Cleaning Air-Cooled Condensers Case Studies

ACC Users Group

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Case 1: Leaking Tubes

Yellowstone Power Plant
Air Cooled Condenser

Case 1: Leaking Tubes

- Each module contains
  - 1 fan
  - 6 finned tube bundles
- ACC has 10 module consisting of
  - 8 condensing cells
  - 2 reflux cells
- Finned tube bundles have
  - 211 galvanized coated carbon steel oval tubes in a 3 tube arrangement

Case 1: Leaking Tubes

- The ACC has 10 fans
  - 26 foot
  - 10 bladed
  - 2 speed gear reduced motor
- Fans turn at
  - 125 RPM – fast mode
  - 63 RPM – slow mode
- Fan motors have reverse contacts
  - Reverse fans in severe winter

Case 1: Leaking Tubes

Center of ACC

Case 1: Leaking Tubes

Tubes – Frozen and Degraded from Debris Trapped Behind Support Beams

Case 1: Leaking Tubes

Frozen Burst Tube

Case 1: Leaking Tubes

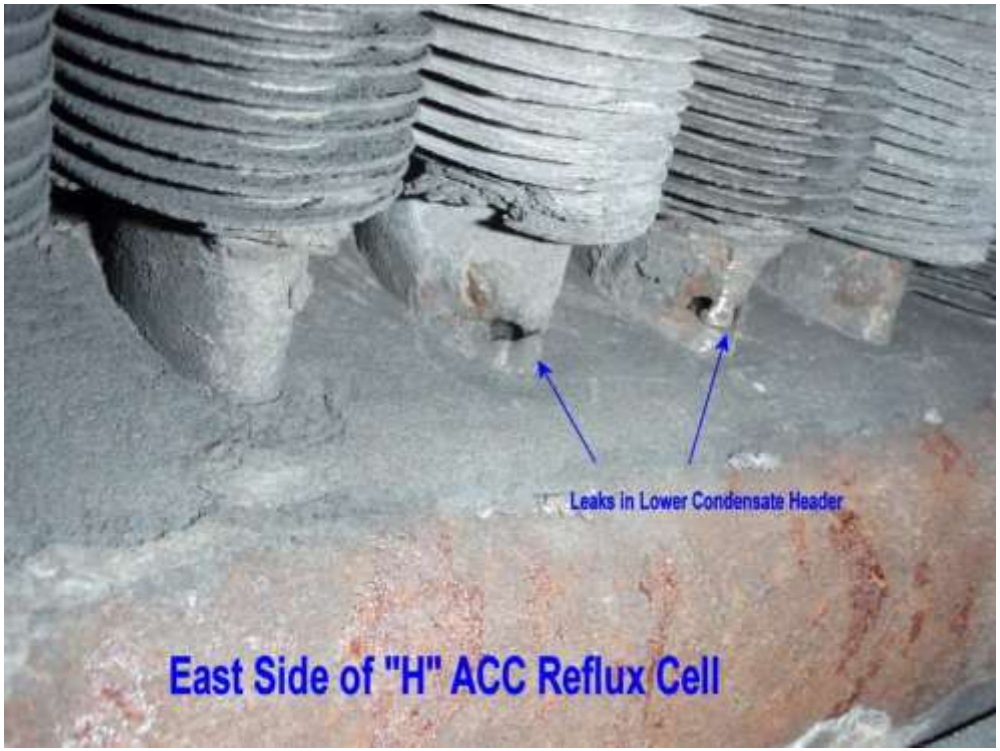
Holes in Top of Tube Connections to Steam Header

Case 1: Leaking Tubes

Removal of Outer Tubes – Gain Access to Inner Row Tube Leaks

Case 1: Leaking Tubes

Leaks in Tubes at Lower Condensate Header Connections



Case 1: Leaking Tubes

Environmental problems

- Wind
- Debris
  - Cotton from cottonwood trees
  - Ash
  - Coke dust
  - Other debris
- Cold weather
- Hot weather

Case 1: Leaking Tubes

YPP's Solutions

- Use of underground cable shrink wrap and aluminum duct tape
  - Patch major leaks in tubes
- Use of sleeve inserts and outer sleeves
  - Fix tube to header connection leaks
- Sandblasting and pressure washing of tubes
  - Remove debris from finned areas

