



***Shell Deer Park Refinery
Delayed Coker Incident
March 4, 2004***

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Bottom of the Barrel Seminar

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Outline

- Unit Information
- Incident Details
- Resulting Impacts
 - Plugged Gasoil Product Systems
 - Partially Coked Drum
 - Another Drum Filled With Resid
 - Fractionator Tray Damage
- Investigation Findings
- Recommendations



Delayed Coker Information

- Capacity: 88 MBD
- Feed: Maya Vacuum Resid
- 6 Drums, 3 Heaters, 1 Frac, 1 B/D
- Drums: 28' ID x 121' F/F, 89' T/T
- Startup in 1995, 4 Drums (FW design)
- 2001: Expansion to 6 Drums
- 43 MBD Gasoil Hydrotreater



Incident Details

- Prior Status: Drums 1&2 and Heater 1 down for drum repairs; Drums 3&5 coking, Drum 4 quenching, Drum 6 preparing to warmup
- Frac experienced an upset causing a large, rapid temperature drop (105°F in first 16 minutes)
- Charge Pumps began to cavitate, flow was lost to both Heaters
- Heaters tripped, but some flow was still going to 2 coking drums
- Drum inlet temperatures quickly dropped and never recovered
- Frac Bottom Level got out of control, carrying over resid into HGO and LGO product systems

