Feed Interruption, Foamover, Tarball, and Cooked Drum Experience

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Feed Interruption

- **Three separate incidents within Marathon petroleum.**
  - **Garyville 2005, 05 Coker Unit - Feed interruption/furnace tripped caused by water in the charge pump seal flush resulting in massive foamover (2005). The unit was down for 21 days for clean-up and repairs.**
  - **Robinson 2006, #5 Drum - charge pump seal issues and TDC 3000 conversion problems resulted in a furnace trip. The furnace could not be relit on time and the coke drum did not reach operating temperature. The coke drum bypass procedure was followed. Lined up steam to open flow path to the coke drum. The unit was shutdown for 3 days to clean up the tar in the unheading deck and rail cars.**
  - **Garyville 2010, 205 Coker Unit – During start-up of the new coker unit, the charge pump tripped and could not be re-started on time. The coke drum bypass procedure was followed. Lined up steam to open flow path to the coke drum. Hot steam stripped the coke drum with 1000 F superheated steam for 10 hours. Start-up was delayed for 48 hours. Steam vaporized the gasoil and coked the resid in the drum.**

05 Coker Unit – Garyville 2005

- Commissioned in late 2001
- 2 – 30’ Diameter Drums
- Feed is composed of ~60% ROSE Pitch / ~40% Vacuum Tower Resid
- Normal charge rate is 38,000 BPSD
- Drum Cycle is 16.5 hours
- 4 neutron backscatter level indicators are used on each Coke Drum. The 4th device is used as high level.

Initial Conditions – October 2005

- The Coker was operating normally at 38,000 BPD
- Throughout the month of October there were several minor operating issues:
  - Heater cell trips due to individual pass flow transmitter blips
  - Small coke carryover events
  - Drum dumps / soft coke
  - Coker gas oil system pluggage

Incident Discussion

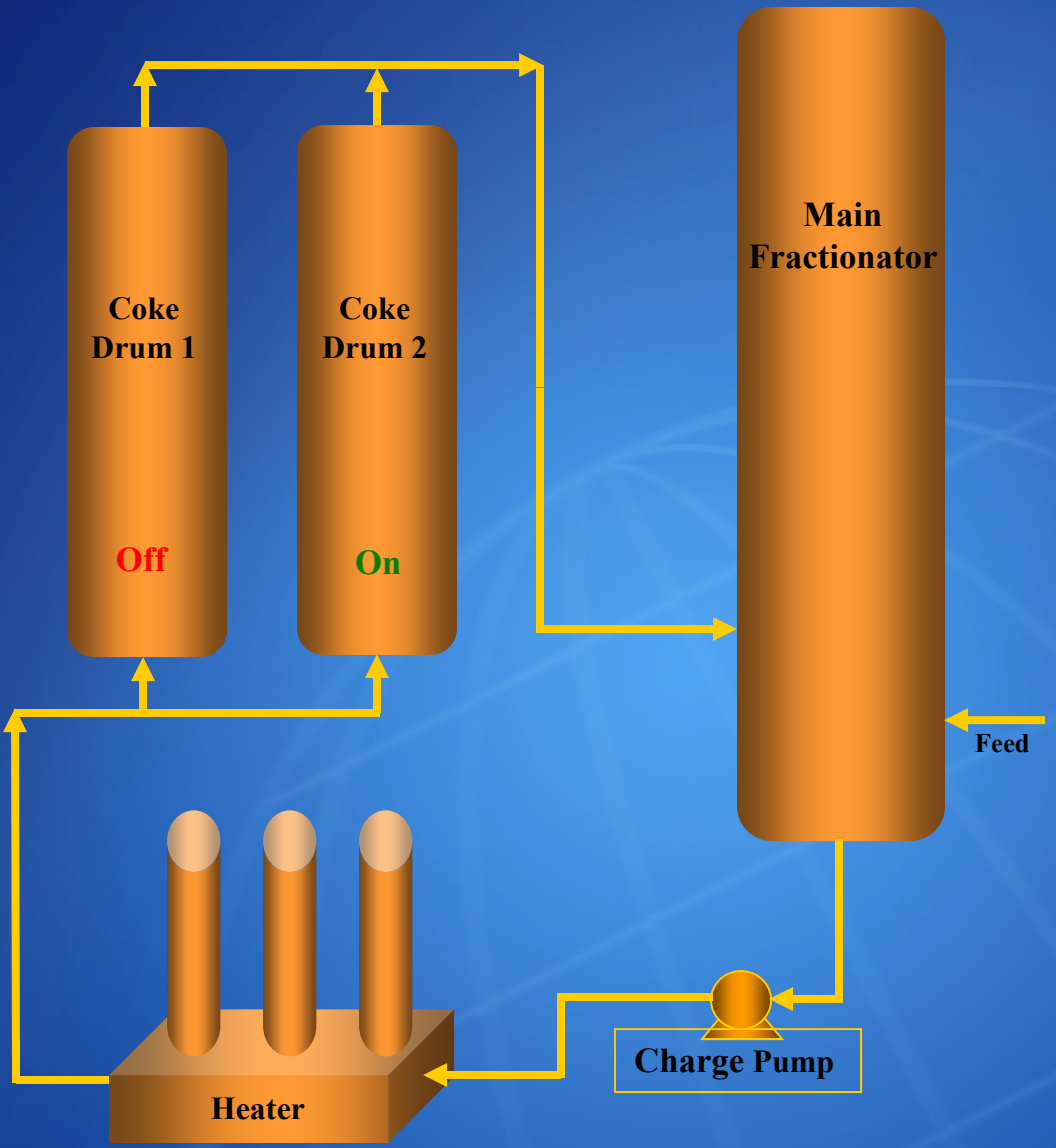
- Feed was routed to Drum 2 @ 2330 hours
  - This was a normal swap.
  - No concerns noted
  - Next scheduled drum switch is 1600 hours
- 2 hours later @ 0130 hours the Coker Charge Pump seal flush automatically swapped from gas oil to its back-up of distillate due to low gas oil header pressure.
  - The low pressure was the result of system fouling from the minor incidents occurring throughout the month of October

Incident Discussion *(continued)*

- Operation's shift change occurs at 0600 hours
- During the morning rounds, the unit operator noted the distillate filter pressure drop (DP) was higher than normal
  - The operator was unaware that the seal flush had swapped to its back-up
  - The high DP was caused by the additional flow required to satisfy the gas oil flush system
- The distillate flush filters were swapped @ 0716 hours

