PBF Energy

Chalmette Coker 1 Restart and Unheading Project

Marie Wright / Alex Tajonar / Robert Mosley
Chalmette Coker 1 Restart Decision

Background

- **January 2020:** Implement MARPOL 0.5wt% sulfur Bunker Fuel Oil spec
- **2010:** Prior owner shut down Chalmette Coker 1 - CK1
  - Began blending Resid Feed for CK1 into Bunker Fuel and Asphalt
- **2017:** Decision to restart CK1 based on processing resid for MARPOL
  - Major equipment was evaluated as “Go- No Go” to determine whether to progress restart project
Overview

Unit Overview

- 1967: start-up - Bechtel Design
- 10-12 kBD: unit throughput
- August, 2010: unit shut down
- Historically reliable unit
  - 2 Small Coke Drums (20’ D)
  - 15 -24 Hours Drum Cycle
  - Lower Pressure - 25 psig
  - Resid Feed
    - 18-30% CCR
    - 3.5-4.5% Sulfur
  - Steam Decoking / Pigging
  - Sponge / Shot / Transition Coke
Work Scope

• Historical Constraints were evaluated to determine restart work scope
  o Coker 1 ranges from 10 - 12 kBD - depends on crude slate
  o Coke morphology manageable - unit can process a variety of crudes
  o Offline decokes (pigging) conducted every two months
    ❑ Crude oils caused inorganic fouling - perceived not be a future issue
  o Typical rate limits
    ❑ Furnace TMT / duty limits
    ❑ Wet gas compressor motor amps
    ❑ Cycle time - as low as ~16 hrs, but typically 18-24 hrs
      ➢ Sour Resid - high coke yield - drum outages
      ➢ Sweet Resid - wet gas compressor limit
    ❑ Heavy Gas Oil hydraulics
  o Historically - the unit ran reliably
    ❑ Unplanned capacity loss: 1.1% - 3.6% demonstrated
Scope Basis

• **Scope basis**
  o Safety, reliability and environmental compliance
  o 2011 T/A work list, historical constraints, and major equipment conditions

• **Work Scope Considerations**
  o Refurbish existing equipment
    ❑ Replace obsolete equipment
    ❑ Evaluate lease vs. purchase equipment
    ❑ Comply with regulatory changes since 2010
    ❑ Refinery Sector Rule for Coker Venting
    ❑ Operator Shelter for overpressure

• **Safety and Reliability Improvement Projects Evaluated**
  o Coke Drum Valve Interlocks
  o Coke Drum State of the Art Unheading Equipment
  o Reliability - electrical infrastructure / 2nd feed, feed tank, coke conveyor

• **RDS Engineering chosen as Engineering Contractor**
Coke Drum Assessment Vital

- Coke Drums: only equipment that could jeopardize unit restart
  - Cost and delivery
  - Reliability evaluation proved drums good
    - Reviewed prior operating data
    - Drum measurements completed
    - Obtained metallurgical samples from the drum and confirmed weldability
  - Recommendations to maximize reliability of drums
    - Install strain gauges, thermocouples, & accessible data ‘logger’
    - Careful monitoring of cycle time vs. remaining life parameters
    - Regularly inspect the circumferential weld seams and skirt-to-shell weld
Inspection Results: Key Equipment

• Heater
  o Cabin smoke test performed with minimal issues noted
  o Convection section - retube due to inability to clean and inspect OD
  o Radiant section - creep stress-rupture life calculations show end of life
    - Pig scoring also contributing factor

• Fractionator
  o External CUI inspection complete with no major issues
  o Internal inspection showed some tray replacements

• Process piping
  o All piping external visual & targeted radiography/UT completed
  o UT data analysis effort complete
  o Piping identified for replacements/repairs based on data
Inspection Findings

Heater

Side wall radiant tubes
Burners
Roof/Shock Tubes

Fractionator

Corrosion Under Insulation
- Minimal pitting
- General scale corrosion
Project Scope

• **Safety Projects**
  o Project improves unit to a “best in class” level on safety systems
    - Addresses prior Process Hazard Assessment (PHA) items
  o Operator shelter blast zone compliance - installing blast resistant trailer
  o Delta Valve State of the Art Automated coke drum unheading project
    - Includes Bottom Unheading with Center Feed and Top Unheading with Drill Stem Enclosure
    - Coke Drum Switching Valve interlocks

