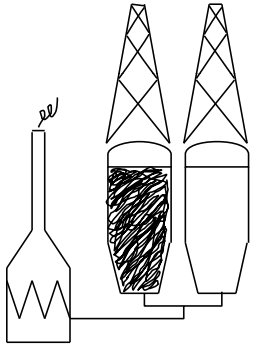
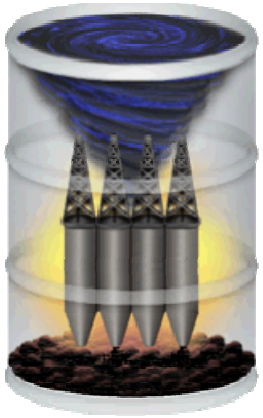
Delayed Coker
Low Coking Temperatures
& Recent Site Experience





Presented by Mitch Moloney of **ExxonMobil**

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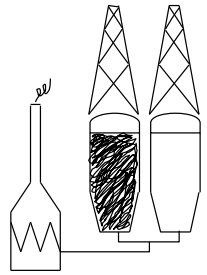
@ Coking.com April-2010

Delayed Coker: Low Coking Temperature Procedures



Handling Coke Drums that have experienced Less-than-Required Coking Temperatures

Logic Flow Diagram Recommended

+ Short-Run Drum Procedures

  => Oil Dilution & Drain to Blowdown System

  => Extended Steam Stripping & Quenching

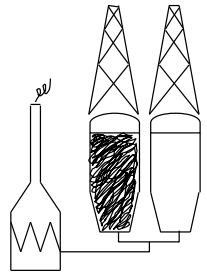
  => Superheated Steam Stripping

+ Low Coking Temperatures

  => When to RETURN to coke drum

  => When to GET OUT of the coke drum

Delayed Coker: Low Coking Temperature Procedures



Short-Run Drum Procedures - Attendant Risks

Risks of Not Properly Handling a Short-Run Drum:

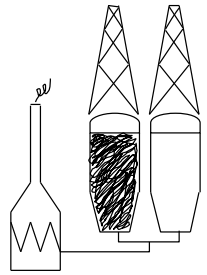
(1) If not properly stripped and cooled, there is risk of fire and explosion

=> Anacortes Coke Drum

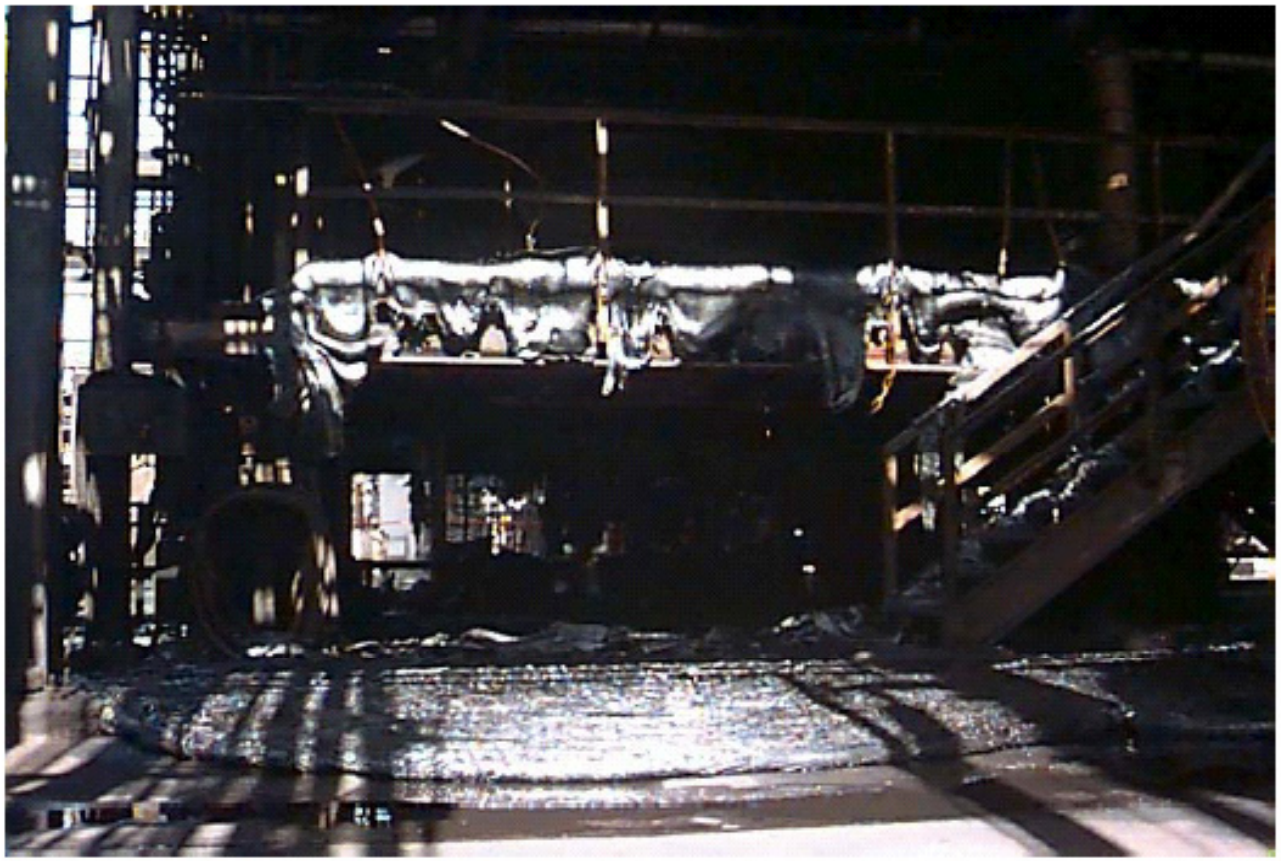
(2) Creating a complete mess on removing the bottom head, that can require a feed cut or train recirculation, if clean-up takes an extended period of time.