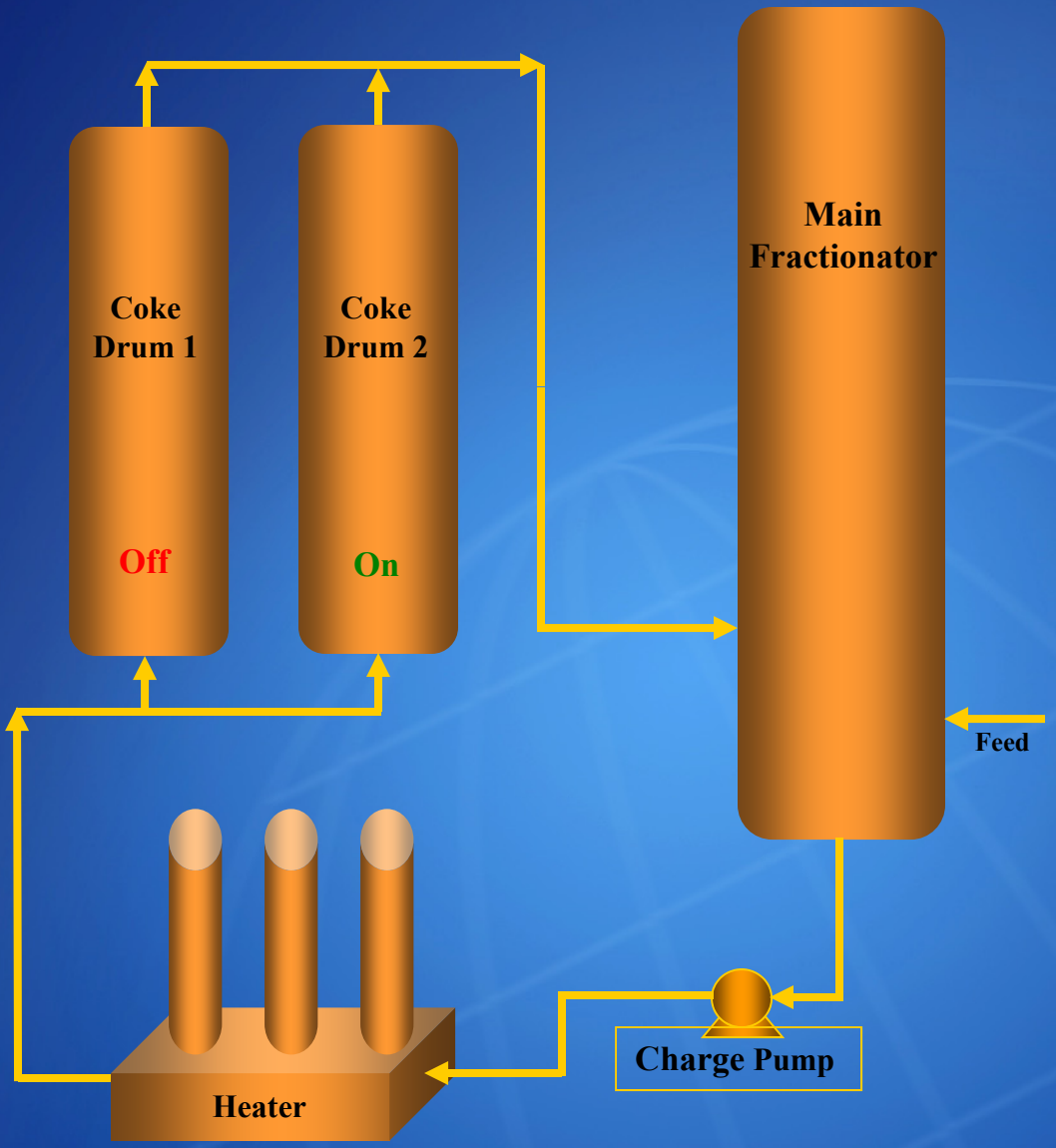
0716 hours

- The Coker Charge Pump cavitates
  - Water or light hydrocarbon is the expected cause of the cavitation



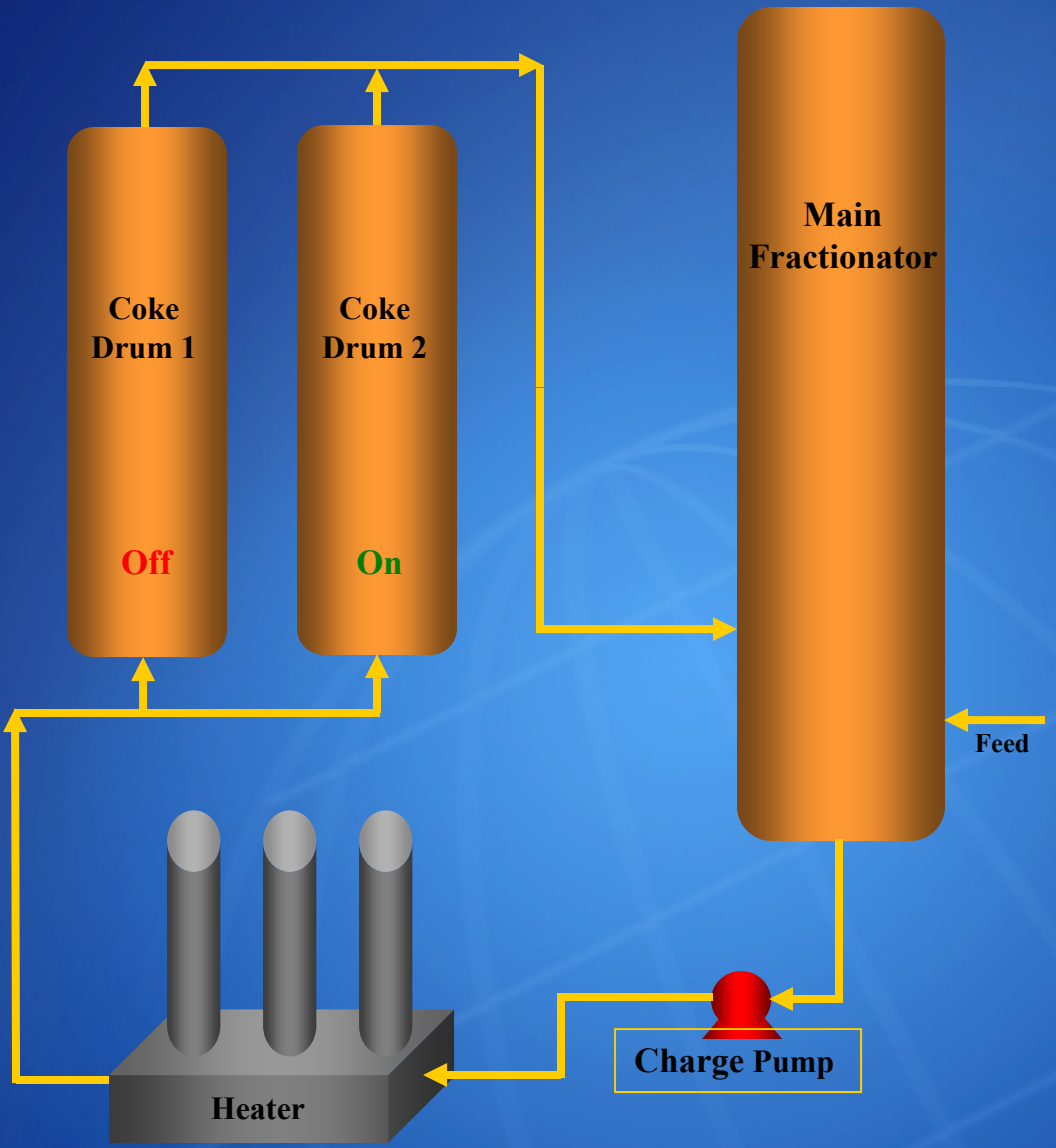
0716 hours *(continued)*

- The cavitating pump causes the heater to trip
  - Low flow should only trip the main burners
  - The pilots trip due to loss of flame indication
  - A complete purge cycle is now required to restart the heater



