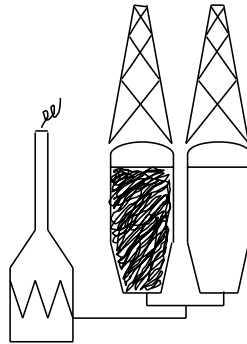


Delayed Coker

Coke Drum Structure Safety during Shutdowns & Maintenance



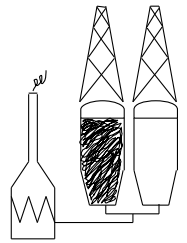
Coking.com[®]
MORE PRODUCTION - LESS RISK!

Presented by Mitch Moloney of **ExxonMobil**

mitchell.j.moloney@exxonmobil.com

New Delhi India, October 2013

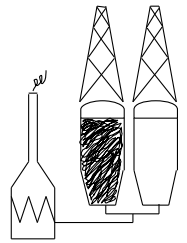
Delayed Coker Structure Safety during SD's



Topics:

- (1) Shutdown Scenarios Key Points
- (2) Normal Drum Decoke
- (3) Vapor Line Cleaning
 - => Sister drum coking
 - => Sister drum out of service
 - => Coker out of service
- (4) Chemical Cleaning
- (5) Turnarounds
 - => Falling Objects
 - => Energy Isolation
 - => Furnace Pigging

Delayed Coker Structure Safety during SD's



Shutdown Scenarios Key Points:

Normal Decoking Isolation

- Deenergize and Lock-Out-Tag-Out (LOTO)
- No entry to piping or drums
- Ideally no exposure to open coke drum

Vapor Line Cleaning

- Requires piping entry
- Leakage of hydrocarbon & steam are a MAJOR concern
- Energy Elimination and Isolation is Key

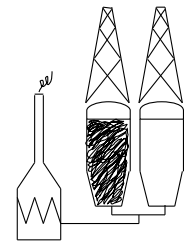
Chemical Cleaning

- Strategic coordination with Mechanical team for set up
- Completed before final handover to Mechanical for Blinding
- Worker exposure to hydrocarbon is key risk
- Trips and Falls is 2nd highest risk

Turnarounds

- Falling Objects, Fall Protection, Energy Isolation
- Communication
- Confined Spaces - Ventilation and Access

Delayed Coker Structure Safety during SD's



Normal Decoking

SISTER DRUM in service & No entry to Piping

PLC Interlocks - **Nothing is Perfect**

- => Vibrations, bad relays, temporary jumper wires can move valves
- => Human Communication is not always complete, and human error does occur

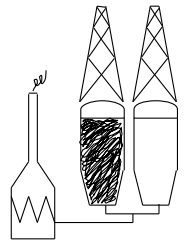
Site-1 has a complete PLC-based MOV interlock system

- => However, they do not rely on this to prevent incidents during drum decoking
- => They use a drum isolation procedure to ensure that the coke drum can be safely decoked by their operators and the hired contractor.
- => All automated valves are de-energized around the open coke drum, except for the top water and cutting water valves. Steam is also available to the drum.
- => MOV switches are moved to OFF & contractor puts locks on the panel switches.
- => Site process operators verify the locks are in place.
 - There is only one key for the locks, that changes hands on shift change. In order to dehead the coke drum, this key is needed.

At Site-2, XOM AND the Coke Handling Contractor install locks on MOV switch.

