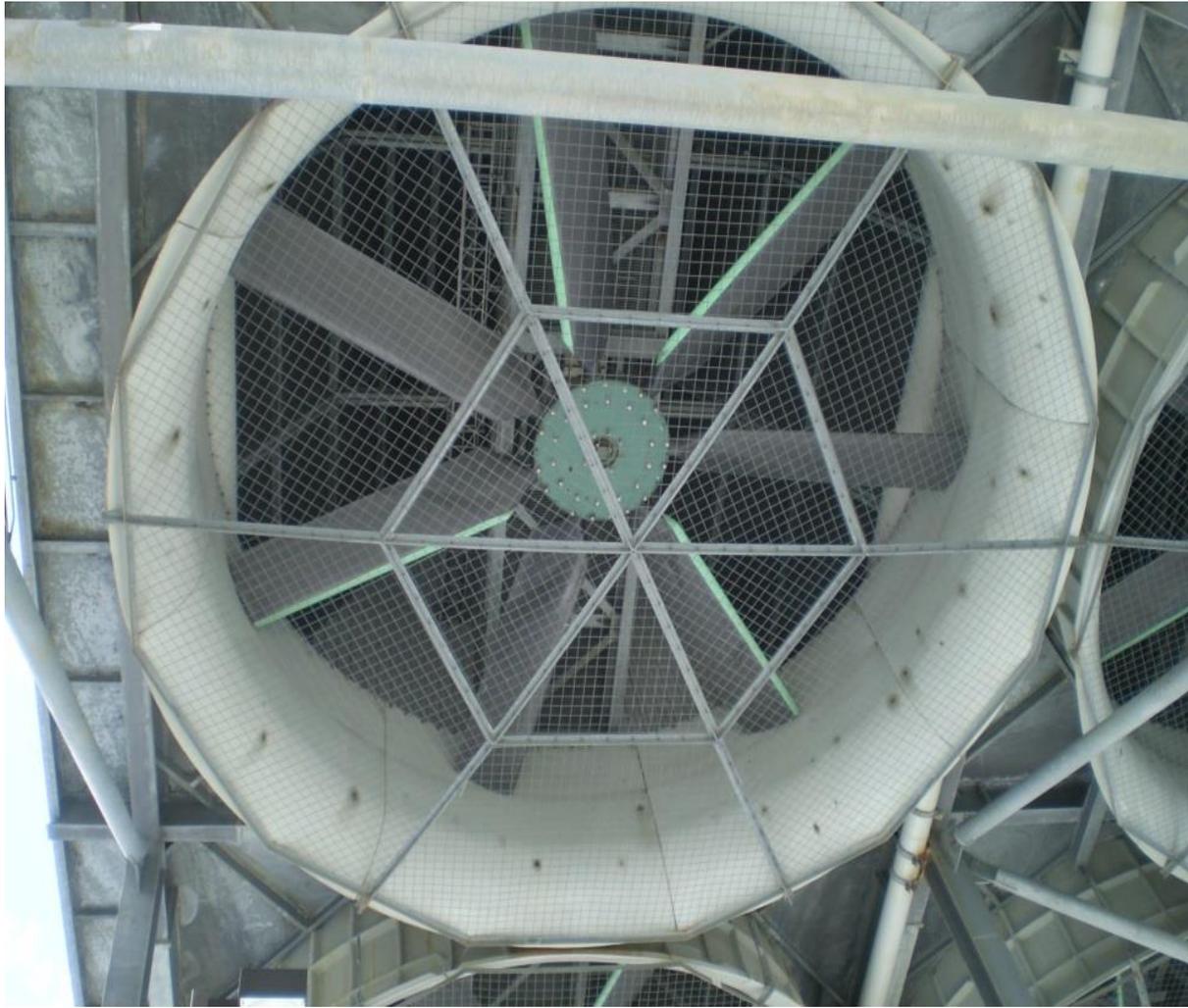
- technical information and examples
- significant issues to consider

Guidance Document Outline

- Introduction
- Operational factors limiting ACC efficiency
 - ambient temperature
 - HX tubing structural/operational inefficiencies
 - airside tube fouling
- Debris/Foulant removal
 - water / air / dry ice / sodium bicarbonate
- Frequency of finned tube cleaning
- Implementing the cleaning process
- Conclusions / References / Photos / Definitions