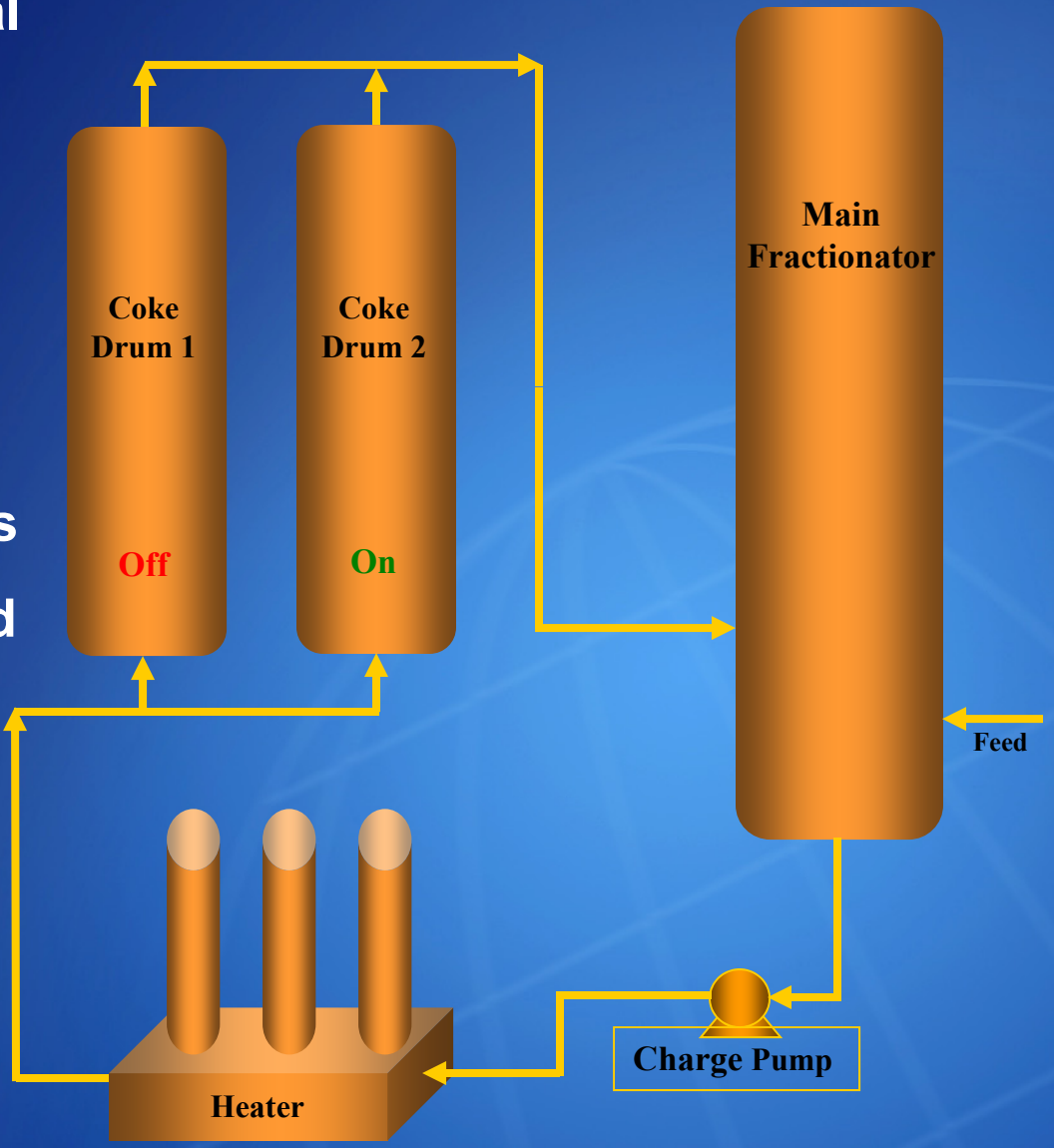
0747 hours

- The purge cycle is completed and all of the pilots are relit
- There are 168 pilot/burner assemblies in the heater
  - The Drum 2 inlet temperature drops from 900°F to 600°F
  - Feed rate is reduced from 38,000 BPD to 29,000 BPD
  - Antifoam is maximized



