



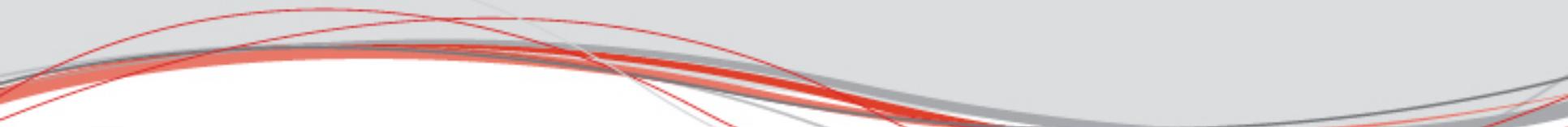
AIR COOLED CONDENSER USERS GROUP

Guidelines for Internal Inspection of ACCs

Andy Howell

**7th Annual Meeting of the Air-Cooled
Condenser Users Group**

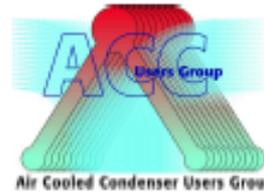
September 21-24, 2015 • Gettysburg, PA



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

- **Completed May, 2015**
- **Scheduled for review & revision May, 2018**
- ◆ **comments / suggestions are welcome**
- **Posted on the ACCUG website:**

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



Air Cooled Condenser Users Group

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

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Chairman, ACCUG:

Dr. A. G. Howell
Xcel Energy
Henderson, Colorado, USA
Email: andy.howell@xcelenergy.com

ACCUG Steering Committee Members:

Gary Bishop
GWF Energy, LLC
Pleasant Hill, California, USA
Email: gbishop@starwestgen.com

David Rettke
NV Energy
Las Vegas, Nevada, USA
Email: drettke@nvenergy.com

Dr. R.B. Dooley
Structural Integrity Associates
Southport, Merseyside, UK
Email: bdooley@structint.com

René Villafuerte
Falcon Group - Comego
Ramos Arizpe, Coahuila, Mexico
Email: rvillafuerte@comego.com.mx

Hoc Phung
PG&E
San Francisco, California, USA
Email: hqp1@pge.com



Introduction

- **ACCs are very large structures with large surface area of iron**
- **Corrosion results in iron transport and air inleakage, which can be big problems**
- **Internal inspection is important to check on status of steam cycle chemistry treatment, and to identify changes that may be needed.**

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**

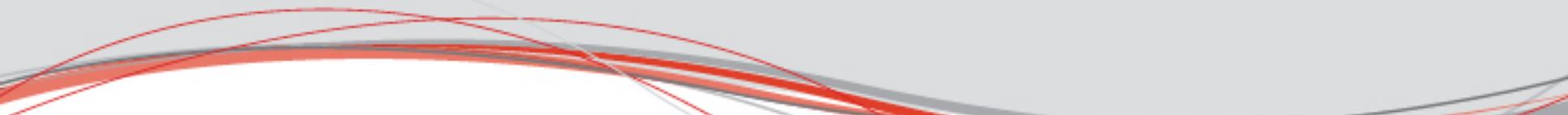
ACC Configuration

- **Factors influencing internal corrosion:**
 - ◆ **cooling tube length / entry shape**
 - ◆ **number of rows**
 - ◆ **number of fans / operational flexibility**
 - ◆ **condensate drainage**
 - ◆ **condensate deaerator**
 - ◆ **parallel cooling – steam velocity**