Case 1: Leaking Tubes

YPP's Solutions Continued

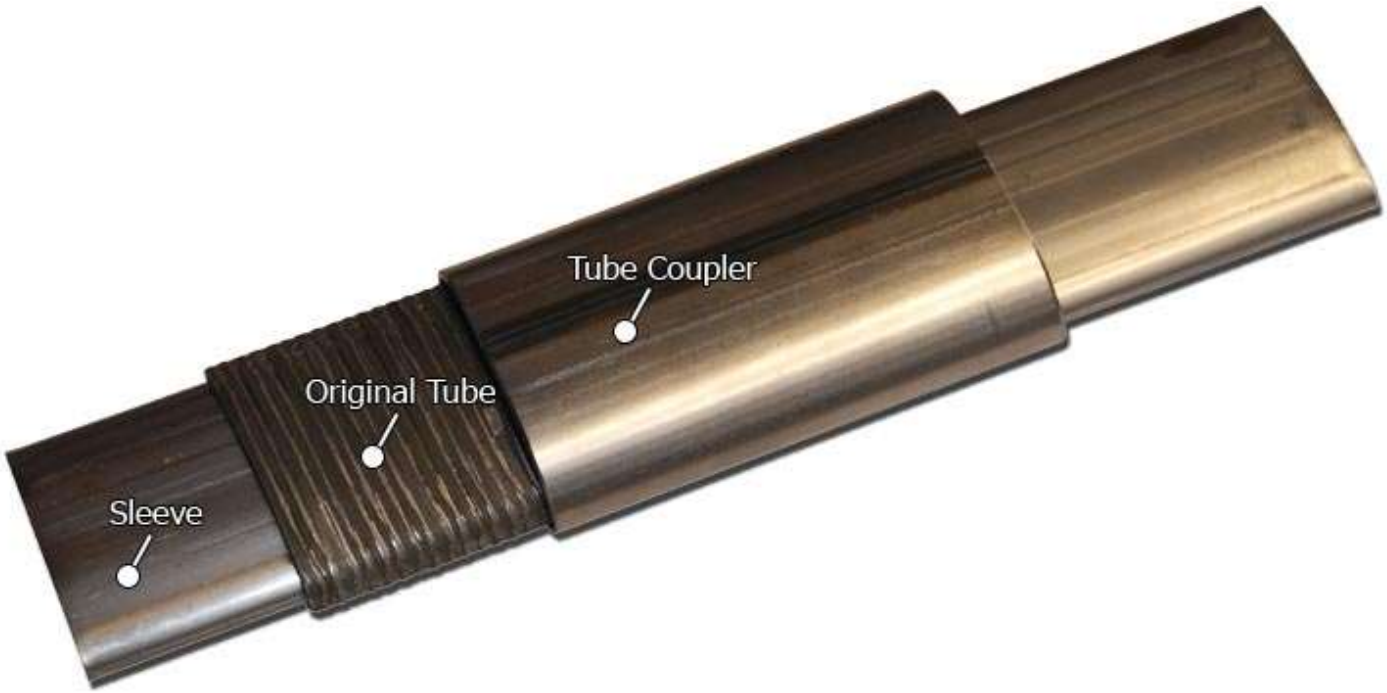
- Use of epoxy paints
  - Help preserve and close pin hole leaks
    - Steam header connections
    - Condensate headers
- Wind Fence
- Wind Wall

Case 1: Leaking Tubes

Cable Shrink Wrap – Repair Major Holes in Tubes

Case 1: Leaking Tubes

Tube Sleeve Inserts and Outer Couplers



Case 1: Leaking Tubes

Epoxy Paint

Holes in Tube Headers

Holes Repaired and Epoxy Painted

Case 1: Leaking Tubes

Wind Fence

Case 1: Leaking Tubes

Wind Wall

Case 2: Cleaning with Biodegradable Degreaser

Plant Conditions

- Plant burns coker gas from refinery
- Steam produced sent back to refinery
- Harsh winter partially froze coker gas line
  - Created blockage in the line
  - High pressure behind the blockage

Case 2: Cleaning with Biodegradable Degreaser

Problem

- When blockage broke free
  - Pressurized oil leaked through the Loop Seal Stack
  - Oil covered
    - Outside surface of the ACC unit
    - Surrounding areas

