

## FFS Applications For ACCs Across the Dominion Fleet

Shana Ferrante- Fleet Chemistry Consultant Dominion Energy Robert Trossbach- Application Engineer SUEZ WTS

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#### Overview

- 3 of Dominion's ACC units currently feed Film Forming Substances
  - 2 HRSGs and 1 Circulating Fluidized Bed (CFB)
- All 3 units are AVT(O) with ammonia/MEA treatment
- Supplementing with Suez Film Form Amine (FFA) polyamine (OLDA)
  - Targeting 20-40 ppb active polyamine residual in condensate
  - Residual filmer tested using Bengal Rose Method
  - $\circ$  Feed point location selection
- All ferrous metallurgy in each unit
- Iron levels during normal operation are generally below detection (<2 ppb total iron)
- Startup iron levels were most concerning
- Use of Hach Laser Turbidimeter for corrosion product transport monitoring



#### Objectives While Feeding FFAs

**Inspection Objectives** 

- Look for signs of hydrophobicity/beading on the metal surfaces in the following areas: ACC, Turbine Exhaust Duct (TED), LP Drum, IP Drum, HP Drum
- Metal Passivation and Repair (Exposed base metal back to passivated oxide)
- Determine Dooley, Howell, Air Cooled Condenser, Corrosion Index (DHACI) in critical areas

**Operational Objectives** 

- Minimize down time corrosion
- Reduce iron transport during startups
- Lower iron levels during normal operation
- Routine lab ICP analysis for chloride & sulfate







#### 14 Hour Laser Turbidimeter Versus Lab ICP Total Iron Trend





## Virginia City Hybrid Energy Center (VCHEC)

- Coal/Biomass Fired CFB (2600 psig)
- 610 MW
- 4500 kpph steaming rate
- Cycling Operation
- In Operation 2012
- Air Cooled Condenser
- Makeup water is UF, 2-Pass RO, Mixed Bed Demineralizers





#### **Operational History**

- High air in leakage and corrosion concerns including FAC in the ACC during the first few years of operation.
  - Caused low pH control issues
  - Needed another layer of protection
- Saw up to 2 ppm of total iron during startups and extended iron transport for days before returning to baseline (2 ppb)
- Original chemical treatment included ammonia/MEA blend with supplemental ammonia for pH control, AVT(O)
- Target pH of 9.9 could not be achieved and operated 9.4-9.6 in BFW & condensate
- Began trialing a FFA in 2014 and switched to film forming chemistry (with no neutralizing amines) in 2020. Feed controlled by steam flow.



#### Chemical Feed Point Locations

- Originally fed FFA to the condensate pump discharge (CPD) from 2014-2019
  - Significant reduction in iron throw during startups
  - $\circ~$  DHACl index reduced from 4 in 2014 to 3 in 2019
  - Robust hydrophobic film in the TED but less so in the ACC streets
  - Possible reasons why we could not get complete coverage across the ACC
    - Surface area in the ACC requiring coverage
    - Potential thermal decomposition of the FFA (2600 psig)
- Relocated feed point to the turbine exhaust duct (TED) in 2019
  - Target the ACC directly
  - Using steam assisted injection to atomize the product
  - o Significant improvement in hydrophobic film coverage in the ACC streets
  - $\circ~$  DHACl index reduced from 3 in 2019 to 1-2 in 2020



#### Inspection Photos- ACC Street



| 2014    | 2019    | 2020      |
|---------|---------|-----------|
| DHACI 4 | DHACI 3 | DHACI 1-2 |



## Warren County

- 3 on 1 Triple-pressure HRSG (2500, 725, 140 psig)
- 1370 MW
- 3000 kpph steaming rate
- In Operation 2014
- Base Load Operation
- Air Cooled Condenser
- Makeup water is UF, 2-Pass RO, CEDI
- Duct Burners
- Inlet Air Chilling





#### **Operational History**

- Original chemical treatment included an ammonia/MEA blend for pH control, AVT(O)
  - Target pH 9.8-10 in condensate
- After seeing results at VCHEC, we began a campaign to use polyamine in all of our units (4 ACCs & 6 conventional water-cooled condensers).
- Began feeding FFA in mid-2017
- Chemical injected directly into TED, controlled by steam flow
- Immediately (months) saw presence of hydrophobic film in the TED and ACC
- Iron levels were very low after initiating FFA feed (<2 ppb) but have some issues where trapped water in some of the ACC streets is causing additional impingement on the metal.



#### FAC Reduction- ACC Condenser Tubes

FAC



Tube welds repaired, hydrophobicity present



2019: DHACI 1

2016: DHACI 3



## Brunswick County

- 3 on 1 Triple-pressure HRSG (2600, 750, 125 psig)
- 1358 MW
- 3300 kpph steaming rate
- In Operation 2016
- Base Load Operation
- Air Cooled Condenser
- Makeup Water is UF, 2-Pass RO, CEDI
- Duct Burners
- Inlet Air Chilling





#### **Operational History**

- Original chemical treatment included an ammonia/MEA blend for pH control, AVT(O)
  - Target pH 9.8-10 in condensate
- Initial passivation of the TED and ACC after commissioning looked great
- In late 2017/early 2018 we had experienced a major air leak in the dog bone expansion joint that caused massive air in leakage, struggles with pH, and increased FAC and corrosion. The dog bone expansion joint had to be replaced during an outage.
- Began feeding FFA in late 2017
- Chemical injected into the CPD, base fed
- Targeting 20-40 ppb active filmer in the condensate
- Saw dramatic reduction in iron transport during startups within a few months
- Took several years to see a hydrophobic film in the ACC



## Startup Iron Trends: Before & After FFA Feed

- Hach TU5400sc laser turbidimeter installed on Condensate After Chem Feed sample.
- Trend is 24 hours
  - Purple Baseline Startup 10/17– No FFA feed.
  - Blue 12/25/17 Startup. FFA feed not very consistent.
  - Red 3/28/18 Startup. FFA feed consistent from 2/16 to 3/12.
  - Green- 5/12/21 Startup





### Video- Polyamine Hydrophobic Film in TED



#### Conclusions

- Arrested iron transport at VCHEC using polyamine even though they operate at a slightly lower pH
- All ACC facilities experienced severe iron transport during startups prior to FFA
- FFA feed in all facilities reduced iron transport by orders of magnitude
- Improved the DHACI in most areas
- Recommend feeding proportionally to FW/Steam flow
- Continuing to evaluate feed locations, dosing, and potentially reducing pH targets
- Conversion from a film forming amine to a new dual film forming product that has both a film forming amine and non-amine film forming component



# Thank you!

## Questions???