ACC Operation

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



Frequency of Inspection

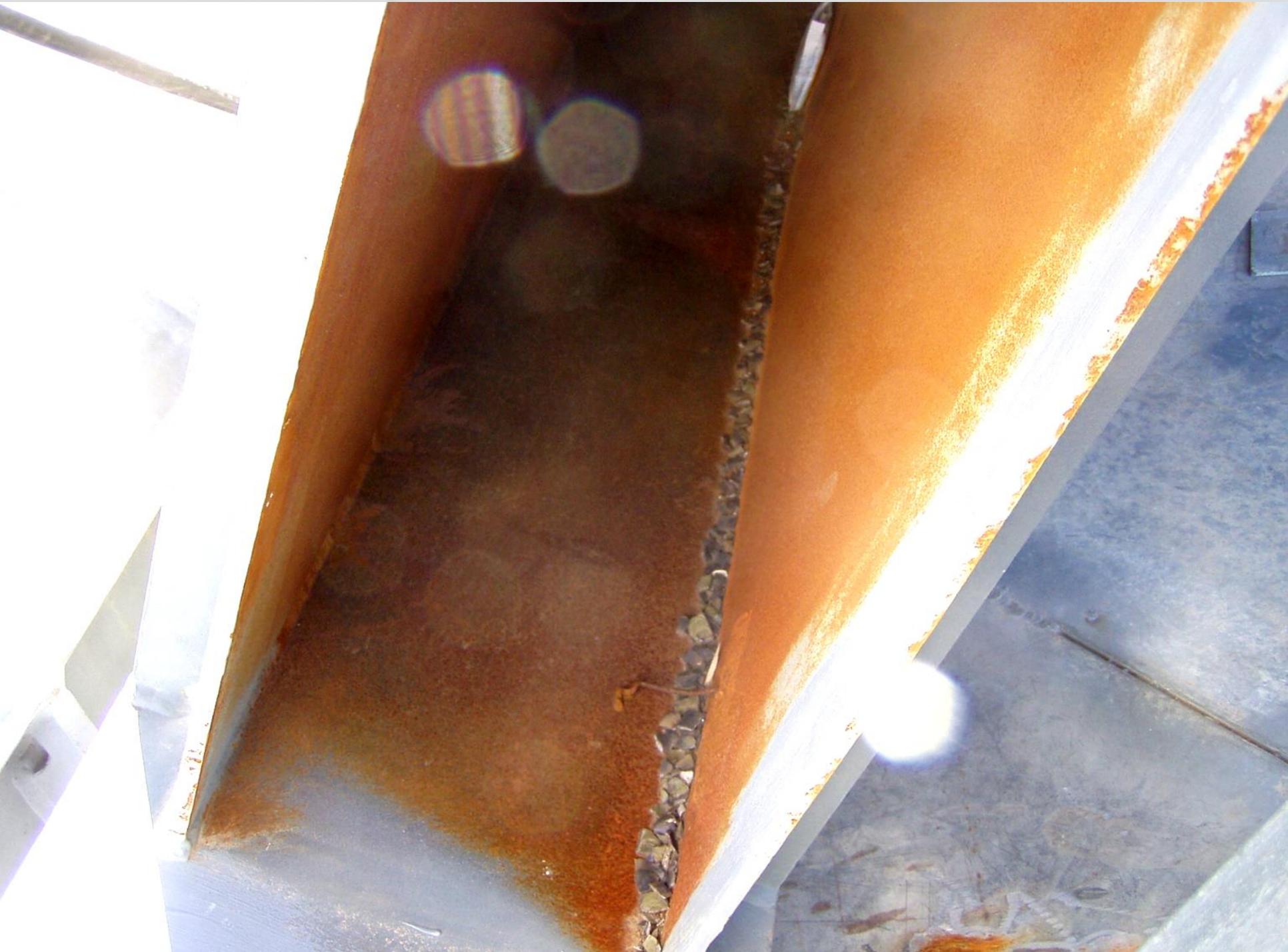
- **Thoroughly during construction**

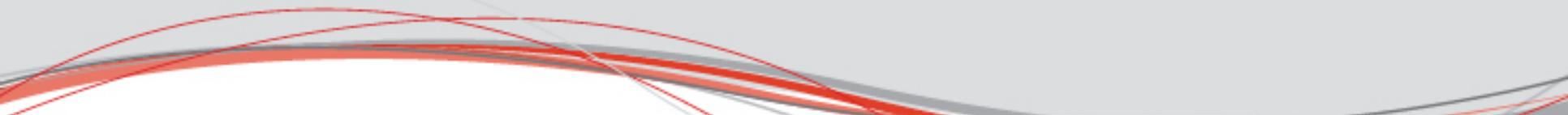
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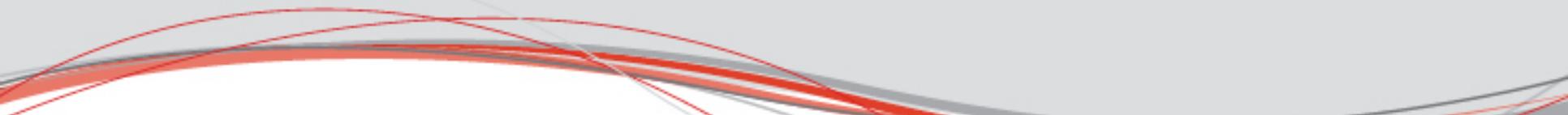
Frequency of Inspection

- **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.**