Case 2: Cleaning with Biodegradable Degreaser

Oil on Surface of Unit

Case 2: Cleaning with Biodegradable Degreaser

Oil Covers Unit

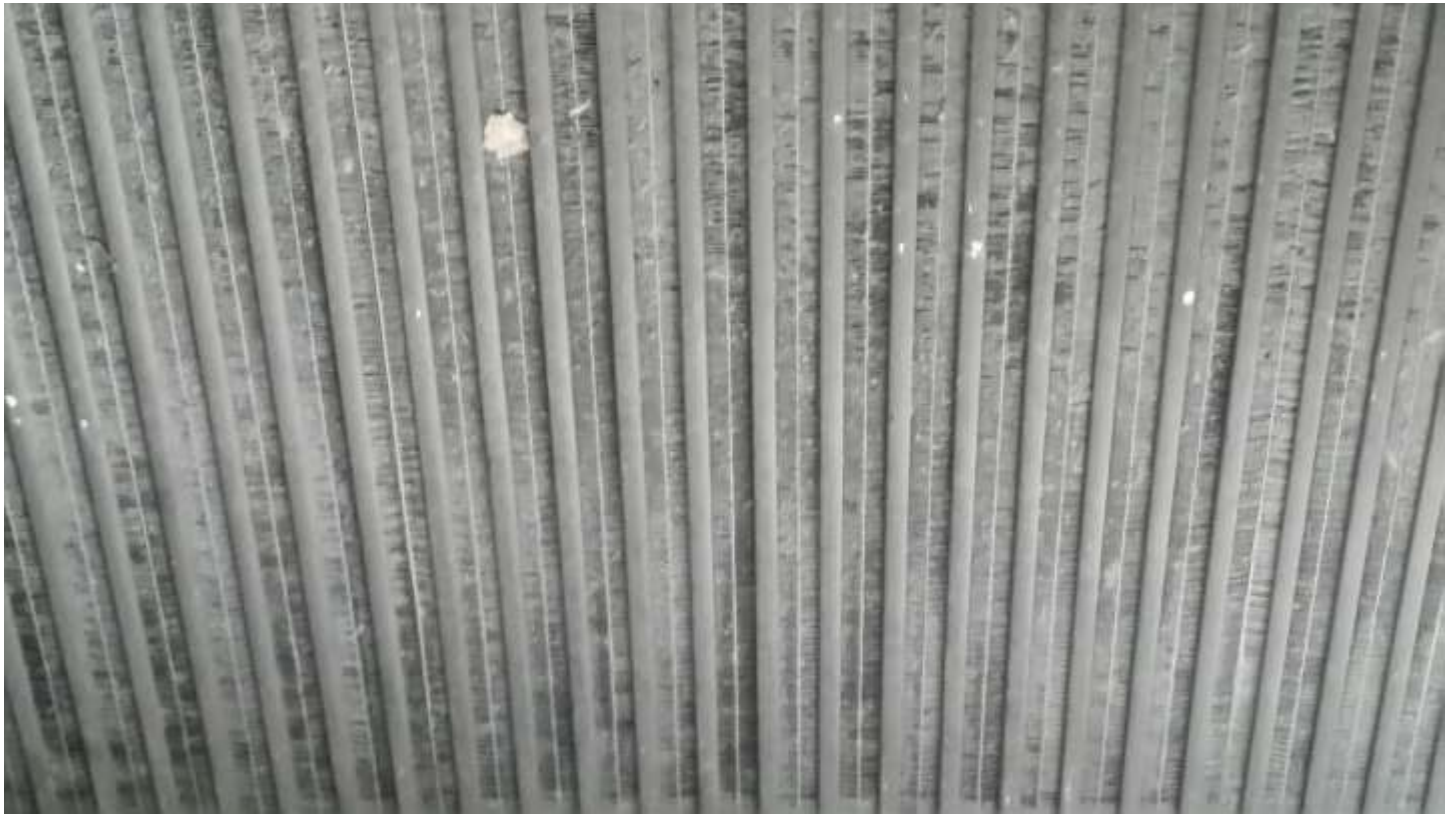
Case 2: Cleaning with Biodegradable Degreaser

Additional Problem

- Truck spilled fly ash near the ACC unit
- Ash sucked into the ACC fans
- Under side of fins coated with oil and ash
- Oil acted like a glue

Case 2: Cleaning with Biodegradable Degreaser

Ash Covers Fins Underneath Unit



Case 2: Cleaning with Biodegradable Degreaser

Initial Attempt to Clean

- Plant attempted to clean unit using:
  - Cleaning system installed with unit
  - High pressure water
- Cleaning was unsuccessful