=> Also creates attendant safety risks

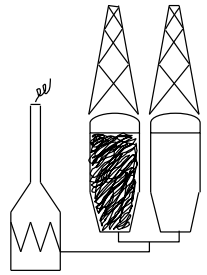
Delayed Coker: Low Coking Temperature Procedures



Creating a Mess (jul-2000):



Delayed Coker: Low Coking Temperature Procedures



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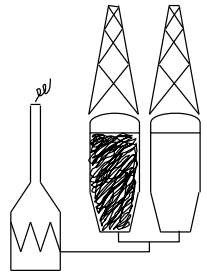

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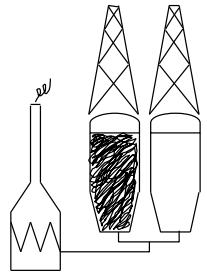


Anacortes Facilities

=> Provide an emergency fluid (e.g., water, gas oil, gas, etc.) to ensure coke drum inlet line and coke bed flow channels remain open, IF both steam and regular quench water sources are lost for an extended period of time during a power failure or other similar event.

There are two alternatives:

(1) Unplug the feed line when utilities back in service

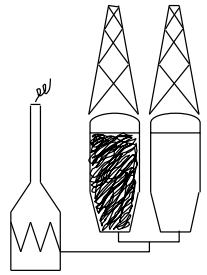
(2) Wait several weeks for the coke drum to cool

This is a low probability event, which makes it difficult to justify an extensive facilities investment

Several sites have justified connecting diesel-powered water or firewater via a low cost jumpover to their quench water line (requires special controls!)

=> Other sites are living with the alternatives

Delayed Coker: Low Coking Temperature Procedures

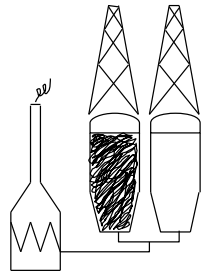


Short-Run Drum Procedures - Establish Site Criteria

Based on Site Experience - Determine Time Criteria that Ensures Completely Coked Resid

Site 1	6 - 8
Site 2	4
Site 3	6 - 8
Site 4	6
Site 5	6 - 8
Site 6	4
Site 7	4
Site 8	12

Delayed Coker: Low Coking Temperature Procedures



Short-Run Drum Procedures - Light Oil Dilution

Repeated Oil Dilution to warm-up condensate drum, followed by steam stripping and normal water quench