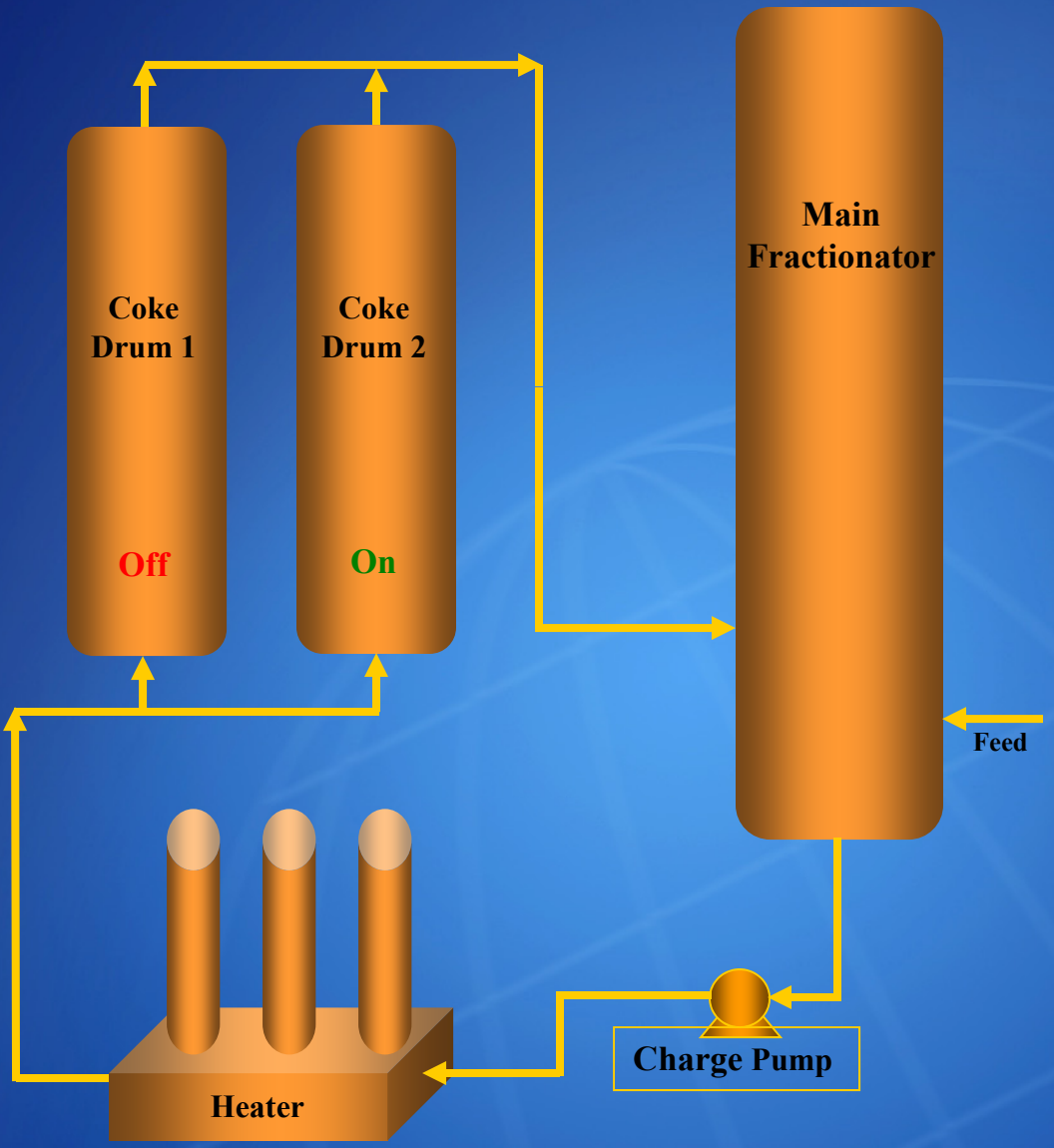
0815 – 1000 hours

- The Coker returns to normal operation
  - Drum 2 Inlet temperature reaches 900°F @ 0900 hours (150% more time than typical)
  - Feed rate returns to 38,000 BPD @ 1000 hours
  - No problems are reported



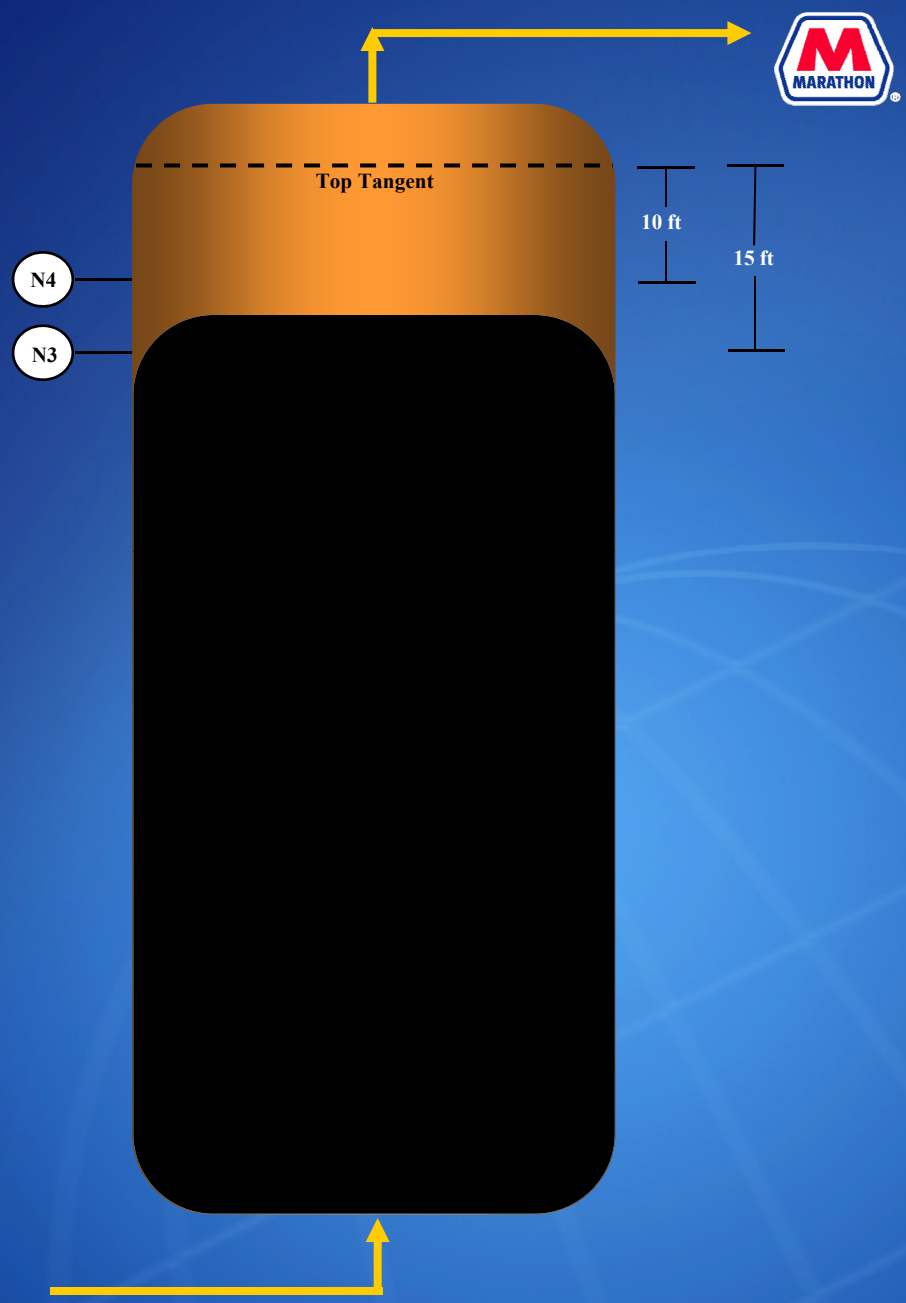
1000 – 1400 hours

- The Coker runs normally with no noted concerns
- Drum 2 outlet temperature reaches 790°F by 1400 hours. (temperature was 810°F before heater trip)