Case 2: Cleaning with Biodegradable Degreaser

Cleaning using De-Greaser

- ACC cleaning system brought to plant
  - Capable of higher pressure – adjustable
- Bundles presoaked with bio-degradable degreaser
- Unit cleaned using a higher pressure with ACC cleaning system

Case 2: Cleaning with Biodegradable Degreaser

ACC Cleaning System

Case 2: Cleaning with Biodegradable Degreaser

ACC Cleaning System: Riding the Rails

Case 2: Cleaning with Biodegradable Degreaser

View from Inside Unit

Case 2: Cleaning with Biodegradable Degreaser

Results

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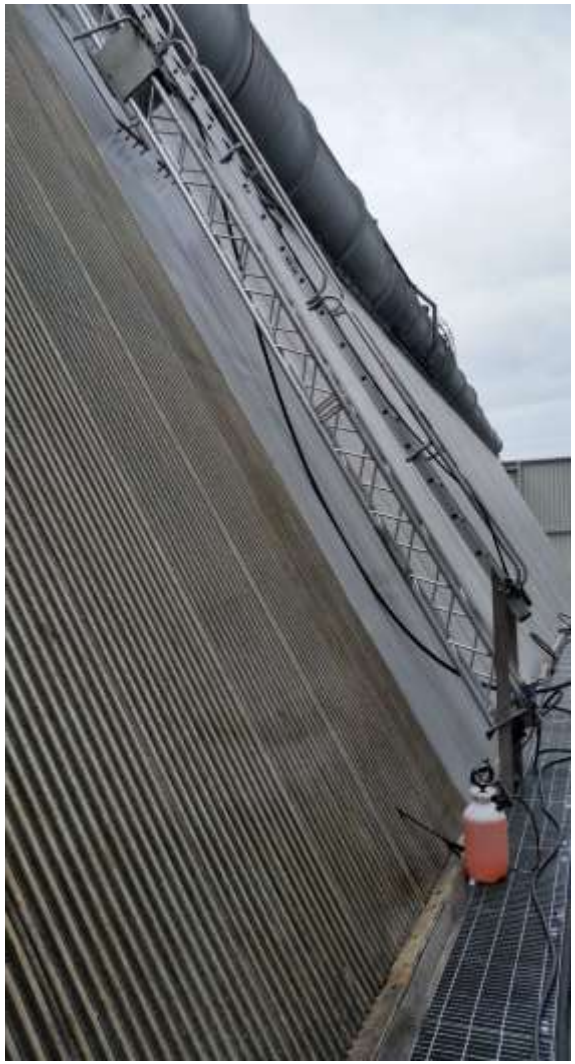
Results



Case 3: ACC Vertical Unit Cleaning Solution

Haverhill

- Issue – unable to effectively clean unit
- Standard ACC cleaning system did not fit
- Had to modify entire unit
- Cleaning system had to fit between fans and unit

Case 3: ACC Vertical Unit Cleaning Solution

- Vertical ACC unit
- Consists of 78 fans
- Rectangular structure
- Fans on each of the 4 sides
- Fans are 2 high on each side
- ACC structure on the top of Main Building