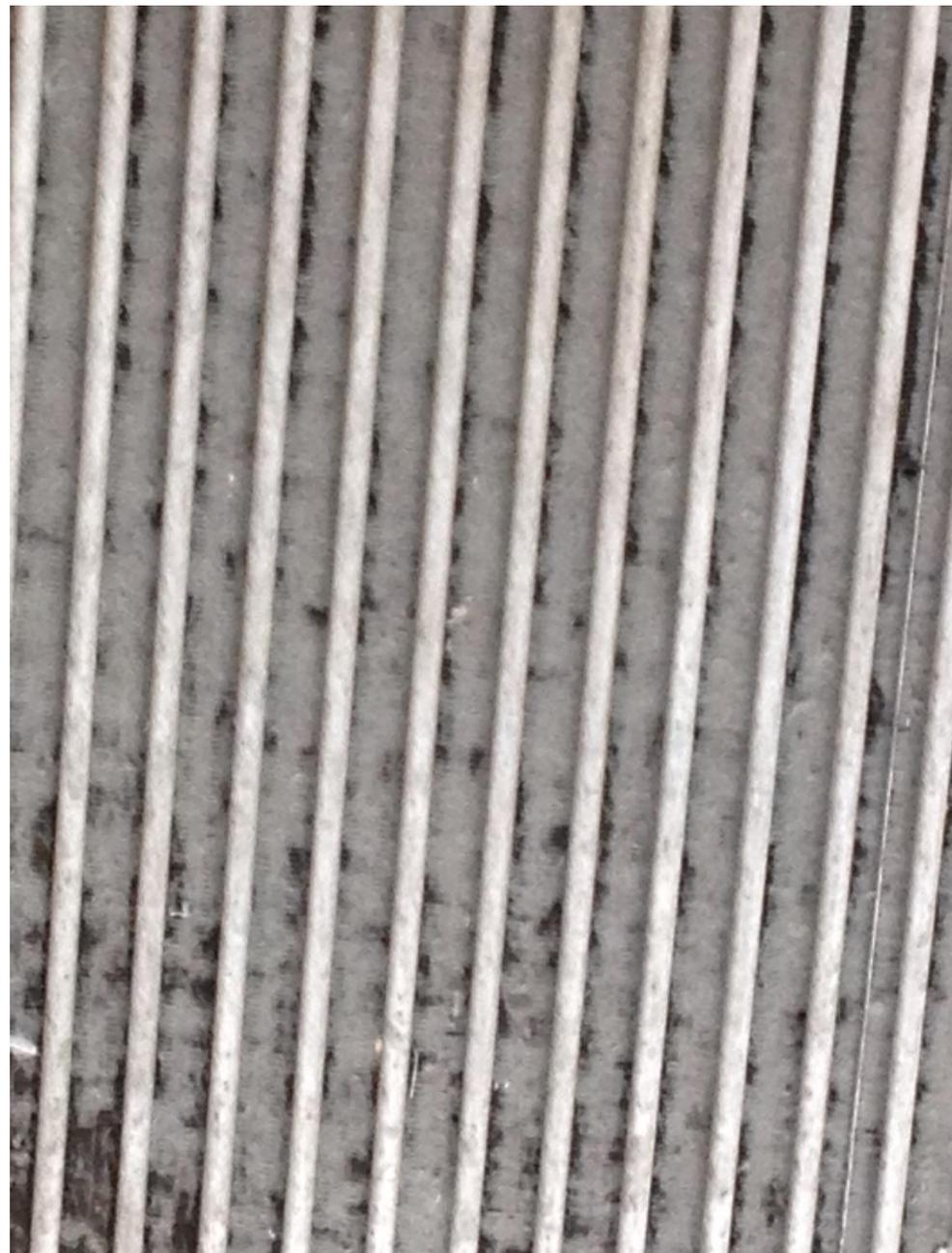




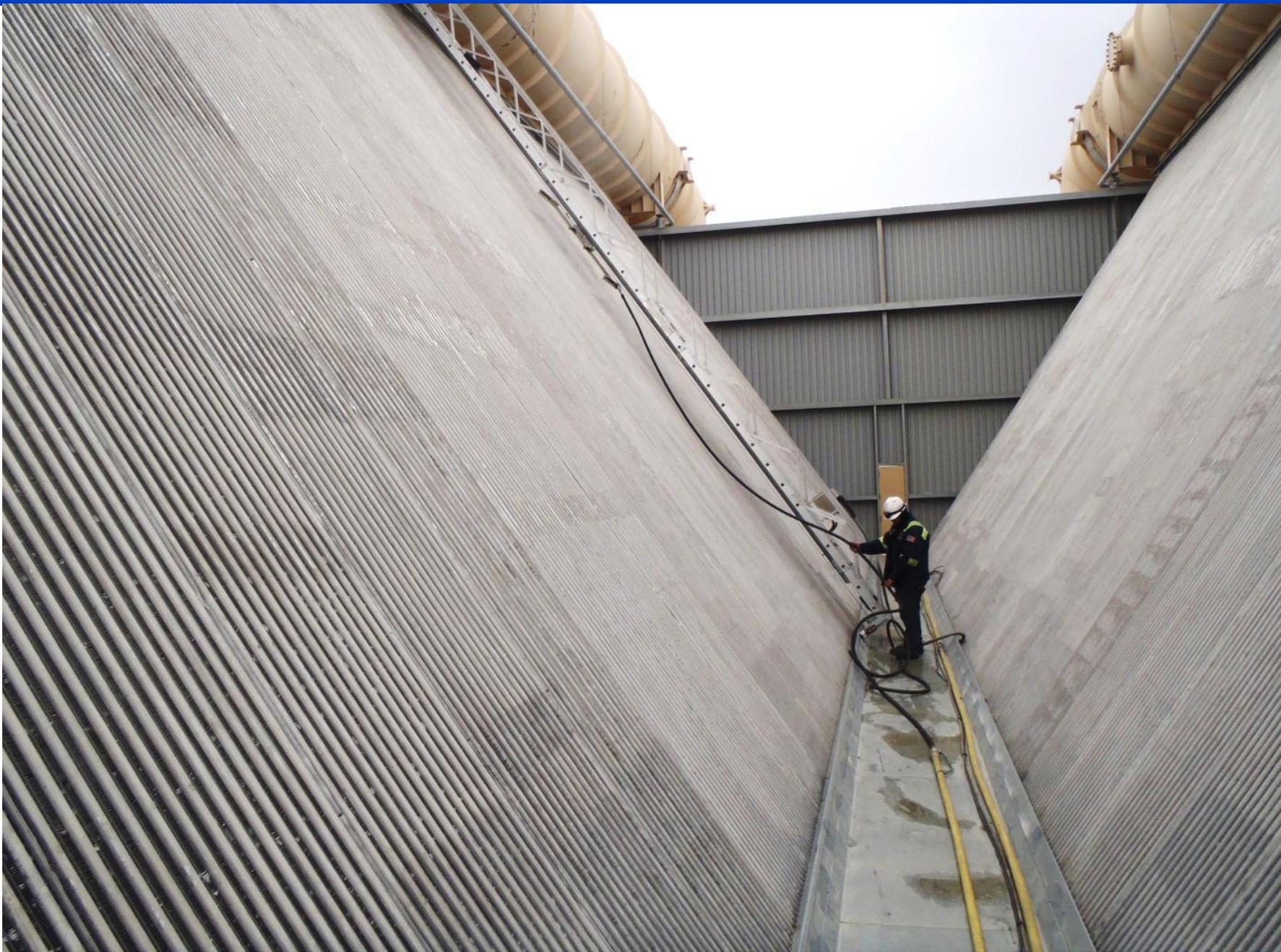




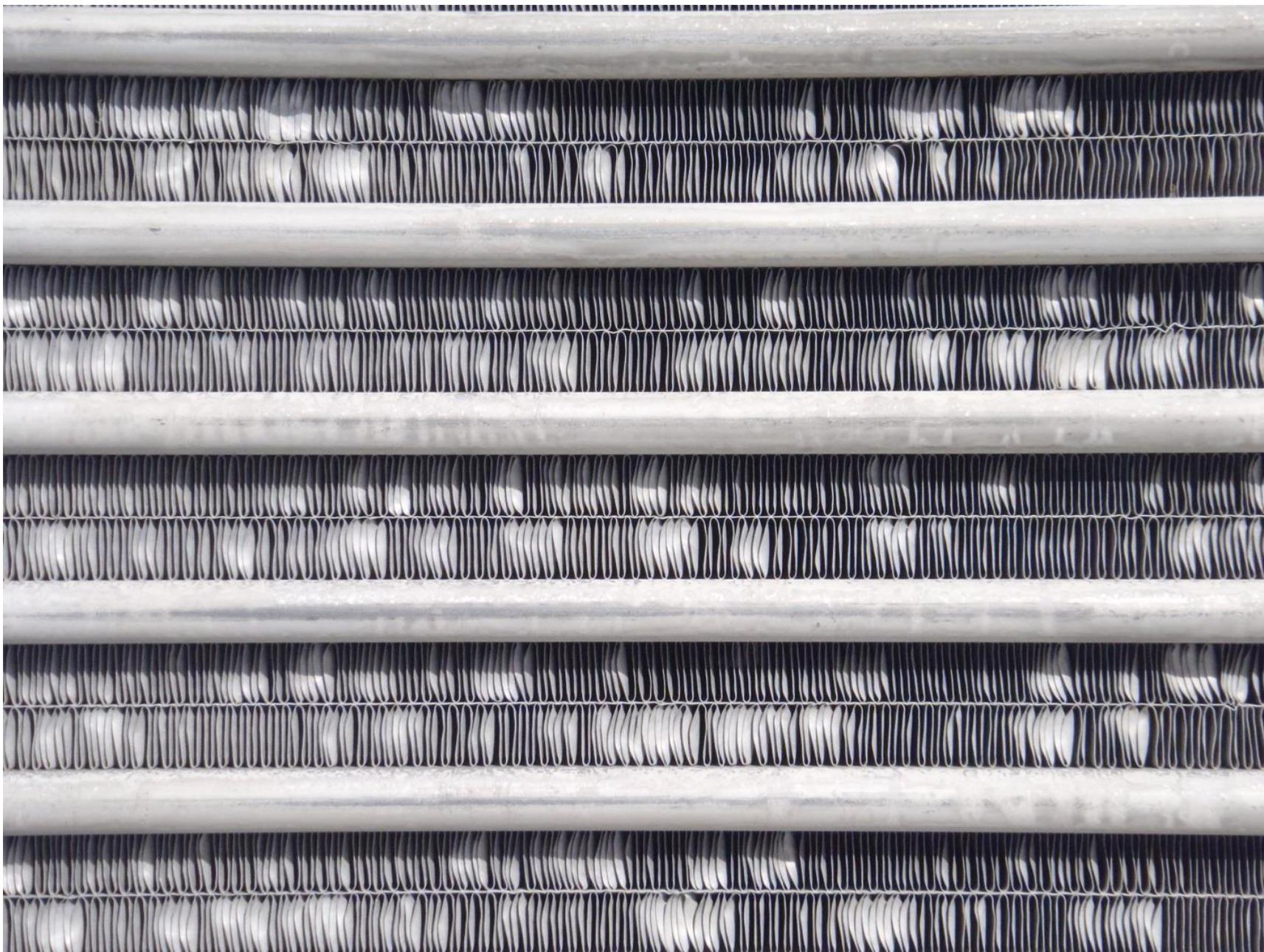






















Conclusions

The guidelines for internal inspection of ACCs is intended for the benefit of users / operators, and any suggestions to further this intent are welcomed.

ACC Air Inleakage Guidelines (in progress)

Objectives:

- provide guidance for air inleakage issues specific to ACCs
- provide an expandable document for the ACC community to input on ACC air inleakage experiences and locations
- provide an initial basis for considering options with finned tube cleaning systems
- identify the effects of air inleakage on cooling system performance and system chemistry

Input:

- ACC users, consultants, OEMs, air inleakage service companies

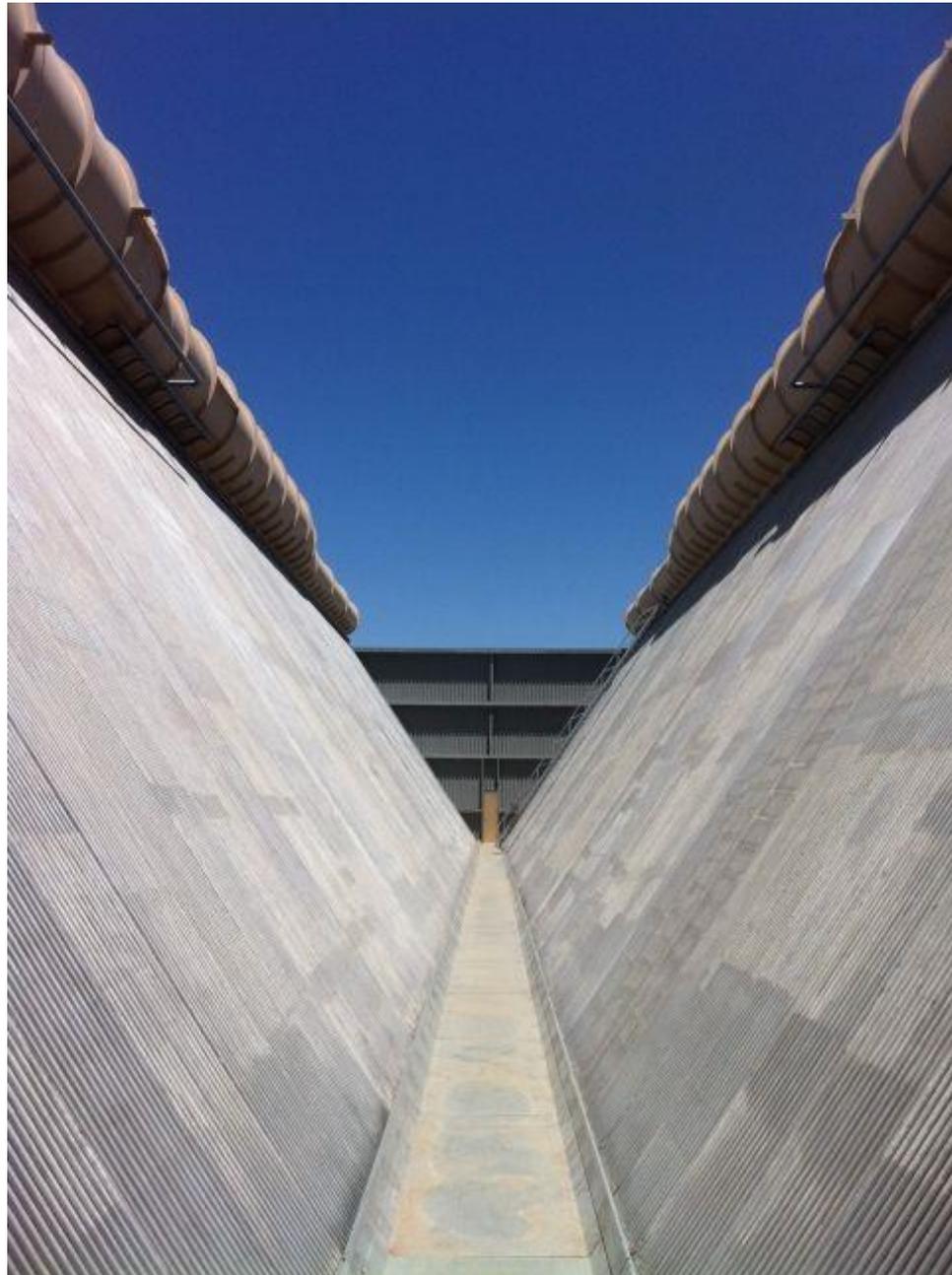
Product:

- technical information and examples of ACC-specific locations
- significant issues to consider with ACC air inleakage testing
- testing approaches for ACCs

Guidance Document Outline

- Introduction
- Effects of air inleakage
 - cooling system performance
 - system chemistry
- Recognizing the presence of air inleakage
- Application of air inleakage to ACCs
- Common locations for air inleakage for ACCs
- Prioritization of air inleakage repairs
- Air inleakage program
- Conclusions / References / Photos / Definitions





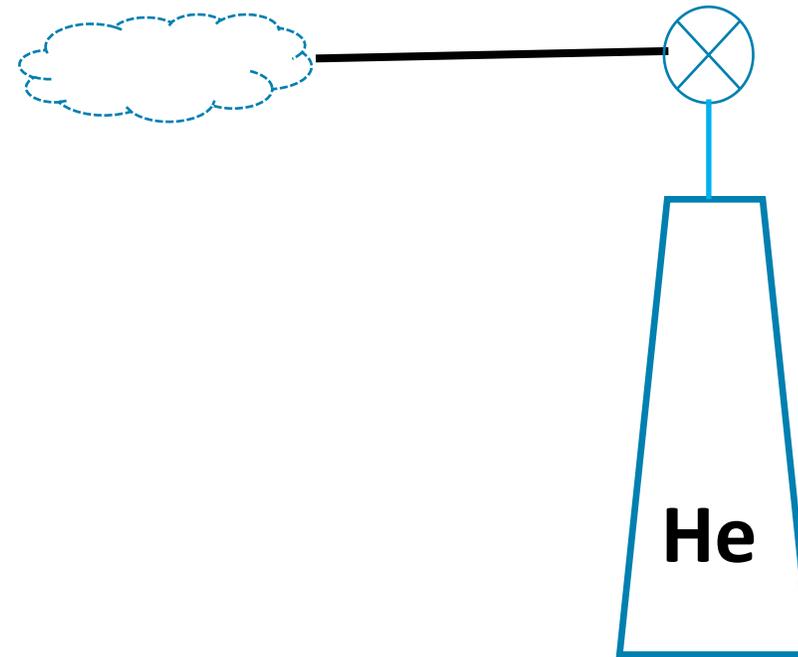
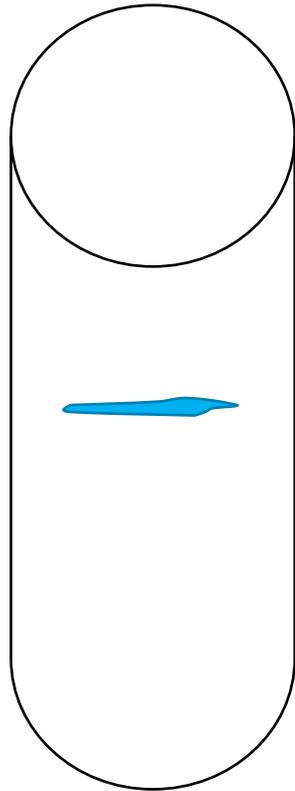
Air In-leakage into ACC vacuum