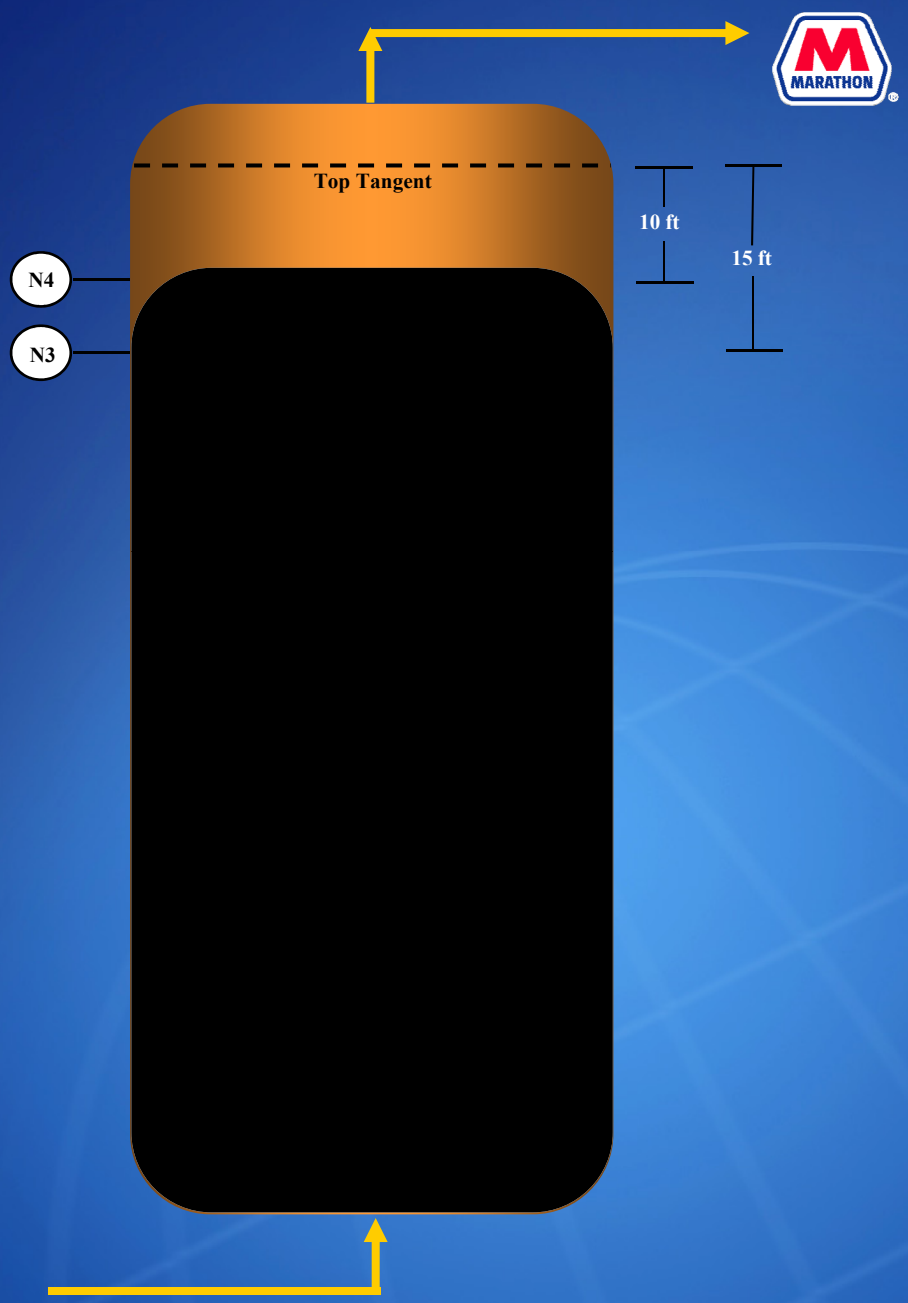
1425 hours

- The 3rd (of 4) nuclear level indication rapidly climbs from 14% to 100%
  - 3 minutes vs. the typical 15 minute time frame
  - This detector is calibrated to indicate coke, not foam, @ 100% of scale
  - This is approximate 1.5 hours before the scheduled drum switch time



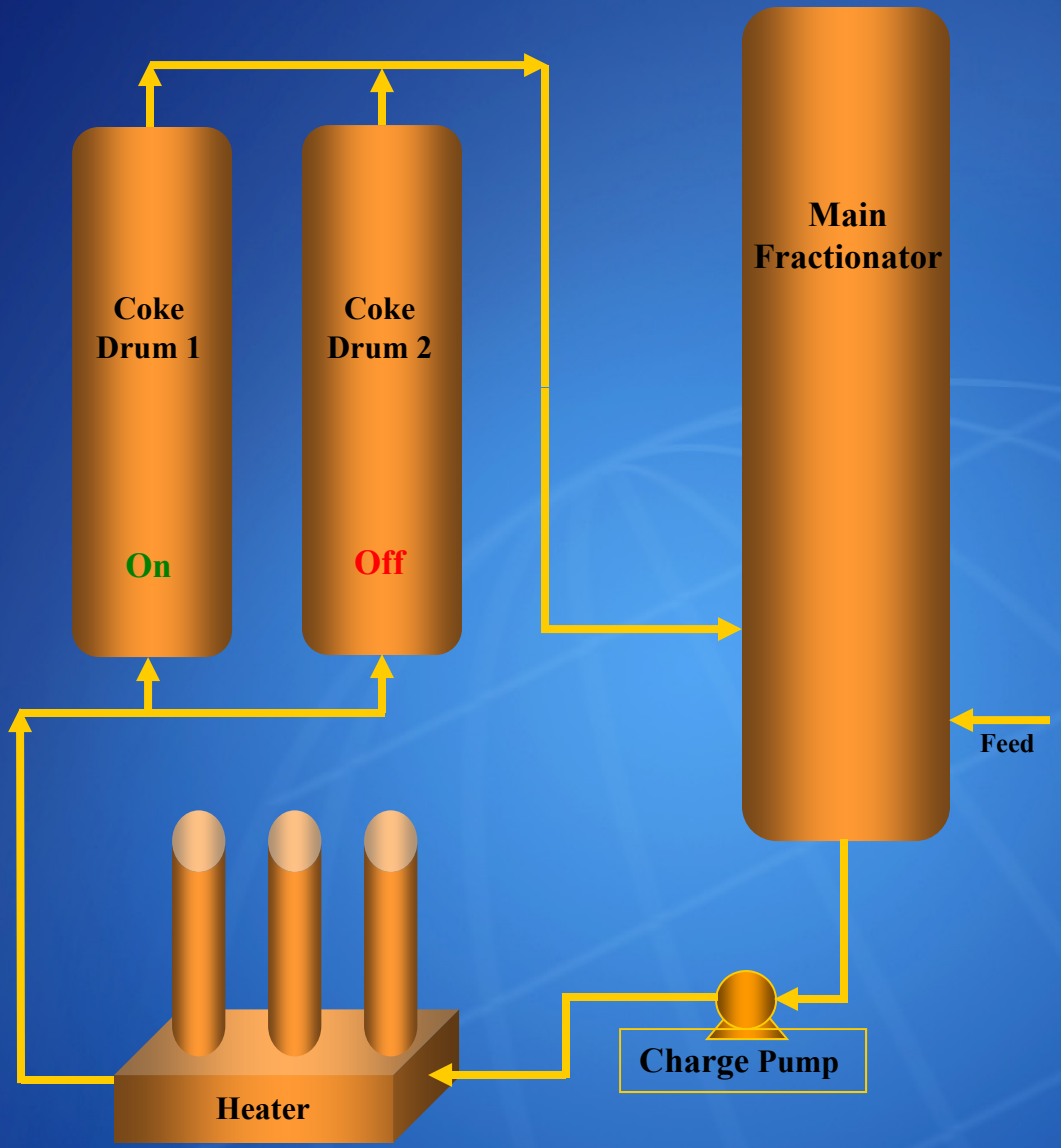
1430 hours

- The 4th (of 4) nuclear level indication shows movement to 28%
  - This detector is calibrated to indicate foam @ 20% of scale
  - It normally takes 45 minutes to see activity after the 3rd nuke is activated
  - The decision to switch drums early is made by operations