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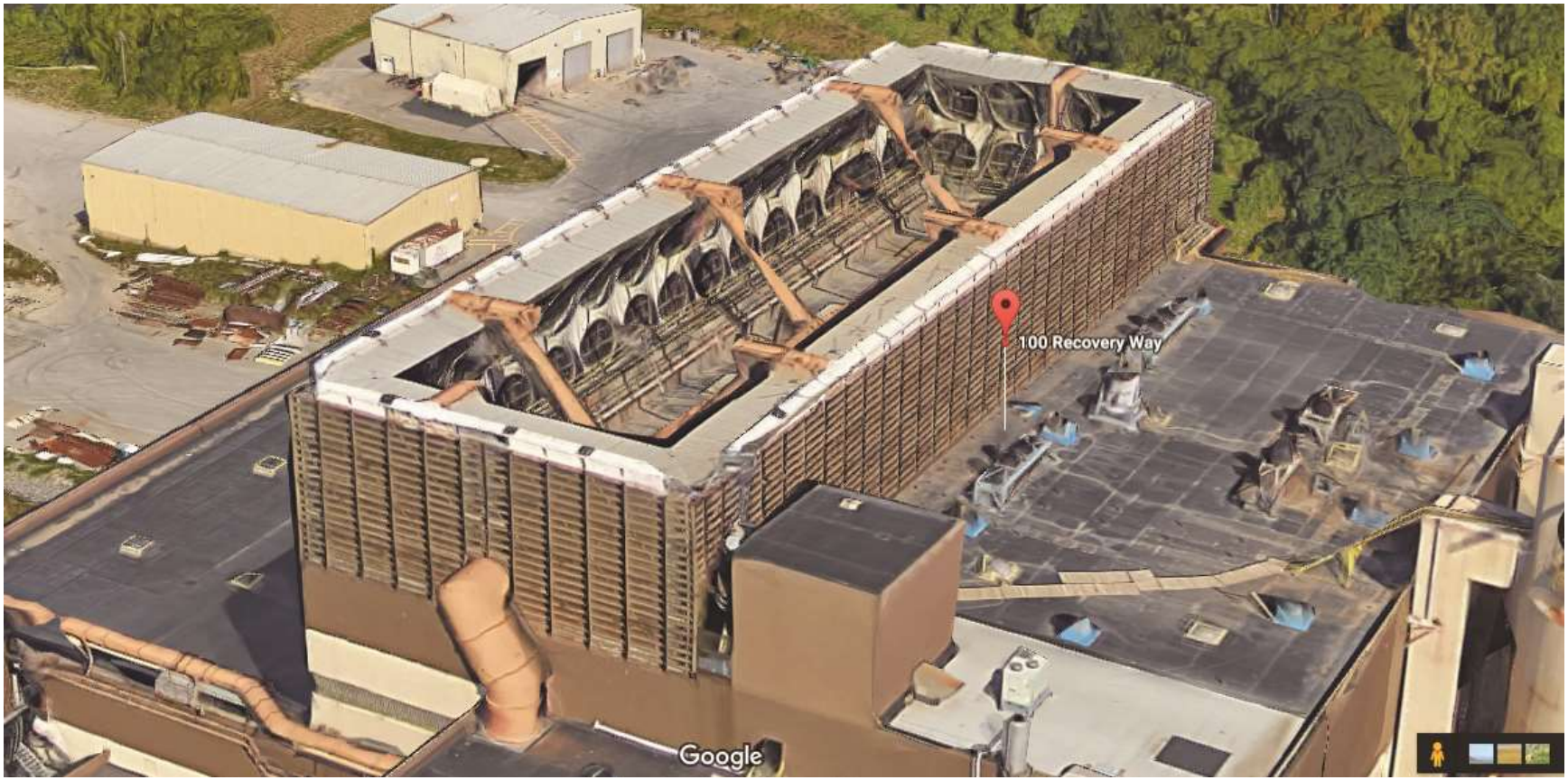