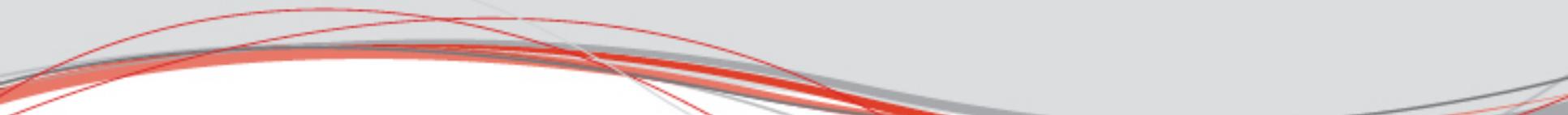
Safety

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

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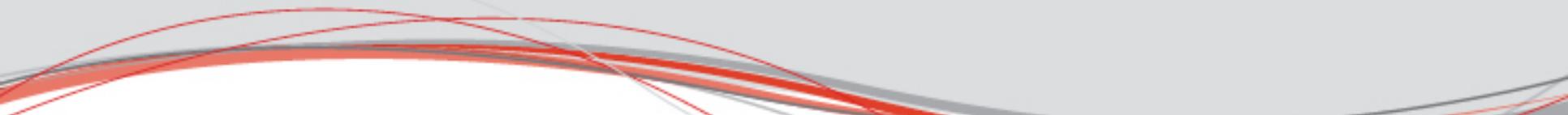
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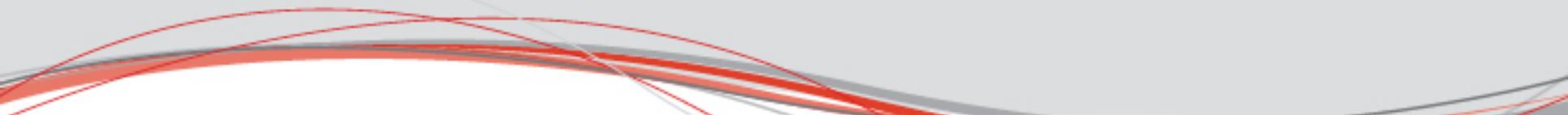
Safety

- **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**

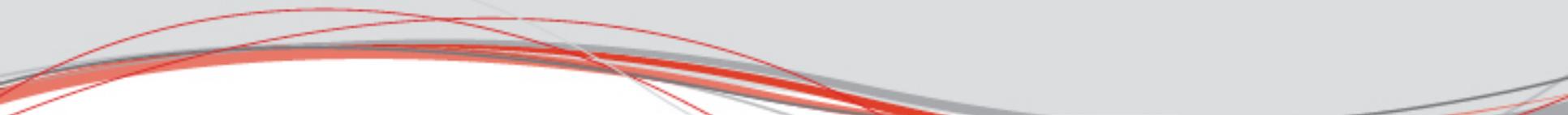


Rating: DHACI (1 – 5)