(1) Inject steam in bottom

(2) Inject LGO through condensate drum and overhead quench, for same period of time as oil was in the drum

(3) Agitate LGO with steam from bottom (can hear liquid)

(4) Block in and drain to condensate drum (pull strainers from blowdown condensate pumps)

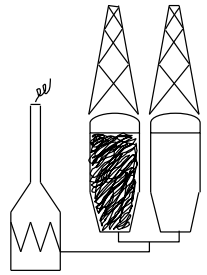
(5) Continue washing and agitation until material is thinned out, based on visual inspection at the warm-up drum

(6) Open little steam until blowdown is available

(7) Open big steam for 30 minutes to blowdown

(8) Cool drum with normal procedure

Delayed Coker: Low Coking Temperature Procedures



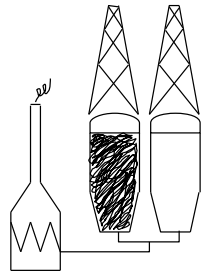
Short-Run Drum Procedures - Superheated Steaming

Take Feed Out of train & pass steam through coker heater to superheat it to +900°F in order to help finish the coking reactions

=> Disadvantage of this procedure is that it requires that circulation of resid be stopped

=> Requires comparison of the time required to accomplish this procedure with the other two options presented

Delayed Coker: Low Coking Temperature Procedures



Short-Run Drum Procedures - Extended Steaming

Advantage - Can Cool Resid without Circulating Train

Disadvantage - Can result in a mess to handle or clean up

=> May be only option in multi-train cokers

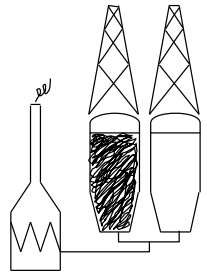
(1) Inject little steam 1-½ hours

(2) Switch drum from combo tower to BD; big steam @ 15 klb/hr for 12 hours

(3) Block steam; start water flow at max rate limited by pressure; fill to 18-ft probe

(4) Shut water, monitor probe; if mid-probe falls, refill with water.
Repeat until mid probe holds water level

Delayed Coker: Low Coking Temperature Procedures



Short-Run Drum Procedures - Extended Steaming (cont'd)

(5) After overhead temp is < 200°F for 1 hour, open drum drain and monitor probe

(6) If drum will not drain, refer to Safe Coke Drum Draining Procedures, which include blowing back the feed line with steam and pressure draining.

Other more drastic measures to consider:

=> Open top head

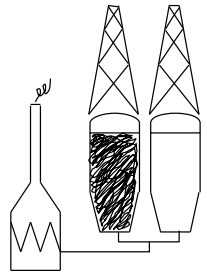
=> Have pit cleaned out and water in pit

A Drill through tarry coke with bit in pilot mode

B Pump out water with submersible pump attached to drill stem

C Drop bottom head and drain water to deck and pit

Delayed Coker: Low Coking Temperature Procedures



Low Coking Temperatures - Logic Flow Scenarios

=> How to handle coke drums that have experienced less-than-desired coke drum temperatures

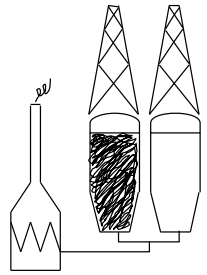
There are three basic scenarios to consider:

(1) Low coke drum temperatures due to train recirculation

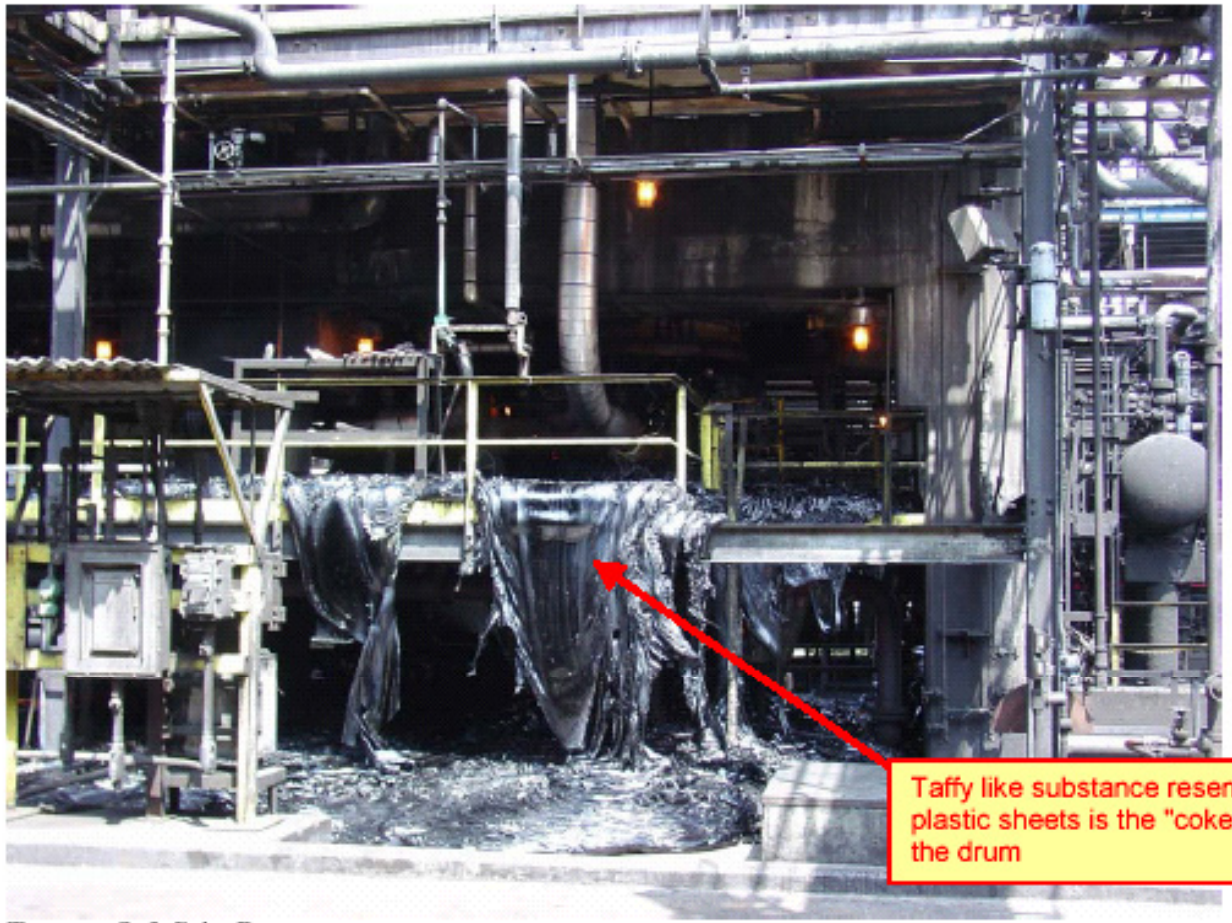
(2) Reduced coke drum inlet temperature while feeding resid

(3) Reduced coke drum outlet temperature while feeding resid

Delayed Coker: Low Coking Temperature Procedures



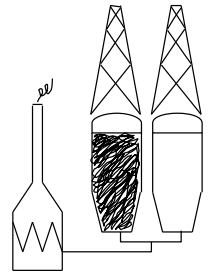
may-2004:



Torrance Soft Coke Drum

Low Coke Drum Temperature attributed to quench water leaking into feed line during coking operations

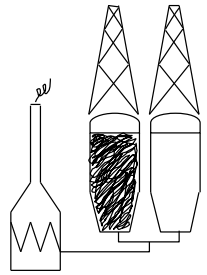
Delayed Coker: Low Coking Temperature Procedures



Creating a Mess (2005):

Cause of Low Temperature Unknown

Delayed Coker: Low Coking Temperature Procedures



Scenario (1) Controlled Coke Drum Train Circulation

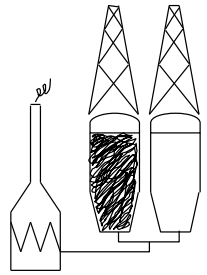
The keys are as follows:

(1) Completely displace the resid in the feed line
(from the switch valve outlet into the coke drum) with steam
(6 - 10 klb/hr is a good rate)

(2) Maintain stripping steam (at least 8 klb/hr) into the coke bed,
until a decision is made on how to proceed.