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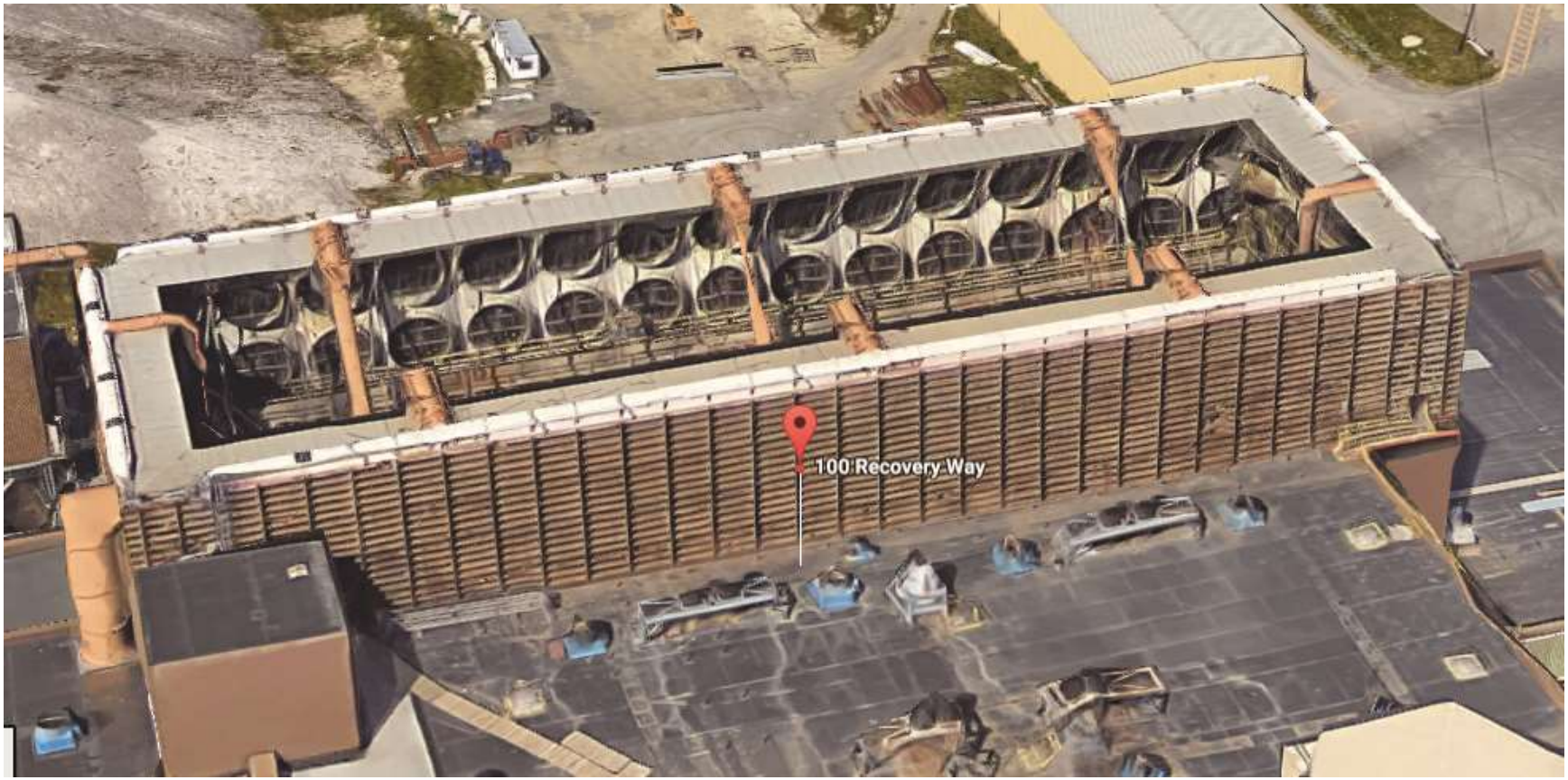