Upper Section: duct, cooling tube entries

- **1 - Good condition: no corrosion found**





Rating: DHACI (1 – 5)

Upper Section: duct, cooling tube entries

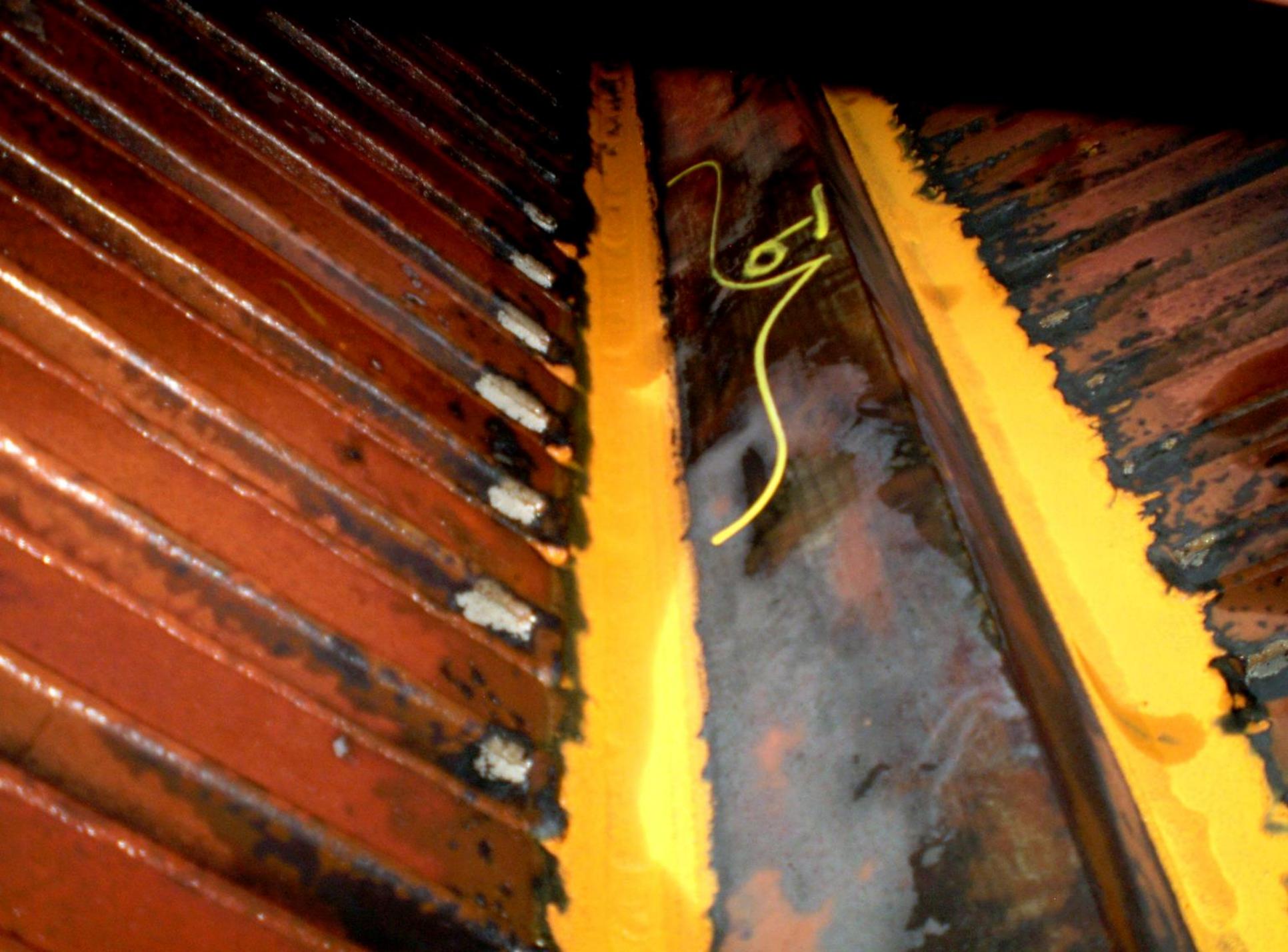
- **1 - Good condition: no corrosion found**
- **2 - Minor corrosion: no bare metal, but black deposits at tube entries**