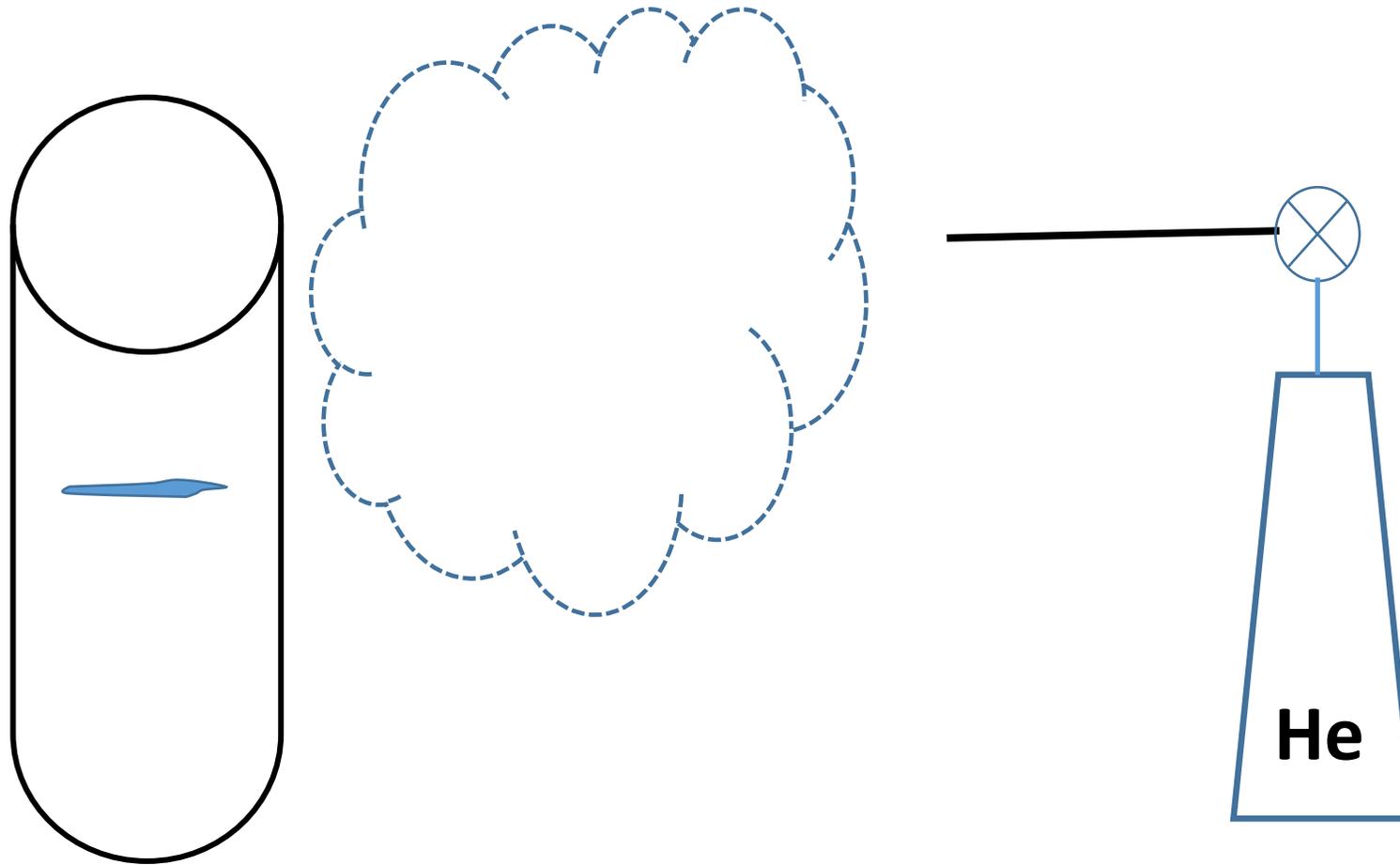
Air In-leakage into ACC vacuum



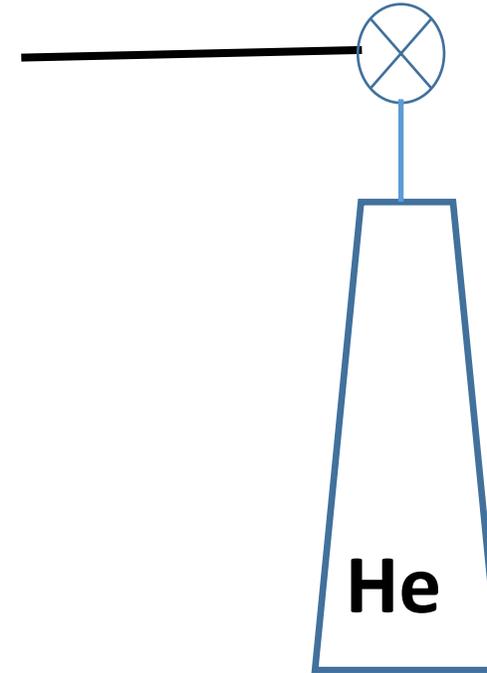
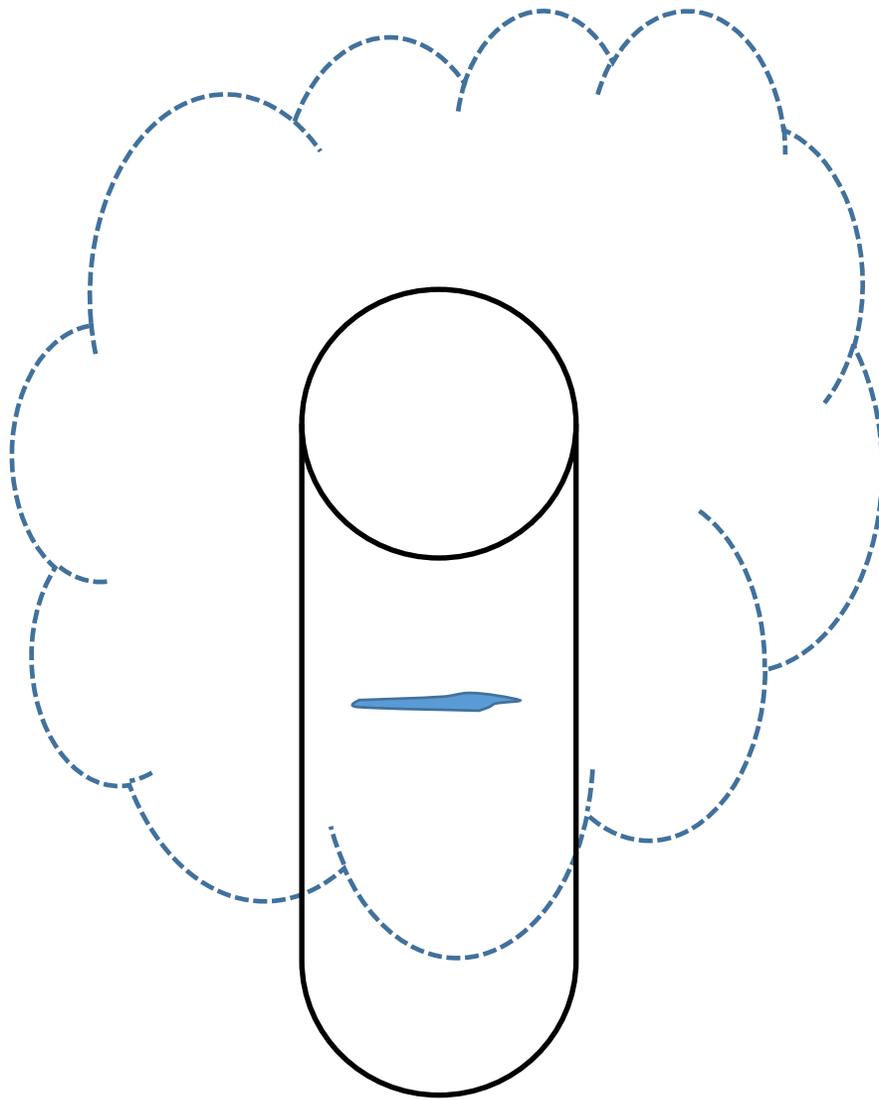
Helium Air Inleakage Testing: Indoor