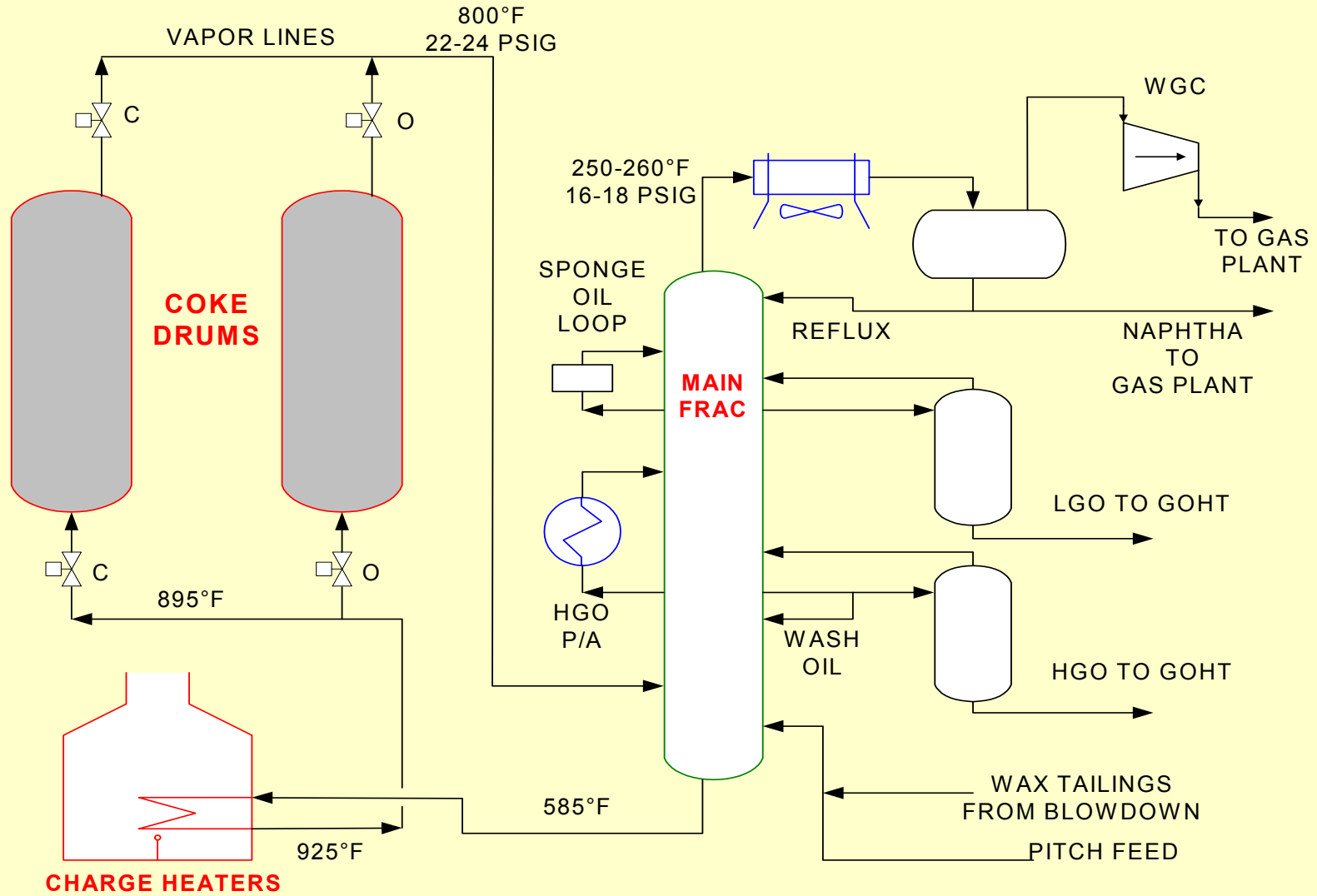


Incident Details (cont'd)

- Bypassed GOHT to prevent Resid in feed
- Fought Heaters for hours due to Charge Pump cavitation
- Bypassed Drum 5 after 3 hours – Partially Coked “Tarry” Drum
- Bypassed Drum 3 after 9 hours – mostly cooler resid inside
- All Fresh Feed cut out after 9 hours
- Note: Drum 4 quench was not normal; more on this later...



Coker Simplified Flow Scheme





Plugged Product Lines

- Carryover of Resid from Frac plugged:
 - HGO Product and Pumparound lines
 - LGO Product lines
 - Gasoil to Storage lines
 - Blowdown lines to Frac
 - MDO lines
- The plugged lines were critical path for restarting, resulting in 8 day S/D



Plugged Lines: Mitigation

- Removed insulation
- Wrapped thousands of feet of piping with temporary electric tracing
- Heated the piping until the material flowed again
- This process took days and cost big \$\$.
- There is no quick and easy way to unplug lines containing solid Resid.



Drum 5 – “Tarry” Drum

- Drum 5 had been coking for about 11 hours prior to the heater trips
- Drum was fed for 3 hours after that
- Estimated 4 MB Resid in the drum that didn't finish coking
- As soon as drum was bypassed, steamed at 7 Mlb/hr for about 4 days
- Had to wait because Blowdown system was not available due to plugging



Drum 5 – “Tarry Drum” (cont’d)

- After weighing our options, decided to quench the drum as best we could
- Quenching itself went pretty well.
- However, as anticipated, drum would not drain afterwards
- Since we did get a substantial amount of cooling during quenching, we decided to unhead and try cutting.



Drum 5 – “Tarry” Drum (cont’d)

- Unheading was performed remotely
- Small amount of “black lava” oozed out the bottom as chute was raised
- Cutting was very difficult and took hours; lots of hot spots
- However, in the end the material was safely and successfully removed
- Left with a giant “lava mountain”



Drum 3 – Full of Uncoked Resid

- Fed “cool” Resid for 9 hours after heat loss
- After bypassing steamed at 10+ Mlb/hr for over a week
- Temperatures suggested that Resid was still hot enough to flow
- Several potential options considered
- In the end, it was decided to build a special temporary system to drain the Resid out
- Resid would be blended with cutter right out of the drum and pumped to MFO tanks
- Ratio of cutter/Resid would be controlled to prevent plugging, etc.