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



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Rating: DHACI (1 – 5)

Upper Section: duct, cooling tube entries

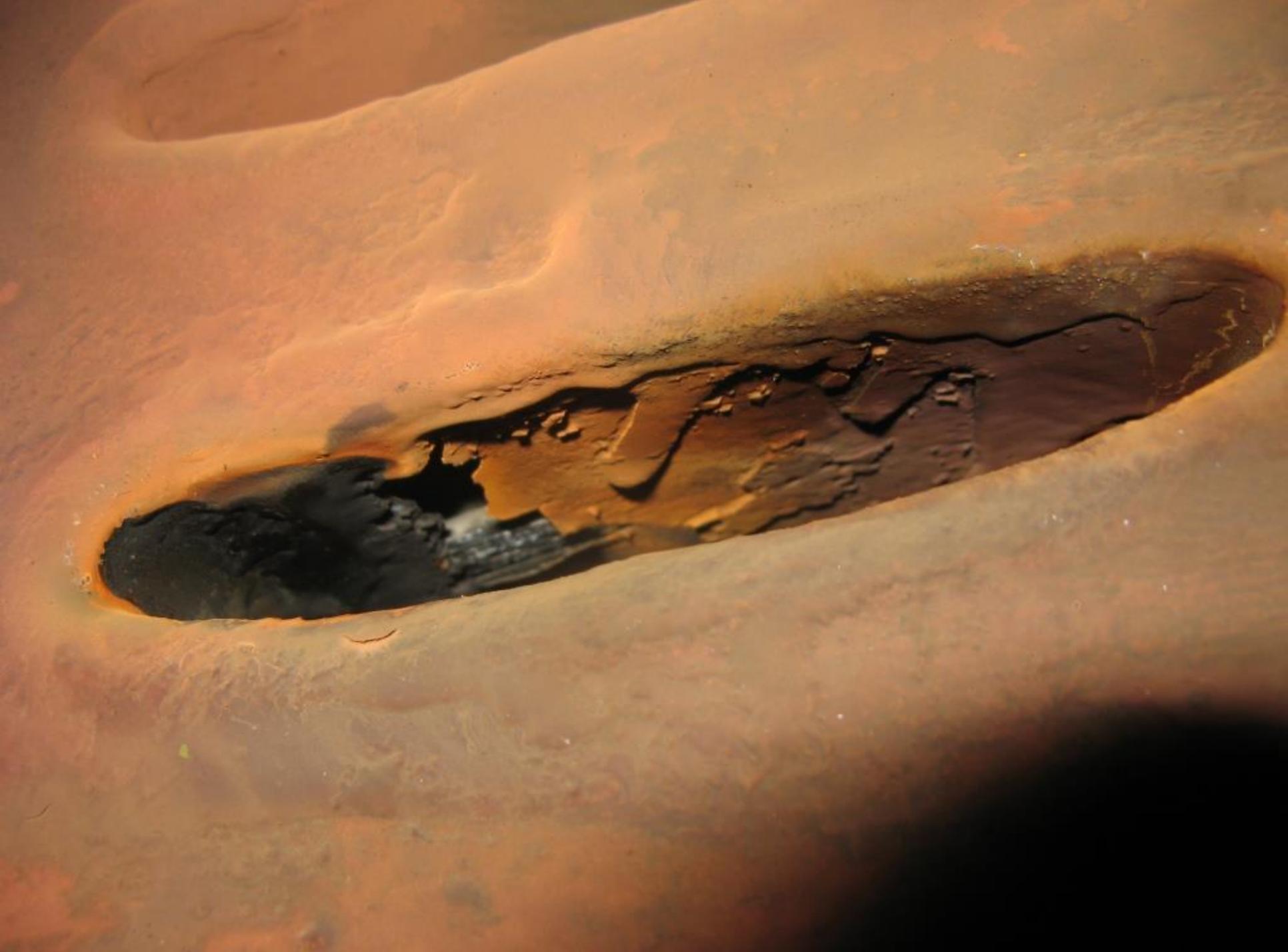
- **1 - Good condition: no corrosion found**
- **2 - Minor corrosion: no bare metal, but black deposits at tube entries**
- **3 – Moderate corrosion: scattered spots of bare metal, black deposits**
- **4 – Serious corrosion: widespread bare metal at tube entries along with widespread black deposits**