Case 3: ACC Vertical Unit Cleaning Solution

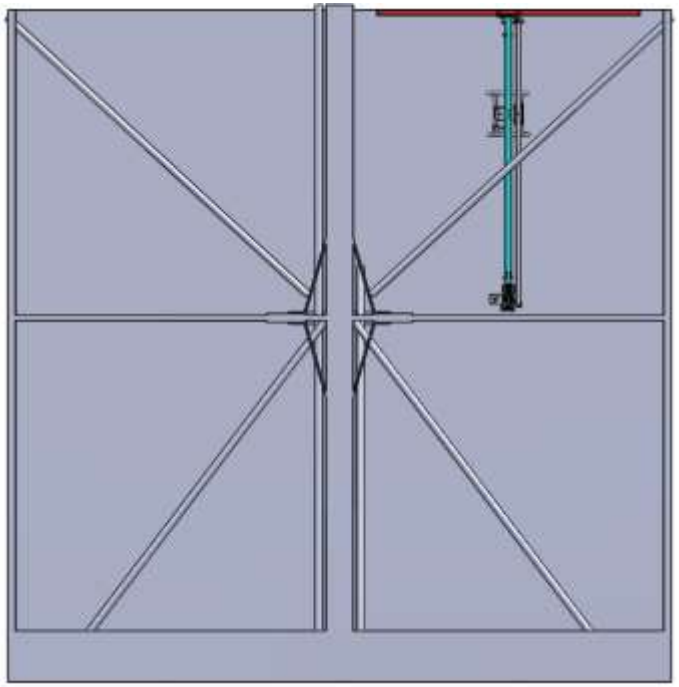
Standard ACC Cleaning Equipment

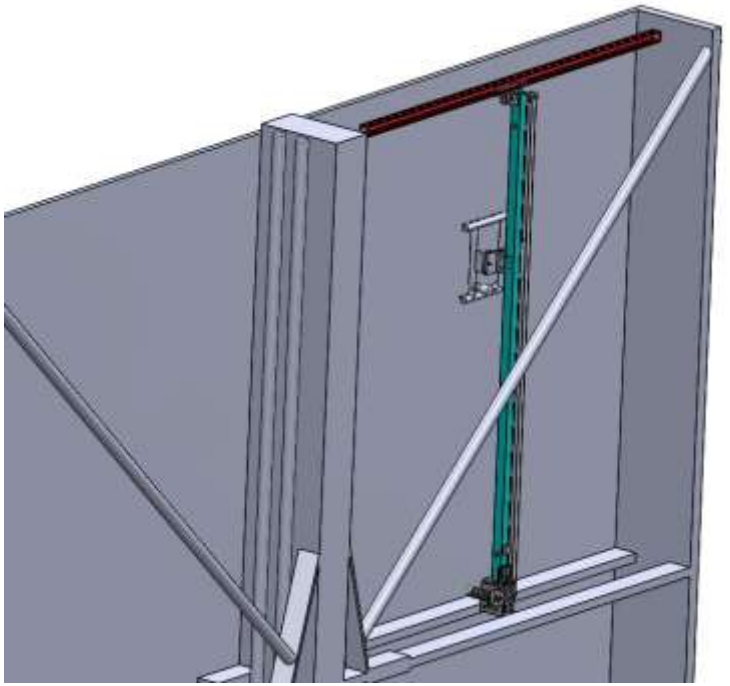
Case 3: ACC Vertical Unit Cleaning Solution

ACC System Modifications

Case 3: ACC Vertical Unit Cleaning Solution

ACC System Installation





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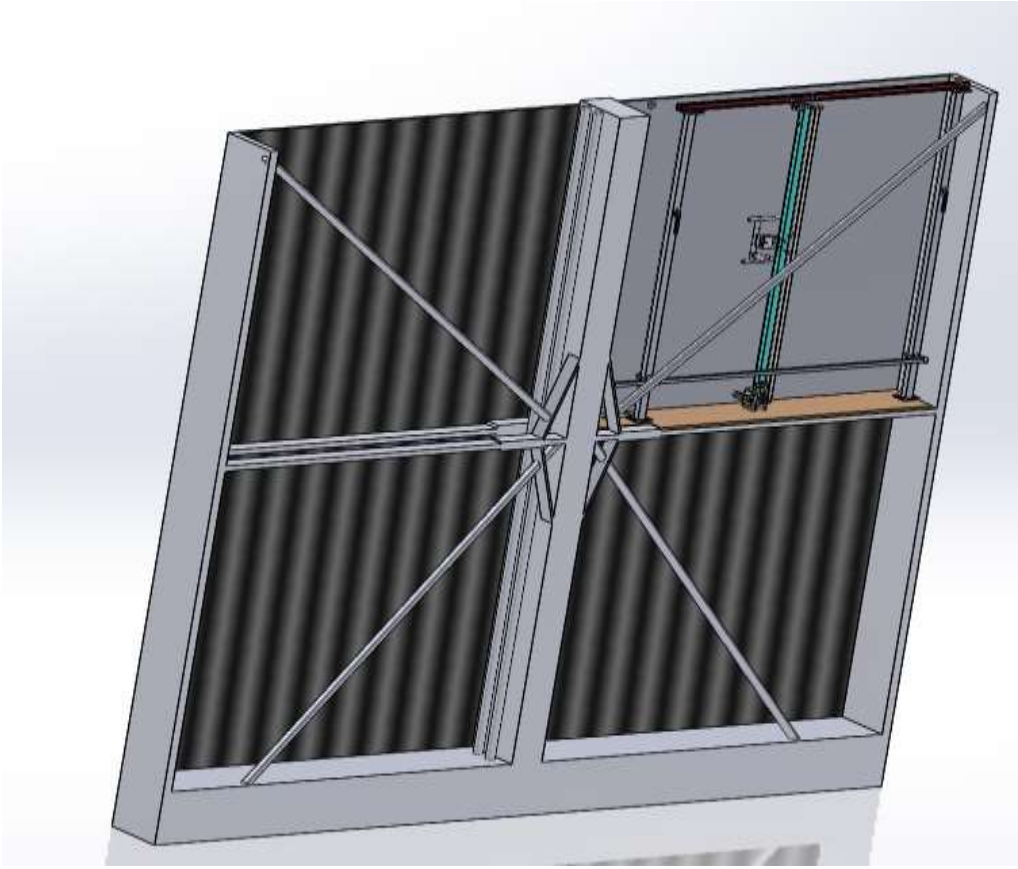