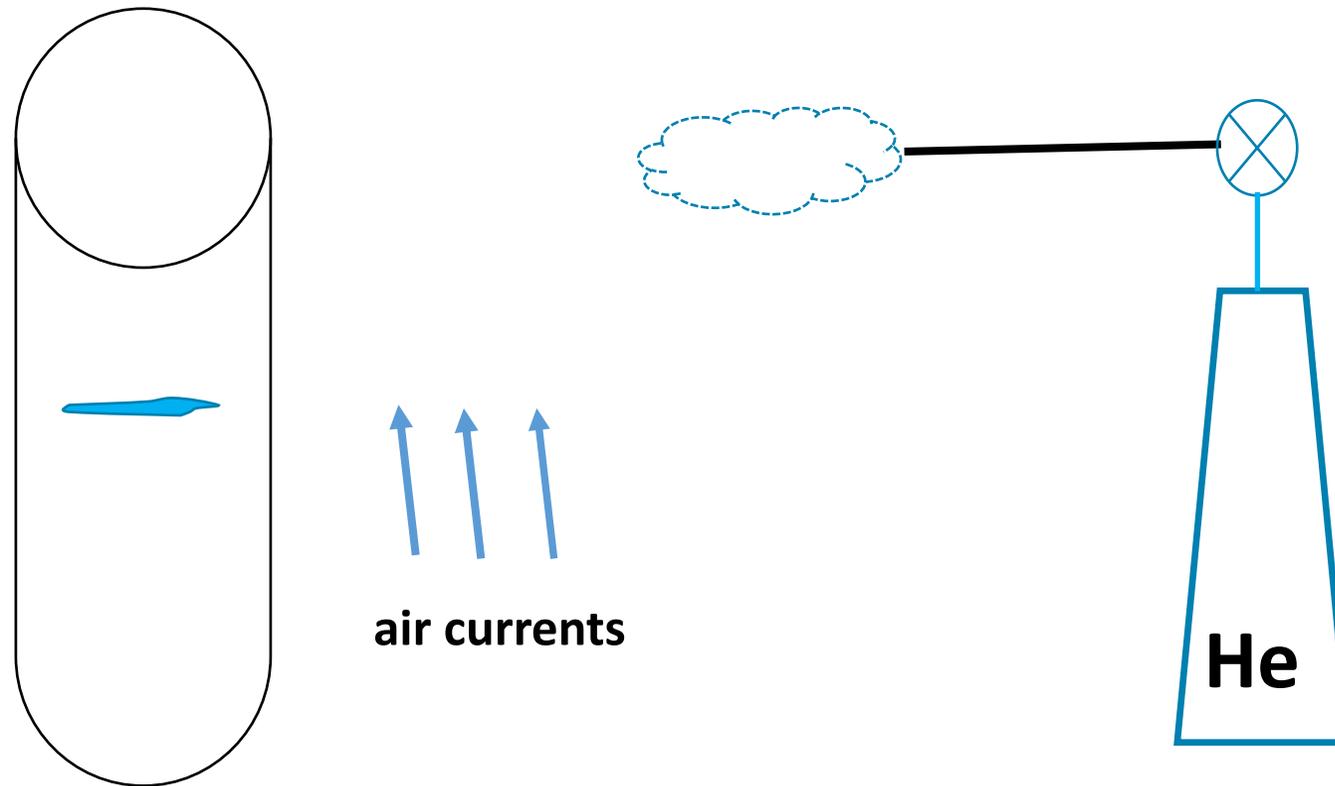
Helium Air Inleakage Testing: Indoor



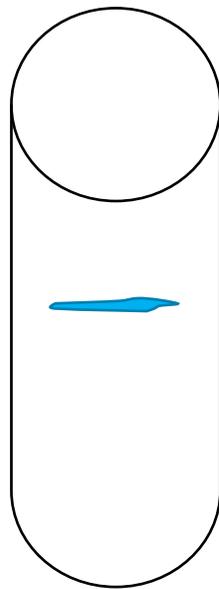
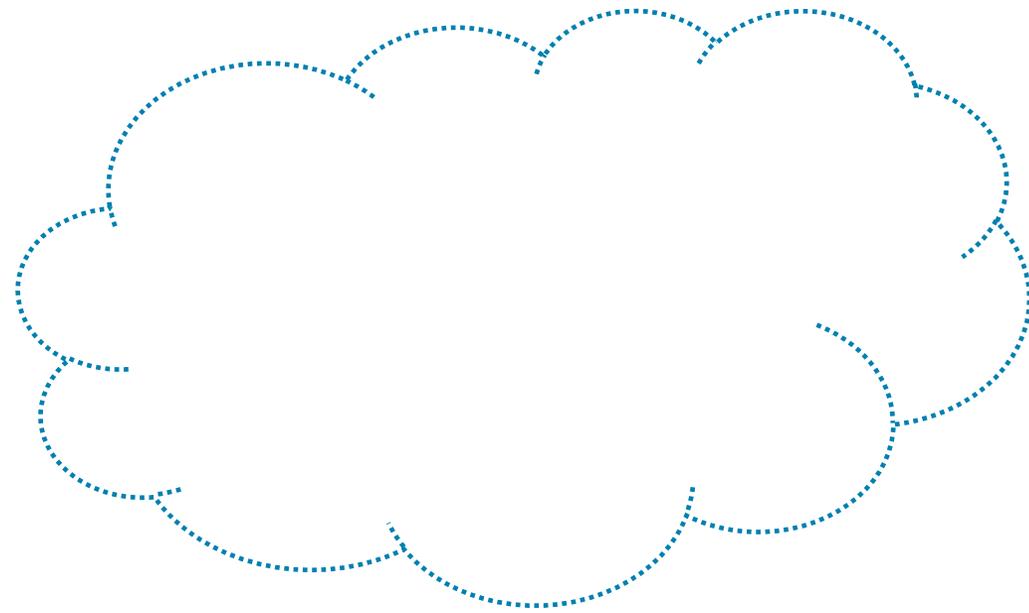
Helium Air Inleakage Testing: Indoor



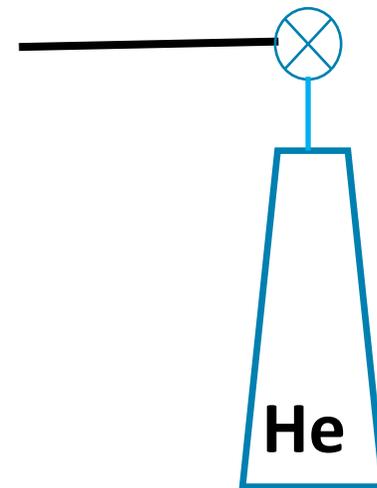