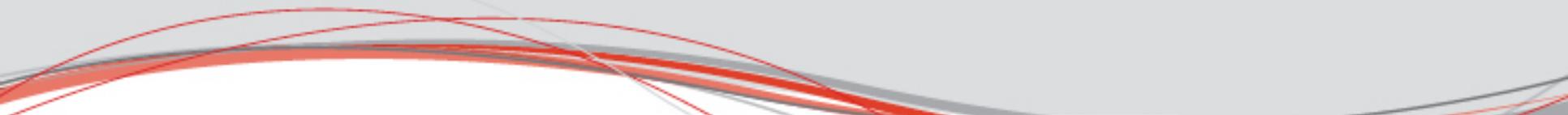
Rating: DHACI (1 – 5)

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**





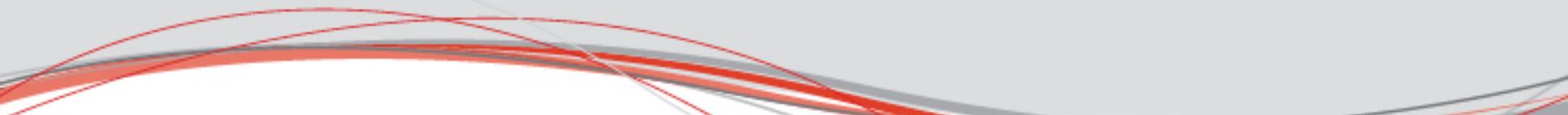


Rating: DHACI (A – C)

