AIR COOLED CONDENSER USERS GROUP

Guidelines for Internal Inspection of ACCs

Dr. Andrew G. Howell

International Air-Cooled Condenser Meeting

October 13-15, 2015 • Xi'an, China

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/

http://acc-usersgroup.org/

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

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

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
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**

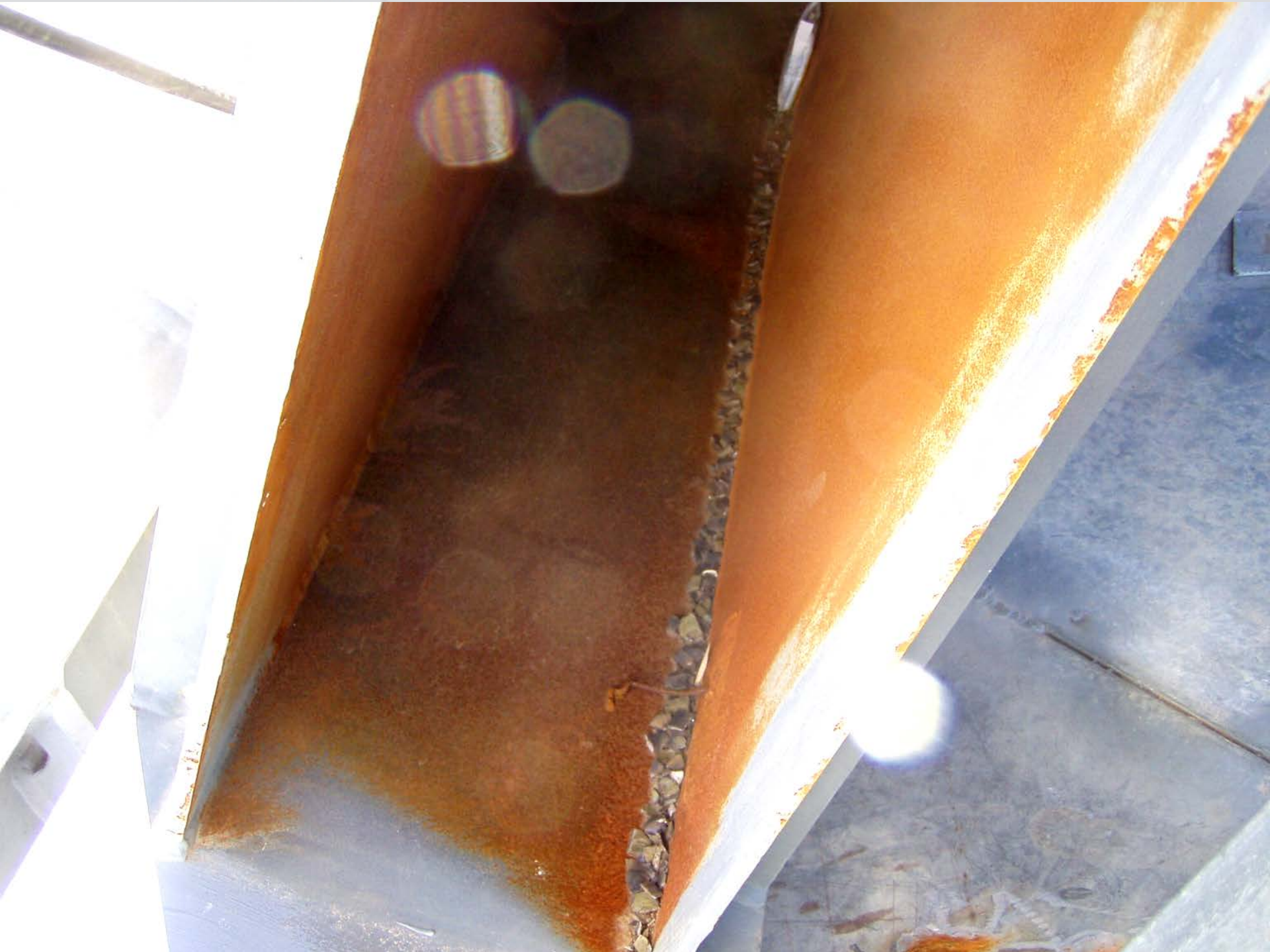
ACC Operation

- 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**


18-08
MH
9-18-08



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


G9-43A
JLG / GRADAL

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)