Helium Air Inleakage Testing: Outdoor



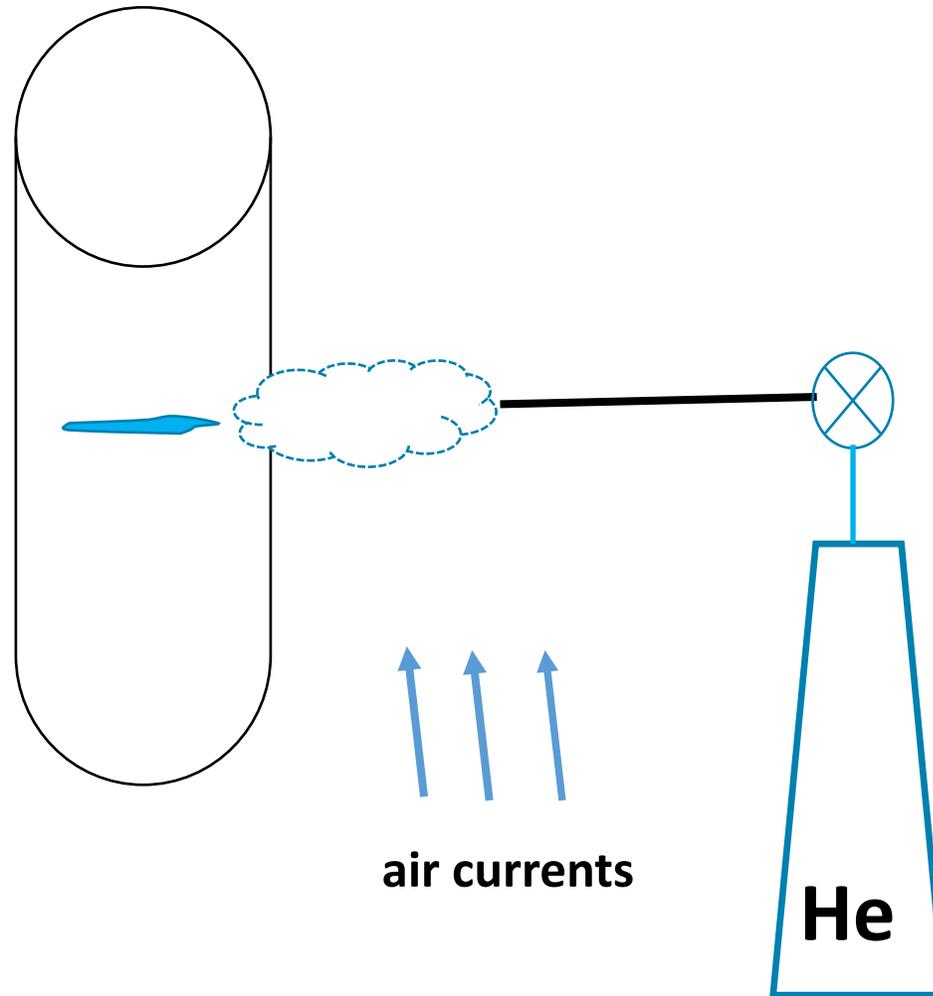
Helium Air Inleakage Testing: Outdoor (unsuccessful)



air currents



Helium Air Inleakage Testing: Outdoor (successful)