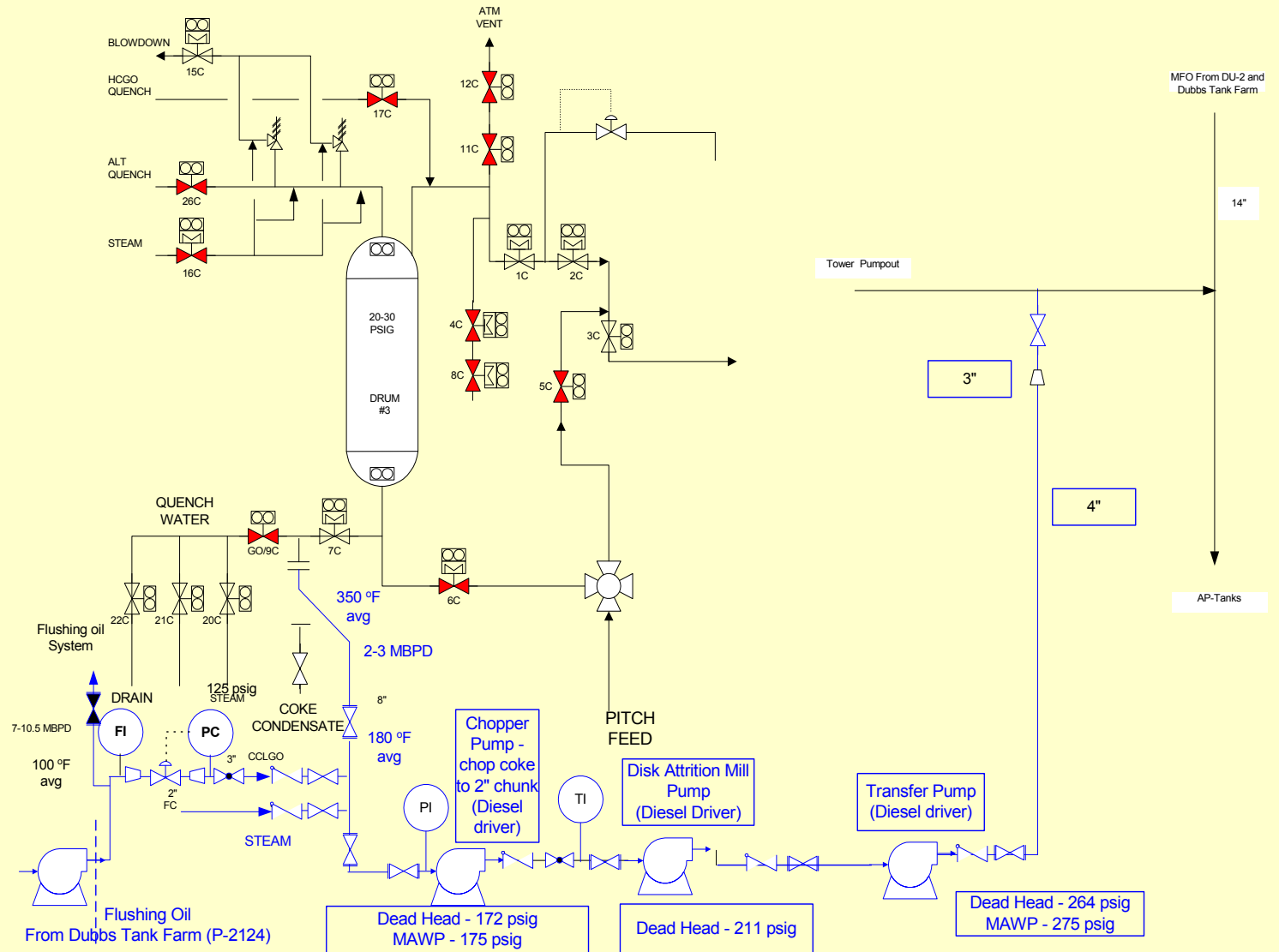


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Drum 3 Drain System

Temporary Facility To Transfer Drum 3 Material To MFO





Drum 3 Draining System

- System worked like a charm
- Draining/blending process took approximately 2 days
- After level was verified to be below 13' level indicator, draining was stopped
- Estimated 1.5 MB of Resid still inside
- Shortly after that, hot feed was switched into Drum 3
- Foam front moved quickly up the drum, started antifoam
- Had to cut feed and double antifoam rate to stop foam front; cycle lasted almost 24 hrs



Problems on Unit Restart

- During restreaming of the unit, a couple of issues were observed
 - Frac Bottom Temperature was much lower than normal (feed heat integration w/ HGO)
 - No pressure drop in HGO section of tower
- Determined that bottom 9 trays severely damaged
- Had to raise column pressure and fire heaters harder to get feed rate up
- Have been fighting this ever since, but managing to keep going