Lower Section: turbine exhaust, lower duct, risers

- **A - Good condition: no corrosion found**

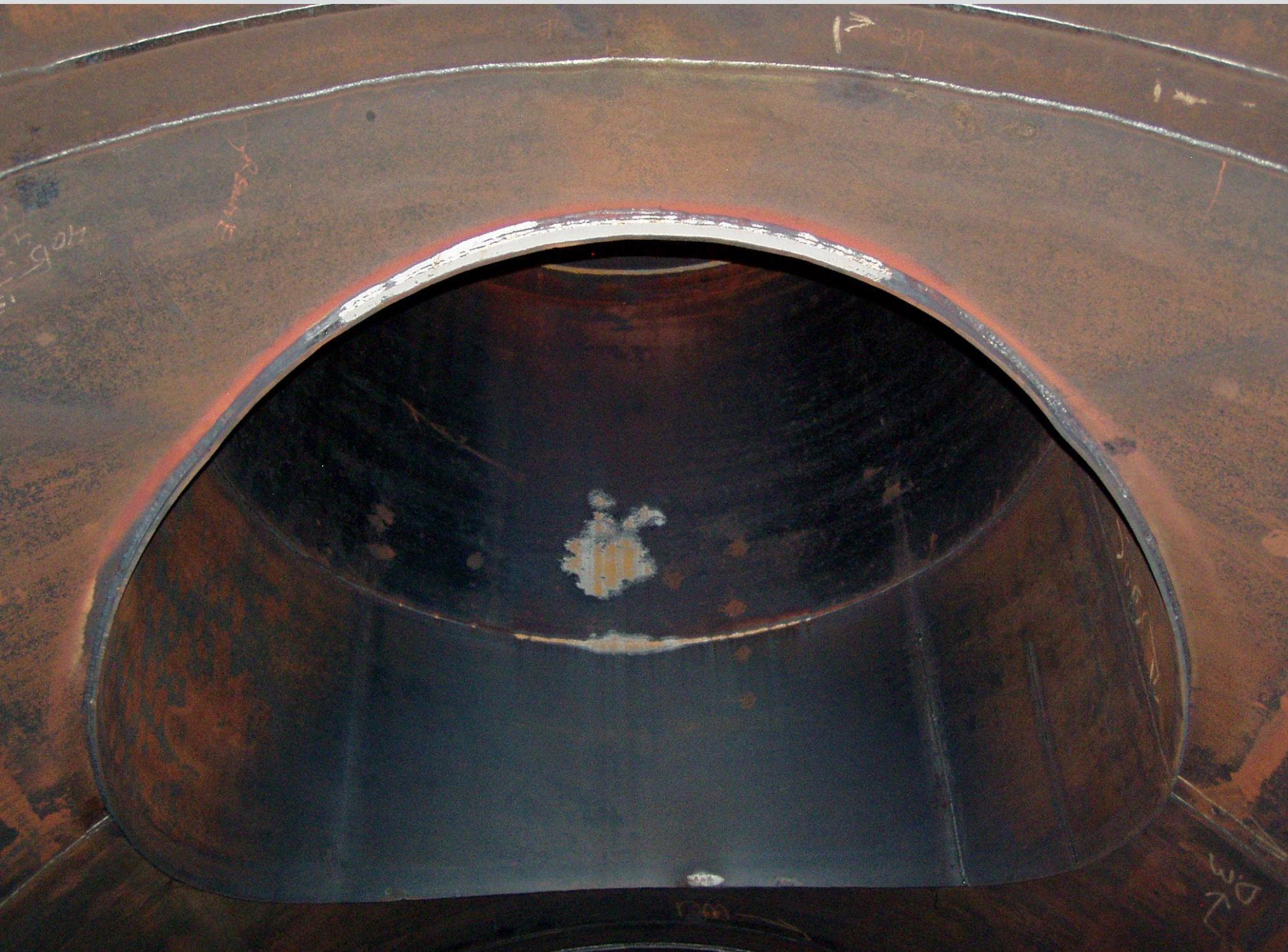




Rating: DHACI (A – C)

Lower Section: turbine exhaust, lower duct, risers

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



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DRL

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 metalscattered spots of bare metal, black deposits**

C



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

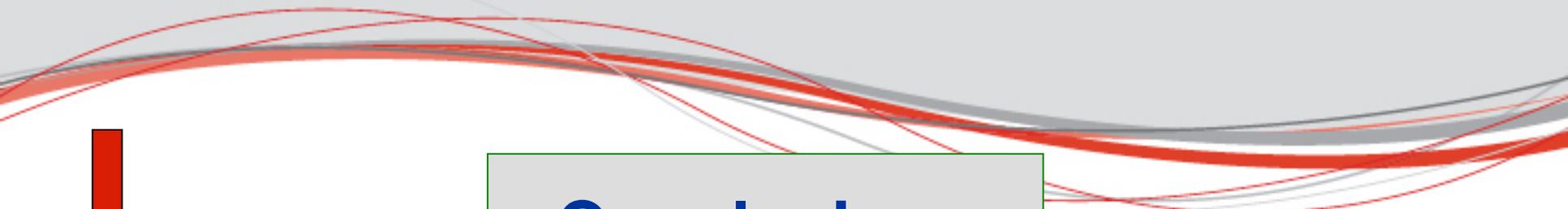
Unit name	
Date inspected	
Inspector	
Plant contact	
Unit design (general / MW capacity)	
ACC design	
Tube type	
ACC manufacturer & startup year	
Condensate T (seasonal)	
Design steam flow	
Condensate polishing? (describe)	
Condensate filtration? (describe)	
Condensate Fe levels: startup	
Condensate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





Conclusions

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

A complementary document for external inspection of ACCs is in initial stages of preparation.

An additional guideline document to address external cleaning of ACC finned tubing is under consideration.



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Questions?