• **Environmental**
  o Permit to restart approved
  o Facilities will comply with new EPA Refinery Sector Rule
  o Project will bring unit into compliance with NSPS Sub J - fugitive emissions
Project Scope

• **Refurbishment project includes**
  - Detailed inspection and typical turnaround maintenance and upgrades
  - Re-tubing full furnace includes new convection section
  - Upgrade DCS to “state of the art” Honeywell controls
  - Installing new furnace burner management system - PLC
  - Replacing existing feed tank
  - Replacing conveyor/crusher system
  - Full Coke Drum Cutting Equipment and Controls Upgrade
  - Replacing Fractionator Tray due to damage
  - Replacing and upgrading Process Piping based on inspection

• **Electrical upgrade project**
  - Provide dual unit feeds
  - Replacing 480v system
  - Install a new power distribution control building
Coke Drum Switch Valve Interlocks Project

• All coke drum switch valves are manual
  - Switch deck very crowded - poor ergonomics

• Developed MOV / Interlocks Project
  - Upgrading manually-operated isolation drum switching valves to motor-operated valves
    - Valves will be in new PLC interlock system

• Conducted PHA to determine scope of valves to be interlocked

• Compared scope to other PBF Cokers to ensure consistency

• Completely redesigned switch deck
  - Difficult to modify existing valves in place due to space constraints
  - Existing Deck will be demolished and replaced with new bigger deck

• Developed control matrix based on Operator Drum Switch Procedures
Coke Drum Switch Valve Interlocks Project

• Replacing manual gate valves with motor-operated valves includes:
  o Delta Valve isolation valves
    □ Double block and steam purged alloy valves as supplied by Delta Valve
  o Isolation gate valves

• Refurbishing Wilson Snyder Switch Valve
  o Scope includes retrofitting existing valve plus spare

• PLC-based control system with distributed HMI Control Panels for MOV Valve Operation from the field and the Central Control Building
  o PLC to include isolation MOV’s as well as BUD, TUD and CFD
Coker 1 Interlock Valve Diagram
Delta Valve Isolation Valves

- Decided to replace valve pairs with single Delta Valve Isolation Valve
  - Delta Valve Isolation Valve considered double block and purge
    - Same concept as the BUD and TUD
  - One valve replaces two valves
  - Limited space on the deck - one Delta Isolation valve requires less space

- Delta Valve Isolation Valves installations - blue valves on prior drawing
  - Drain to Coke Pit
  - Coke Condensate
  - Top Vent
  - Coke Drum Vapor to Fractionator
  - Coke Drum Vapor to Blowdown

- Replacing only one valve with Delta Valve Isolation Valves
  - Feed Inlet Valve
  - Utility Header Valve
Existing Switch Deck and 3D Model of New Deck

- Existing deck to be demolished
  - Very crowded area
- New deck via 3D model
  - Larger deck
  - No upper platforms
  - Improved ergonomics
Existing Switch Deck and 3D Model of New Deck

- Side view of existing deck
- 3D model shows better layout for switch valves
Switch Deck Plan View
Switch Deck Overhead Valves
HMI Control Panels

- Install five HMI Panels with graphic displays that can view all pages / valves
  - Includes Drum Switch Valves, BUD, CFD and TUD
- HMI Panels will be located at switch deck, top deck, ground level, PDC Building and DCS control room
- Operators will use touch screen to operate valves - open/close
- Valves will only be operated remotely from the panel
- Push button to be provided at the valve and to be locked out and used for maintenance issues only - key lock switch
- HMI’s will have redundant power supply
HMI Drum Interlock Valve Schematic
PBF Delta Valve Unheading Projects

- PBF selected Delta Valve for corporate-wide Coker Safety Unheading Projects
  - Project to include BUD, CFD, TUD and SGE - Stem Guide Enclosure
  - Project synergies to have the equipment sizes the same
  - Project will use RDS as Engineering Contractor for all units

- Chalmette Coker 1: Install as part of re-start project - 1 drum pair

- Chalmette Coker 2: Install during next TA - 1 drum pair

- Paulsboro: TUD’s only - install with opportunity slow downs - 2 drum pairs
  - BUDs already installed

- Torrance: Install during offline decokes or opportunity down time
  - Six drum pairs
    - Drum pairs to be installed over several years time
    - One or two drums pairs per year
Top Deck with TUD and SGE
Drill Stem Guide Enclosure
Thank You!

Questions?