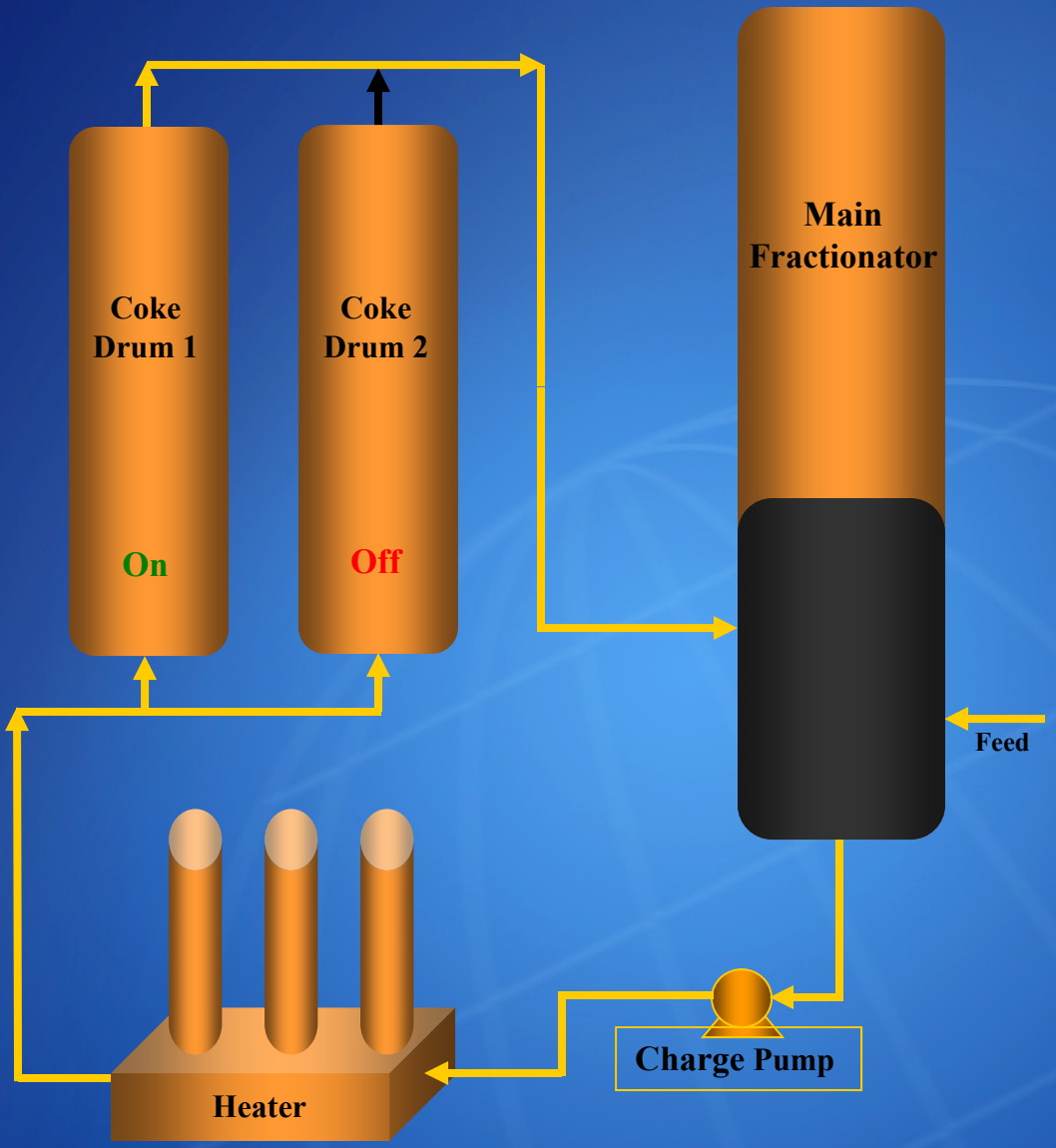
1445 hours

- Feed is fully routed to Drum 1
  - Drum 2 pressure drops 6 psig after the switch
  - This drop in pressure causes the foam height to grow as indicated by the 4th nuke reaching 100% by 1448 hours
  - Recall that feed is out of Drum 2 entirely
  - Drum 2 begins to carryover which is audible in the field