Air In-leakage at Unexpected Locations



Air In-leakage at Unexpected Locations



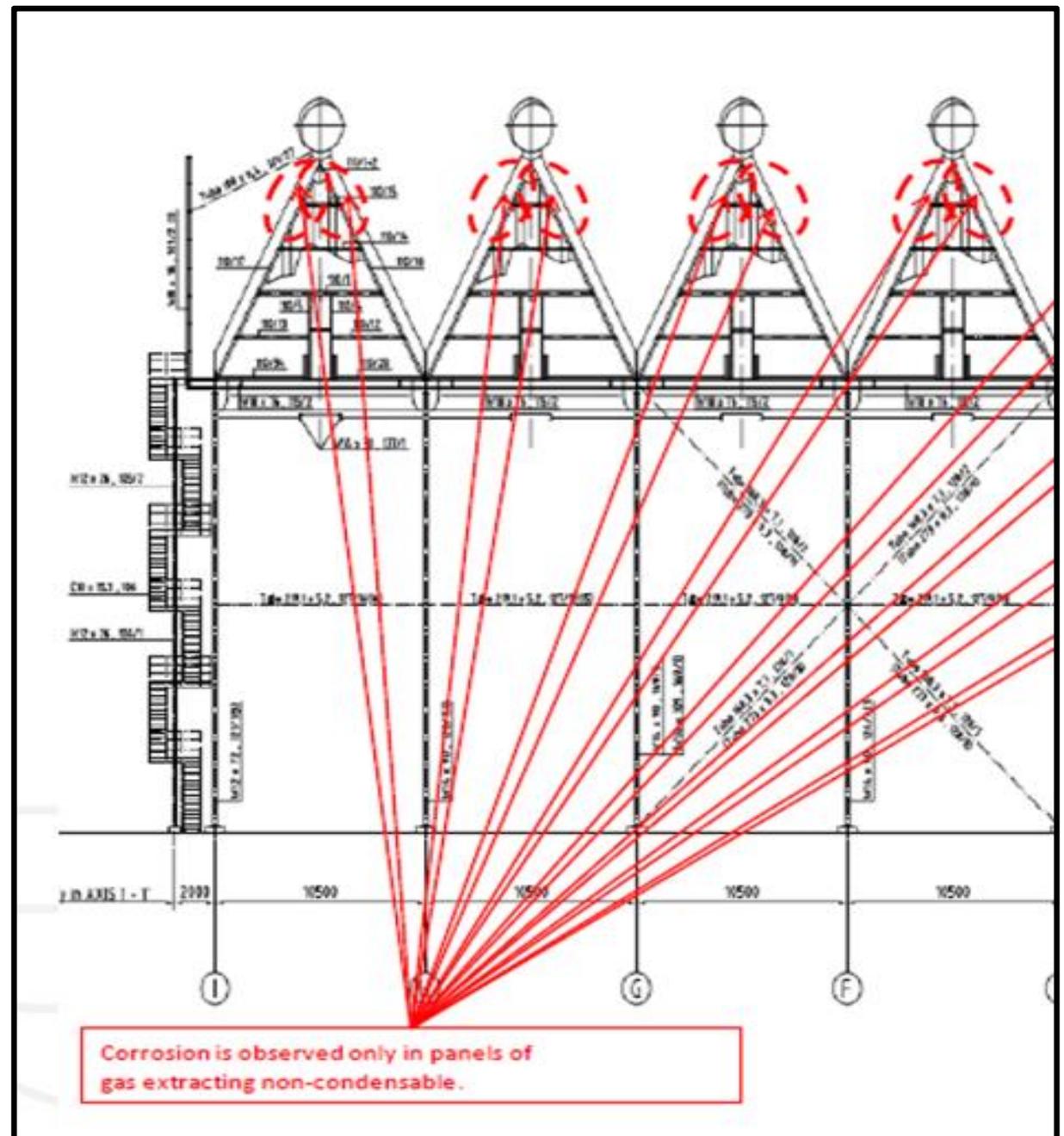
Air In-leakage at Unexpected Locations







Corrosion at upper end of dephlegmators resulted in air inleakage



Strategies for ACC Air Inleakage Testing

Helium:

- fans in the vicinity off
- still air
- plan on comprehensive access, get CLOSE to possible leaks

Alternatives:

- infrared
- acoustic
- other ???

Impact of Excess AIL on Plant Performance

Air Blanketing

Sections of the ACC can be blocked by excess AIL and are not available for cooling

→ increased backpressure / increased fuel use

Heater Blanketing

Nitrogen blanketing of feedwater heaters / deaerators (if present)

Chemistry Control

Oxygen / carbon dioxide ingress

Future ACC Guidelines Documents

- External inspection?
- ??? - prioritization

Q&A

The image features the text "Q&A" rendered in a vibrant, 3D green font. The characters are thick and blocky, with a slight shadow cast beneath them on a light gray surface. The "Q" is on the left, followed by an ampersand "&" in the middle, and the letter "A" on the right. The overall style is clean and modern.