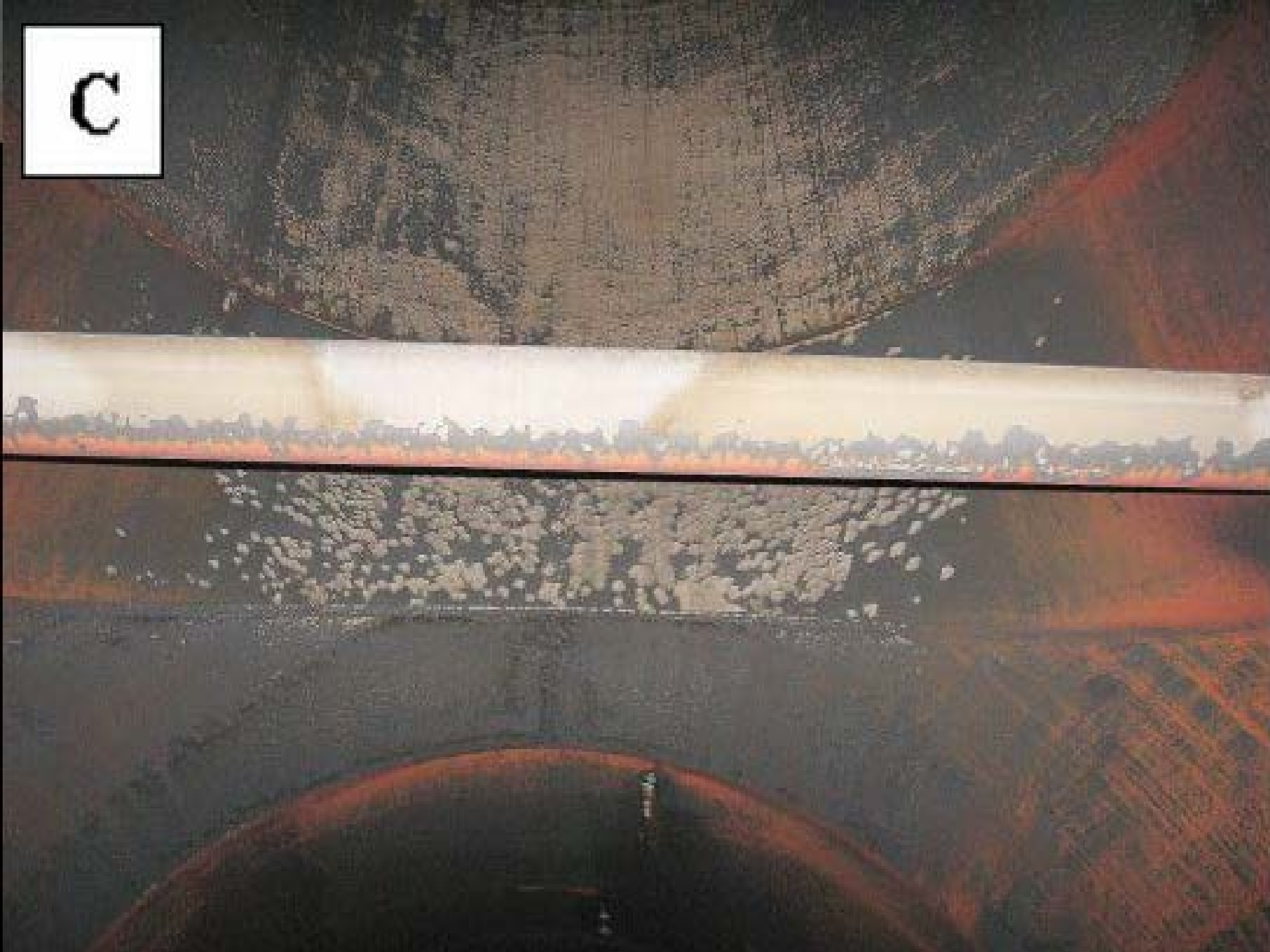
Lower Section: turbine exhaust, lower duct, risers

- **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 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 metalscattered 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.

AIR COOLED CONDENSER
USERS GROUP

Questions?