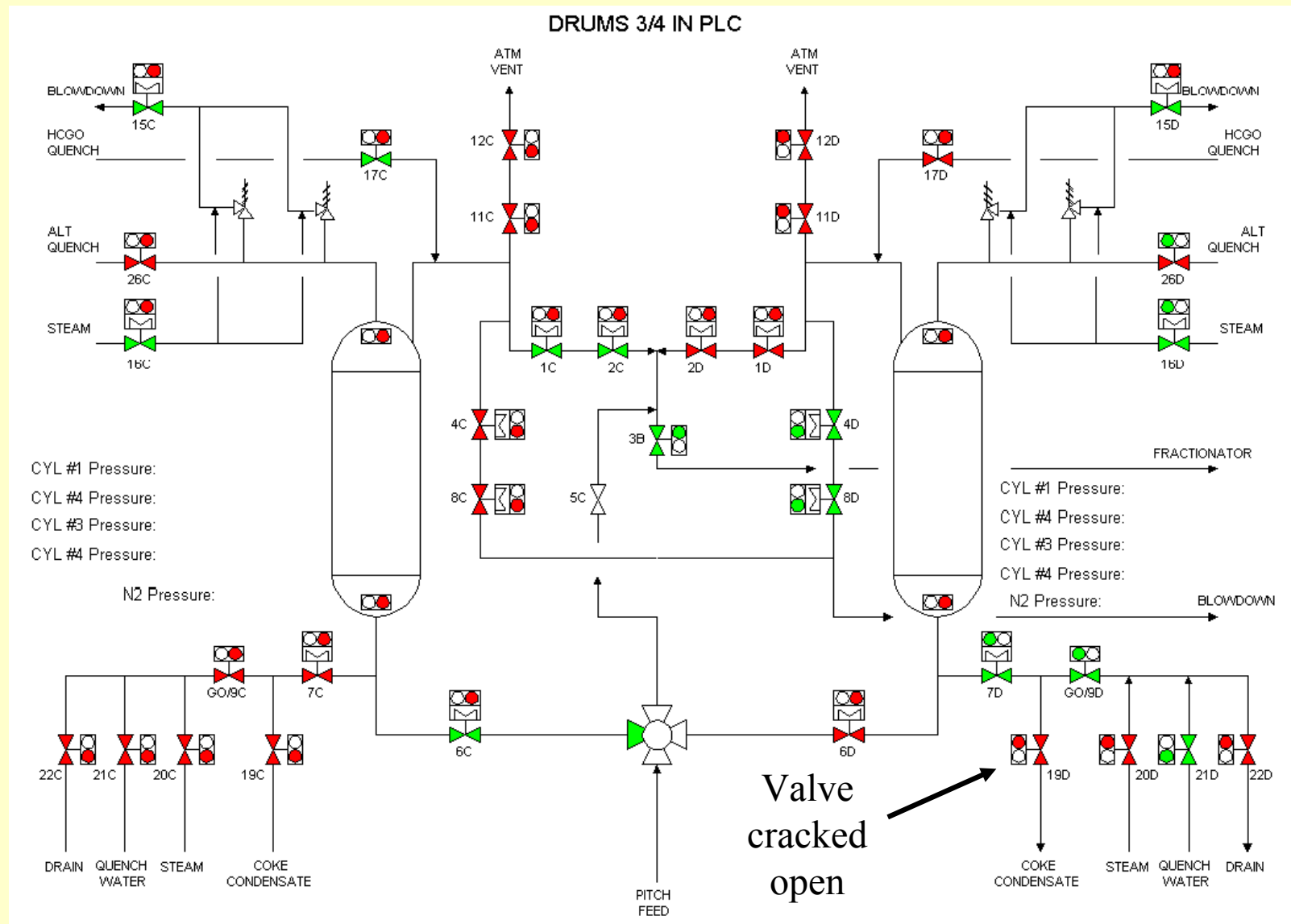


Investigation Findings

- Cause of Temperature Drop
 - Drum 4 Coke Condensate Valve didn't fully close
 - PLC indication showed that valve had closed
 - During Drum 4 quench, water flowed through Coke Condensate and into Frac feed zone
 - Essentially, we “quenched” the Frac
 - Trays damaged due to pressure surge from water vaporization
- Resid Carryover
 - Guidelines were not clear on when it is acceptable to cut out fresh feed
 - Operators were under the impression that they could not cut out feed completely