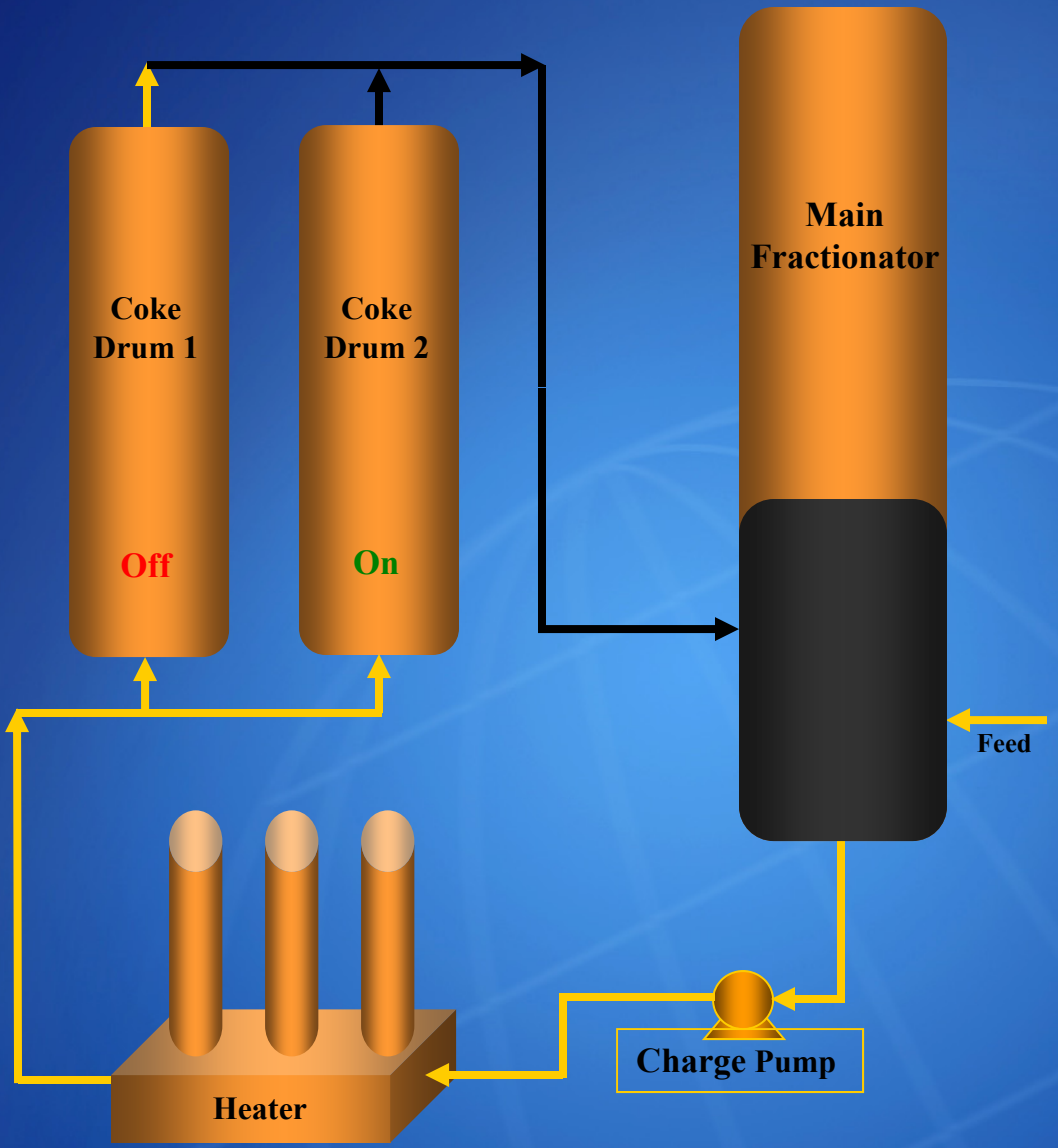
1505 – 1527 hours

- As the carryover occurs, back-pressure begins to be a problem for both Coke Drums
  - The combined outlet line begins to restrict
  - Drum 1 reaches 50 psig
  - Drum 2 reaches 80 psig
  - At 80 psig, the relief valve (RV) opens on Drum 2
  - Coke is carried into the Main Fractionator and the Blowdown system via the RV



1530 - 1619 hours

- The Coker is shutdown
- The system pressure reaches its automatic control point to vent to the flare through the Blowdown Drum
- The Wet Gas Compressor shuts down due to high level in the Interstage Drum
- At 1604 hours the Drum 2 4th nuke drops off indicating the foaming has stopped
- All flaring stops @ 1619 hours



Results of the Incident

- The Coker was down for 21 days
  - Explosive charges, manual chipping, and hydroblasting used for coke removal
- Hard coke was deposited:
  - In the Coke Drum vapor outlet lines
  - In the Main Fractionator
    - Up to the gas oil pumparound return
  - Throughout the Blowdown System
- Significant tray damage
  - Including dislodging of the Flash Zone Gas Oil tray

Causes Leading to the Incident

- The unit feed rate was not reduced to minimum when the Charge Heater shut down
  - Rate was only reduced to 29,000 BPD
  - The rate was only reduced for approximately 1.5 hours
- A large quantity of feed was introduced into Drum 2 below coking temperature
  - Furnace outlet temperature was not raised fast enough to coking temperature (normally takes 45 minutes to 1 hour versus 1.5 hours).
  - Reduced coking reaction as apparent by the low drum outlet temperature (790°F vs. 810°F)
  - Resulted in a 16 ft foam height vs. a normal height of 2 - 5 ft

Causes Leading to the Incident *(continued)*

- The loss of heater pass flow caused a total heater shutdown
  - ESD logic only trips the main burners on loss of flow
  - The total heater shutdown occurred because the flame scanners did not read the pilot flames when the main burners were shut-off

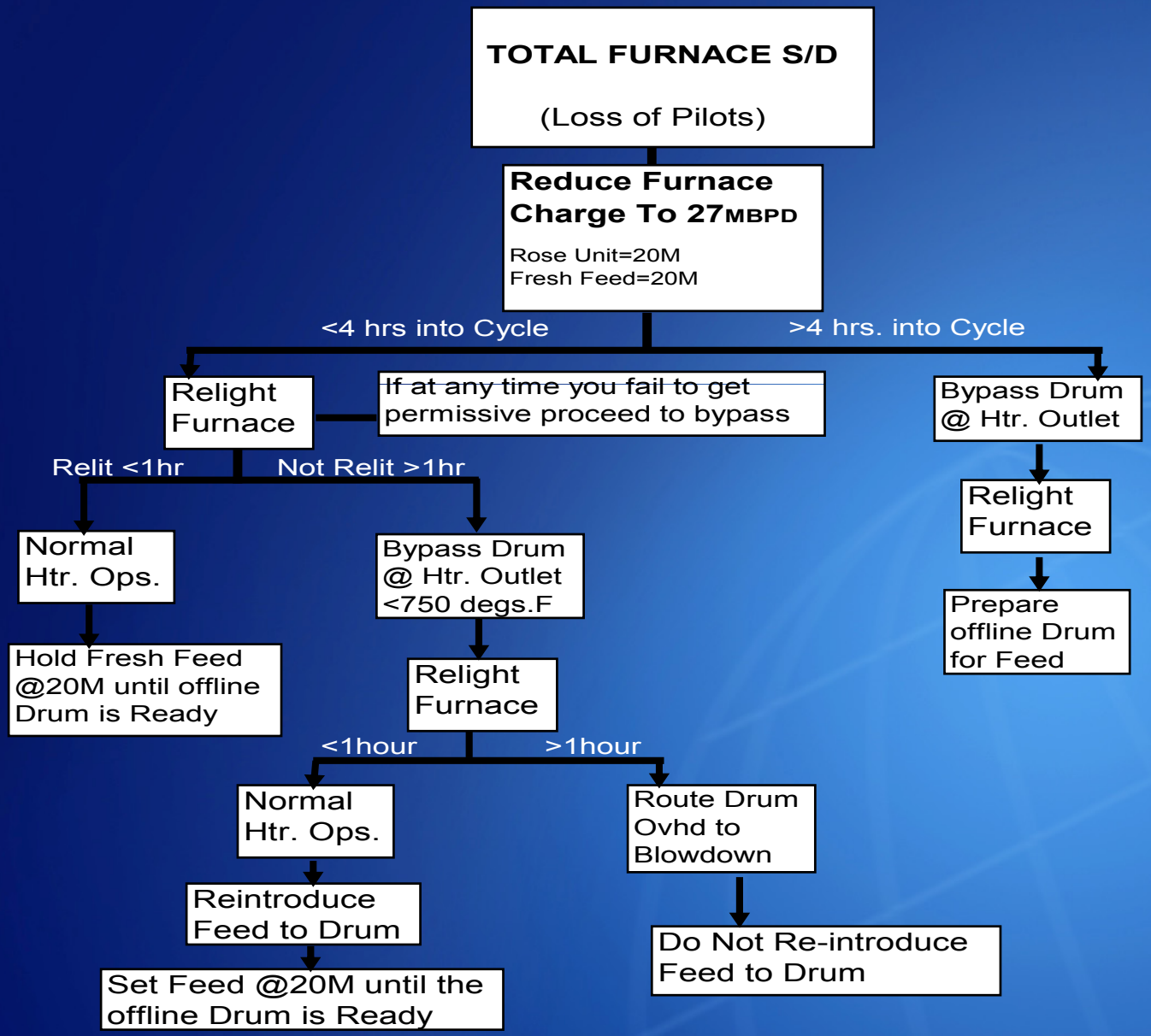
Corrective Actions

- Procedures were developed to swap the seal flush filter systems
  - Steps were added to flush the filters before placing them in service
- Flame rods were added as flame detection in the heater
  - These rods directly measure the pilot flame
  - ESD logic updated to use the flame rods instead of the flame scanners