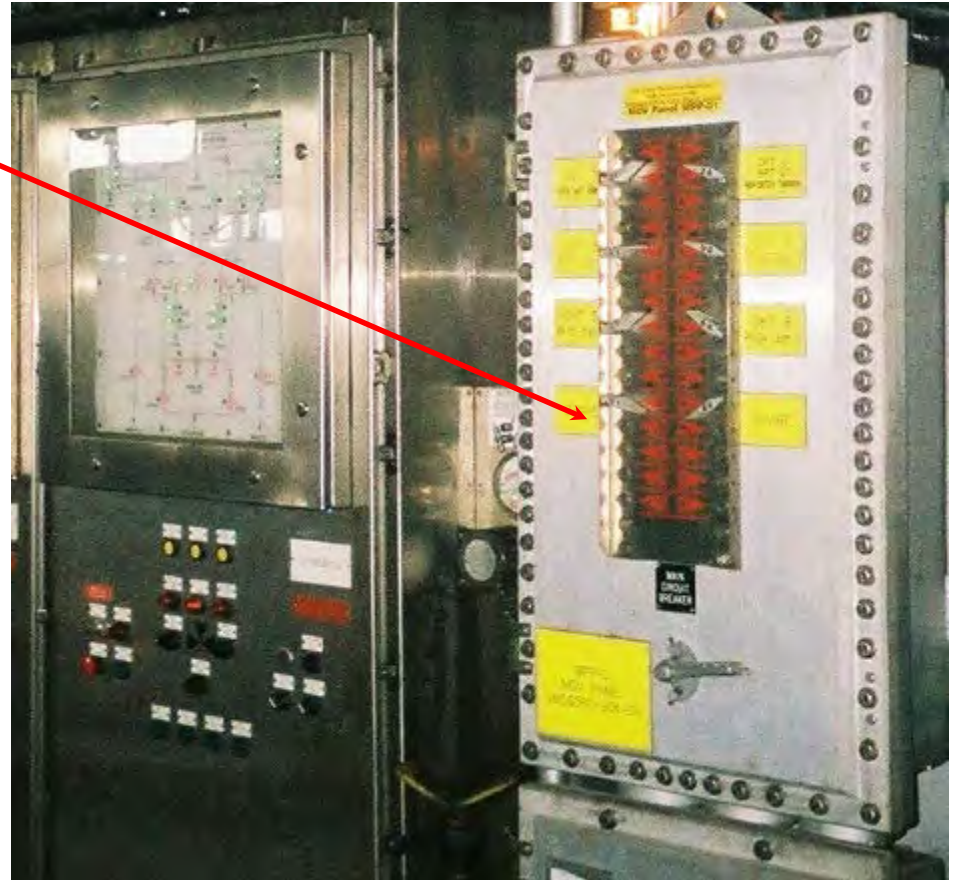
Delayed Coker Structure Safety during SD's

Company - Contractor or Coke Handling Handover

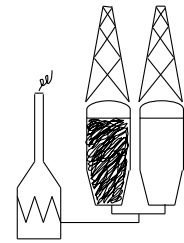


Sites A & B require that contractors place locks on the motor operator switch panel

Communication is the Key !



Delayed Coker Structure Safety during SD's



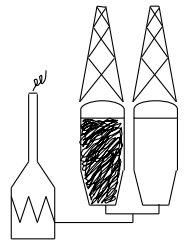
Normal Decoking Standard PPE

- o Standard PPE is defined to be **hard hat** (with goggles or face shield, if splashing liquid is possible), **safety glasses** with side shields, **hearing protection** as required for the given area, **gloves** appropriate for the task, **Nomex** or other FRC (Fire Retardant Clothing), **steel-toed shoes**
- o In addition, it is now common practice for operations technicians and coke handling contractors to wear personal **H₂S monitors**, so this is also considered standard PPE on the coke drum structure.



Delayed Coker Structure Safety during SD's

Normal Decoking



ACCESS CONTROL during Deheading & Coke Cutting

Operations permission always required before climbing the structure

Physical Barriers, Signage Flashing Red Lights and Communication via a Public Address System can be used

2 & 4 Drum Cokers Lock-out access to the structure during Deheading & Cutting

- elevator is kept above grade with door open

6 & 8 Drum Cokers will allow maintenance access to one side with lock-out procedures in place to prevent access sideways during Deheading & Cutting