=> The stripping steam will maintain flow channels in the coke bed
and keep temperature at ~400°F minimum.

Delayed Coker: Low Coking Temperatures



Scenarios (2 & 3)
Low Coke Drum Inlet and/or Outlet Temperature(s)

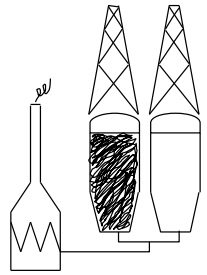
=> A more dangerous situation is when the coke drum suffers an extended period of low coke drum temperature while feeding resid.

Both the inlet and outlet temperatures of the coke drum MUST be considered

Possible causes of a low inlet temperature are:

- feed pump trip
- unstable feed pumping
- fuel gas trip(s)
- heater instrumentation problems
- leaking quench water into feed line

Delayed Coker: Low Coking Temperatures



Scenarios (2 & 3)
Low Coke Drum Inlet and/or Outlet Temperature(s)

Possible causes of a low outlet temperature are:

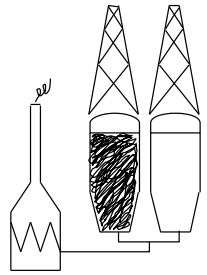
- Leakage of water from a leaking cutting water line onto top head
- Leakage of cold quench oil into the coke drum

These basic points should be considered:

- Uncoked resid in the drum can cause
  - + high foaming
  - + poor quenching
  - + dangers when deheading

- More coke will be made during the period of reduced COT or DOT

Delayed Coker: Low Coking Temperatures



February 2010 Scenario:

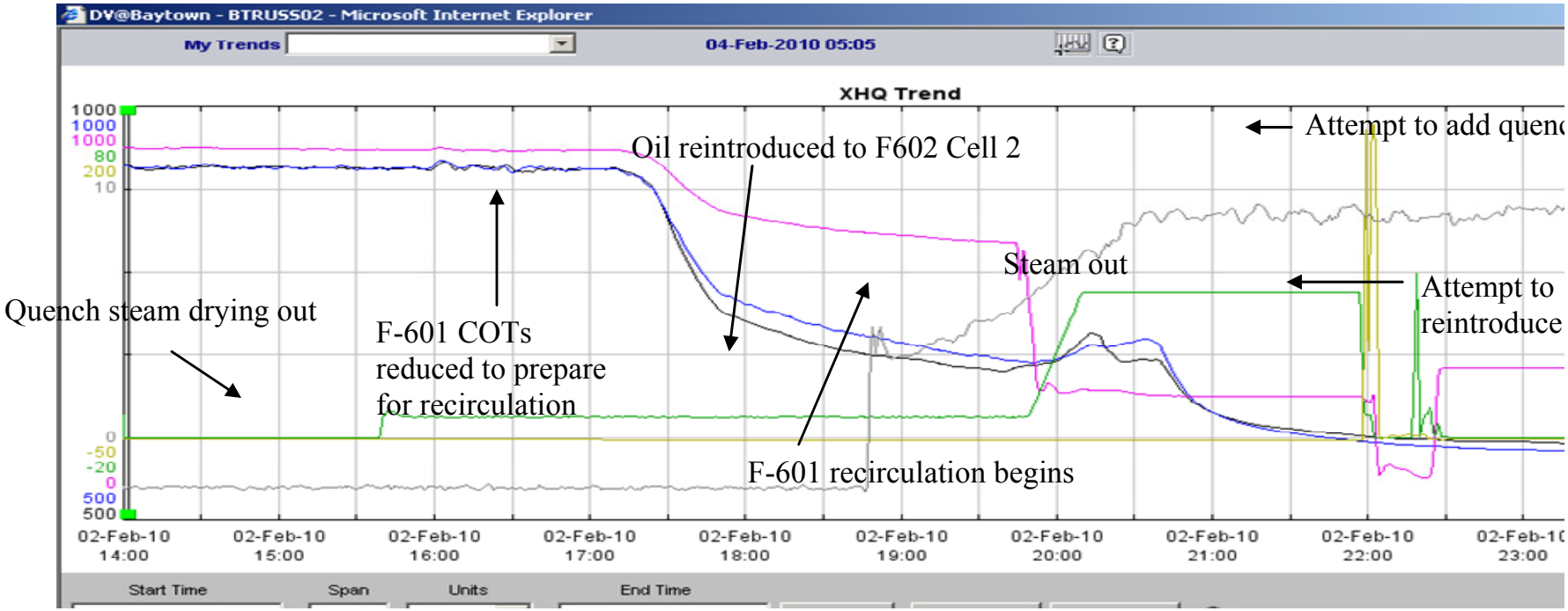
Four-drum coker suffers failure of their Hahn&Clay Force Actuator Bladder:

- Requires train circulation to perform repairs
- 17:15 Day shift began lowering Train-1 COTs in preparation for recirculation
- Train-2 on-line spall was not complete at time (2 of 4 passes)
- 18:00 Night shift postponed feed out to avoid running the Main Frac at 25% of rate
- 18:45 Train-2 spall completed and oil reintroduced to cell 2
- 19:45 Train-1 placed in recirculation, 2.5 hours after beginning to lower the COTs. Coke drum inlet temperature had dropped to 640°F.

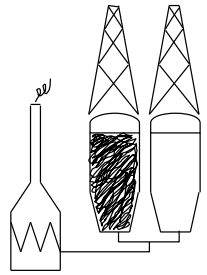
Delayed Coker: Low Coking Temperatures

February 2010 Scenario (cont'd):

Timeline of Events:



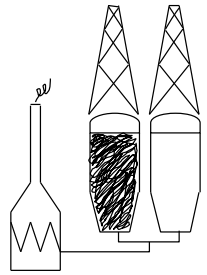
Delayed Coker: Low Coking Temperatures



February 2010 Scenario (cont'd):

- Quench steam was immediately introduced to D-603 after switching to recirculation.
  => Steam ramped to 35 klb/hr and maintained for 2 hours.
- Upon completion of steam quenching, the operator attempted to water quench the drum two times, but was unsuccessful.
- The operator then attempted to reintroduce steam to the drum, but was unable to establish significant flow.

Delayed Coker: Low Coking Temperatures



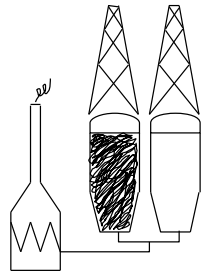
February 2010 Scenario (cont'd):

- Key Learning: It is important for operations teams to have an understanding of the difference between feeding cracking resid at 920F and hot tar at 700F.

  => At >900°F, furnace effluent flow is a turbulent two-phase mixture traveling at 100 ft/s consisting of 80 - 85 vol% light vapor with the balance being entrained cracking tar droplets. Once this material enters the coke bed, it travels up through the coke bed channels at high velocity to the top of the coke bed.

  => When the furnace COT is below 740F, the only vapor present is process steam from the furnace and any steam-purged valves. In that case, the flow is predominantly tar traveling at a much lower velocity (~ 5 ft/s). At those conditions, the tar will deposit in the feed line and coke bed channels (previously the high velocities sheared the tar and prevented deposition). The results will be difficulty in cooling and draining the coke bed, as observed in this case.

Delayed Coker: Low Coking Temperatures



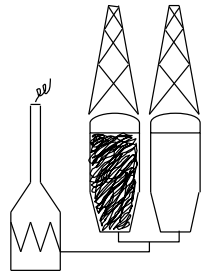
Scenarios (2 & 3)
Low Coke Drum Inlet and/or Outlet Temperature(s)

=> It is important to assess how much the COT has dropped versus a recommended minimum of 900°F

=> Determine if there are changes in other factors that may worsen or improve the situation:

+ feed quality
+ resid cut point
+ operating pressure
+ natural recycle %
+ distillate recycle %

Delayed Coker: Low Coking Temperatures



February 2010 Scenario (cont'd):

- Starting and stopping steam flow eventually opened a small passageway
- Steam flow was maintained and water introduced simultaneously
- Steam was removed and the drum was slowly cooled for about a day
- Draining was very slow and then stopped
- A pressure drain technique was used that actually resulted in expulsion of the soft tar plug from the drain line
- Draining then proceeded normally
- Special precautions were taken during deheading, which occurred without incident
- Cutting was normal as well