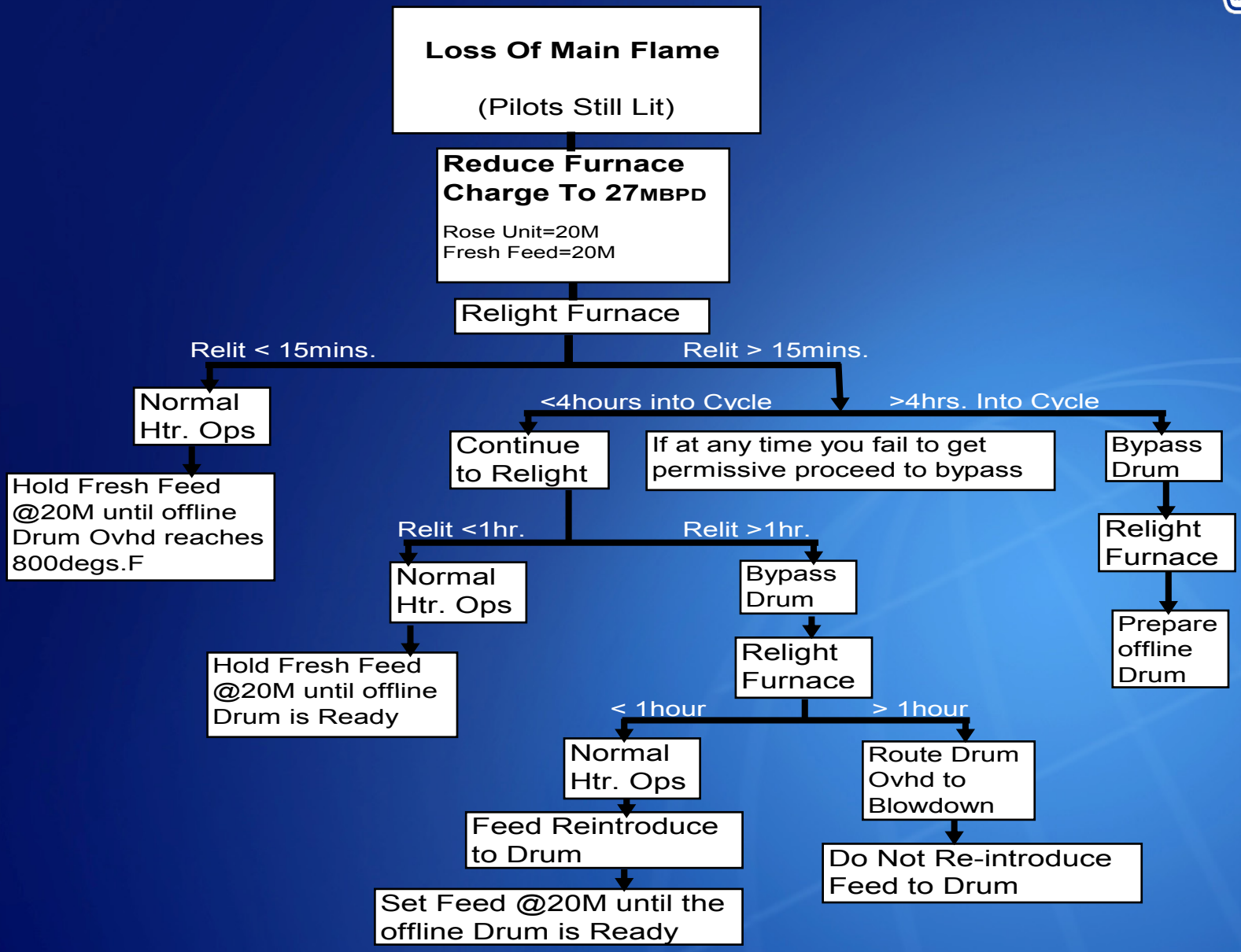
Corrective Actions *(continued)*

- Additional nuclear level devices were added to each coke drum
  - The new instrumentation allows continuous measurement of the coke bed & foam height throughout the top half of the drum
  - This information allows operations more warning and a better opportunity to control abnormal foam height
- Developed operational decision matrix for a loss of furnace event. *(see attached)*
  - Provides direction on:
    - Feed rate reduction
    - Time allowances for each restart step

Corrective Actions *(continued)*



Corrective Actions *(continued)*



#5 Drum – Robinson Special Coker 2006

- During start-up, feed was lined up to the #5 Coke drum
- Less than 1 hour into the drum, charge pump seal issues and TDC 3000 conversion problems resulted in a furnace trip.
- The furnace can not be relit on time and the coke drum did not reach operating temperature. New controls prevented the heater from starting up.
- The coke drum bypass procedure was followed.
- Lined up steam to open flow path to the coke drum.
- The drum was steamed for an extensive period and then water quenched the drum.

#5 Drum – Robinson Special Coker 2006

- Drum will not drain properly, potential for Tarry drum
- Remove drum insulation at the bottom cone to determine if the drum is properly quenched. The cone temperature was cool.
- Applied extra support on the bottom unheading cart in anticipation of excessive Tar/Coke on the bottom head.
- Fire trucks were mobilized as a preventative measure to suppress fire in the coke structure.
- Water was added at the top of the drum and the drum was steamed and drained for 1 ½ days.
- Loosened the bolts on the bottom head. Tar starts flowing out of the drum.
- Coker was shutdown for 3 days during this incident with 1 day to clean up the unheading deck and rail cars.

Results of the Incident

Results of the Incident

205 Coker – Garyville Louisiana 2010

- Commissioned in 2010
- 2 – 30’ Diameter Drums
- Feed is composed of ~10% ROSE Pitch / ~90% Vacuum Tower Resid
- Design charge rate is 44,000 BPSD
- Drum Cycle is 16 hours
- 4 neutron backscatter level indicators are used on each Coke Drum. The 4th device is used as high level.
- Continuous level device on the top ½ of the coke drum

205 Coker – Garyville Louisiana 2010

- 205 Coker first started up on 2/2/2010 with feed switched into the drum at 21:00.
- The coke drum inlet temperature is at 900 F 45 minutes after drum swap.
- The furnace charge pump loses forward flow followed by furnace tripping off 55 minutes after drum swap.
- Velocity steam automatically trips open on low flow.
- Main fuel gas burners tripped on low flow.

205 Coker – Garyville Louisiana 2010

- Stable flow could not be re-established 1 hour after the furnace trip so a decision was made to place the drum on bypass.
- Stripping steam was injected to maintain flow path in the drum.
- The charge pump finally starts running 3 ½ hours after feed interruption.
- Decision was made to follow the operational matrix to not to put feed back in the drum.

Dealing with Tar in the Drum

- It was estimated that between 1000 to 1300 BBL of gasoil and resid was left holding in the 02 drum.
- Procedure was developed to coke the resid using superheated steam (1000 F furnace outlet) for 8 hours.
- Fire truck was mobilized as a precautionary measures.
- Drum was quenched per normal procedure.

Result

- Drain per normal procedure – Water was black with coke fines floating on top.
- Cutting water was placed in pilot mode to remove material/tar sitting on top of the DeltaValve™.
- Coke was cut per normal procedure (not much coke, around 500 lbs)
- Drum outage – 138 ft (world record)
- Shortest Drum Cycle – 50 minutes

Result

Questions?