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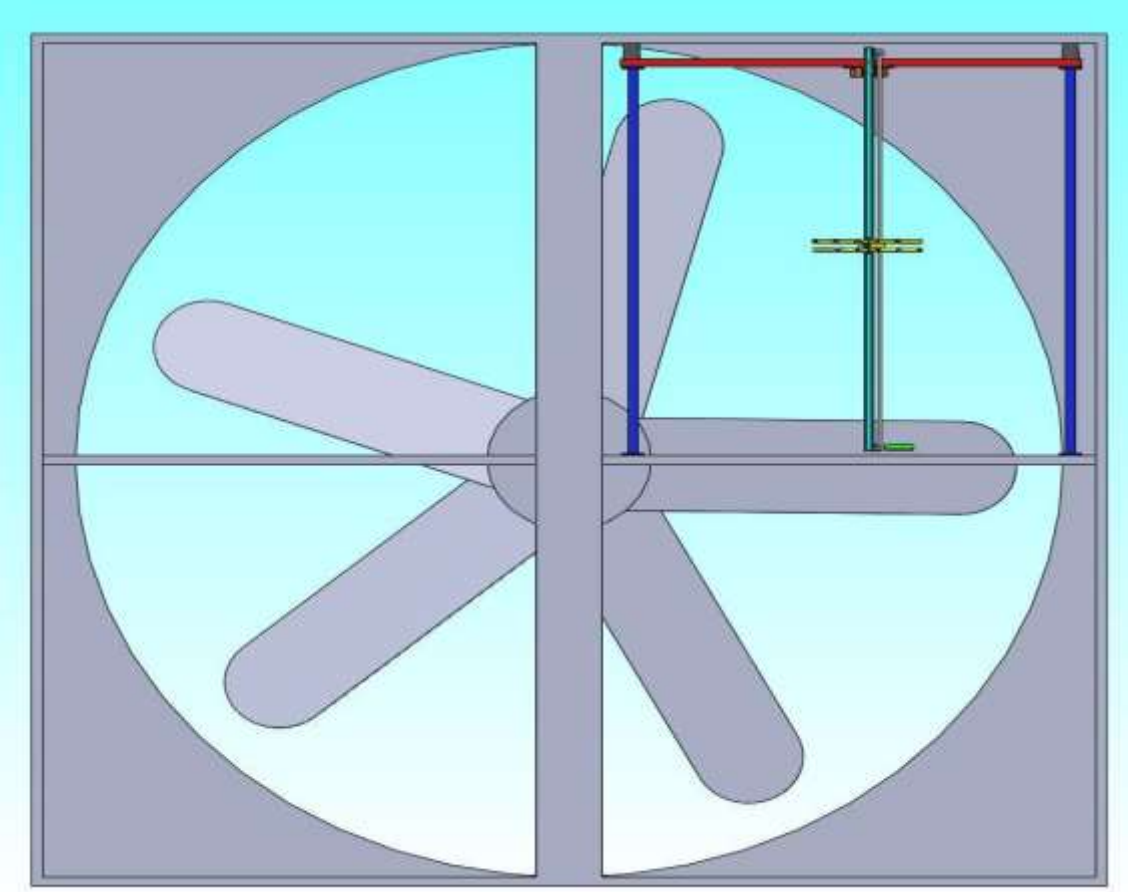

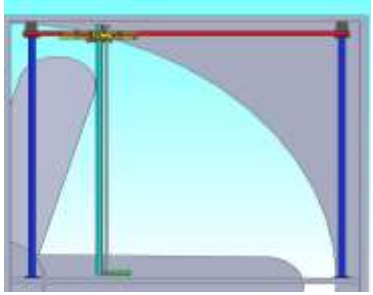

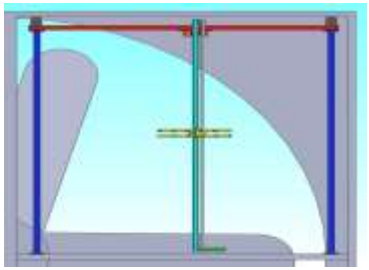

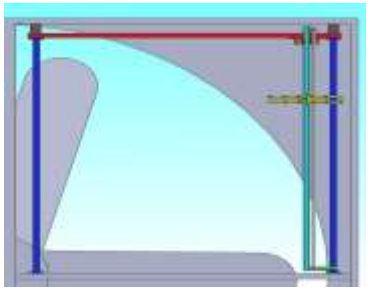

Questions