Drums 3&4 Schematic

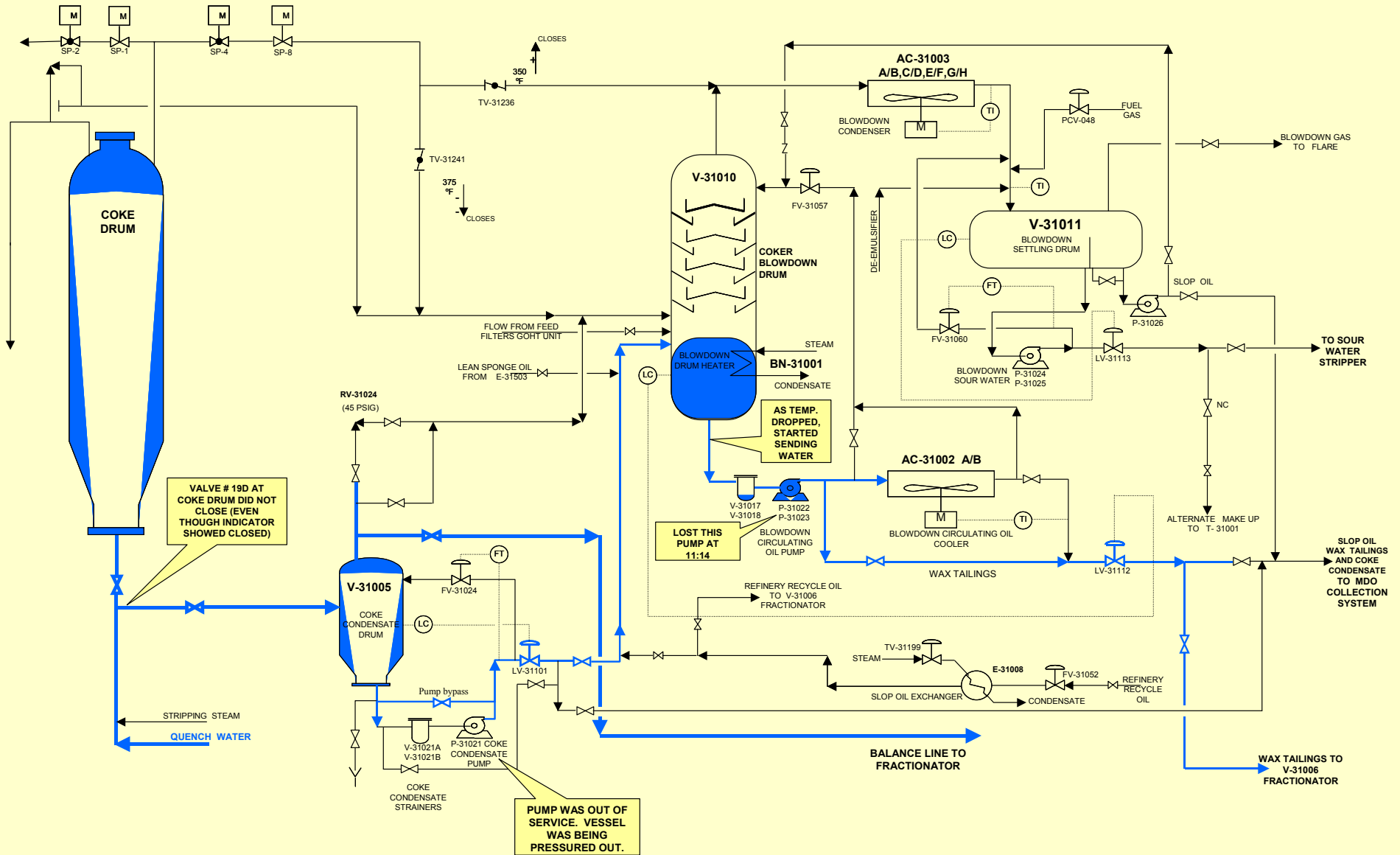




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Blowdown/Coke Condensate System





Investigation Findings (cont'd)

- Partially Coked Drums
 - No consistent guidelines for when to bypass a drum after heat is lost
 - Everyone knew there was a limit, but focus was on troubleshooting the other issues
- General
 - Communications and decision making during event were not structured



Recommendations

- Water in the Frac/Temperature Drop
 - Convert PLC inputs on Coke Condensate valve from external prox switches to internal limit switches
 - Install a low temperature alarm on both Coke Condensate drums
 - Consider upgrading other critical structure valves with MOVs that can be interlocked
 - Provide operator training on the above items and “how to recognize” water in the Frac



Recommendations (cont'd)

- Develop guidelines for managing Frac level excursions and Coker feed system
- Develop guidelines for when to bypass Coke Drums after heat is lost
- Develop guidelines for when to place the GOHT on circulation
- Develop a structured communication and decision making process for managing abnormal situations
- Train operators on all of the above



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Questions?