Delayed Coker Structure Safety during SD's Normal Decoking



ACCESS CONTROL during Deheading & Coke Cutting

Pipe-in-a-Pipe Slide
Barrier

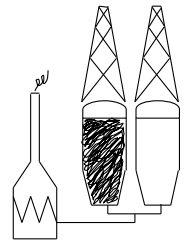


Delayed Coker Structure Safety during SD's

Normal Decoking

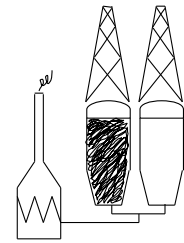
ACCESS CONTROL during Deheading & Coke Cutting

Signage is Important
but Difficult to Keep in
Place



Delayed Coker Structure Safety during SD's

Normal Decoking 4-Drum ACCESS CONTROL CONSIDERATIONS



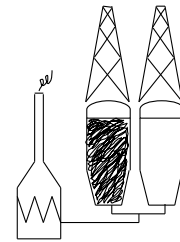
Normal - Restrict structure access during cut to Lead Operator & Cutter
Special Mechanical/Contractor Access can be granted if:

1. Pilot hole has been drilled in coke bed.
 2. "HOT" portion of coke in coke drum has been removed.
 3. No top head is "open" to prevent accidental fall into drum
 4. Proper LOTO in place and verified by all parties
 5. One "closed or OOS" drum separates work area from "open" drum being cut.
 6. If East-side drum being cut, must access on West-side stairway for Bottom Head or Switch Deck work. For Top Deck access to West side, walkway on the South side of the Top Head deck must be used. And Vice-Versa.
 7. If a "side" drum is being cut, work can NOT be performed on that side of structure until drum is completely cleaned.
 8. Safety Pre-checks required. Contractor & Company Reps will have daily communication with Operations Personnel to verify acceptable times and structure locations to be worked.
 9. Operations Field Coordinator has verified these conditions have been met.
- HOT WORK is governed by normal special procedures

Delayed Coker Structure Safety during SD's

Normal Decoking

4-Drum ACCESS CONTROL PROCEDURE



APPROVALS:

Process

_____ Date: _____

Mechanical

_____ Date: _____

Technical

_____ Date: _____

Fire & Safety

_____ Date: _____

Contractor Supv.

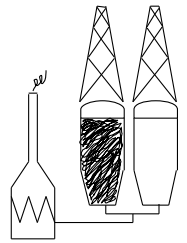
_____ Date: _____

Mechanical Supv.

_____ Date: _____

Delayed Coker **Structure Safety during SD's**

Vapor Line Cleaning - Sister Drum Coking



Typically involves removal of a “coke donut” near the outlet of coke drum vapor line just upstream or downstream of the 1st 90-degree elbow

- After coke bed cutting is completed, the flange end plates (or plates) are removed to provide access for high-pressure water lancing of the donut

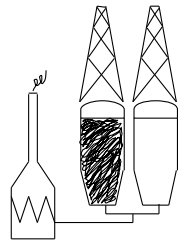
Preferred Approach is to Slip Blind at next Downstream Flange

Secondary Approach requires the following Precautions:

- Double blocks with flow-through steam barriers are operational
- Low point bleeder valve is open down at vapor block valve level to ensure there is no build-up of hot condensate that could create a geyser
- Ongoing gas checks to ensure there is no leaking cracked gas from sister drum or blowdown system, meaning double blocks and steam barrier are effective
- Proper PPE : Full 2-Piece Slicker Suit with Hood equivalent to Bunker Gear, Rubber Boots, Dual-layer Rubber Gloves, Complete Face Shield

Delayed Coker Structure Safety during SD's

Vapor Line Cleaning - Sister Drum Coking



BEWARE THE GEYSER EFFECT

Vertical lines can accumulate condensate if steam enters via a partially open valve or a leaking valve

Condensed steam heats to its bubble point and is pushed out of the way when incoming steam pressure can displace the leg of condensate.

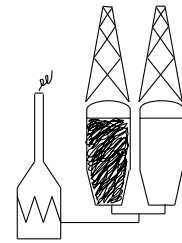
The amount of condensate in the vertical pipe will continue to increase over time.

Eventually the condensate height increases to the point where it can be lifted out the open end of the piping



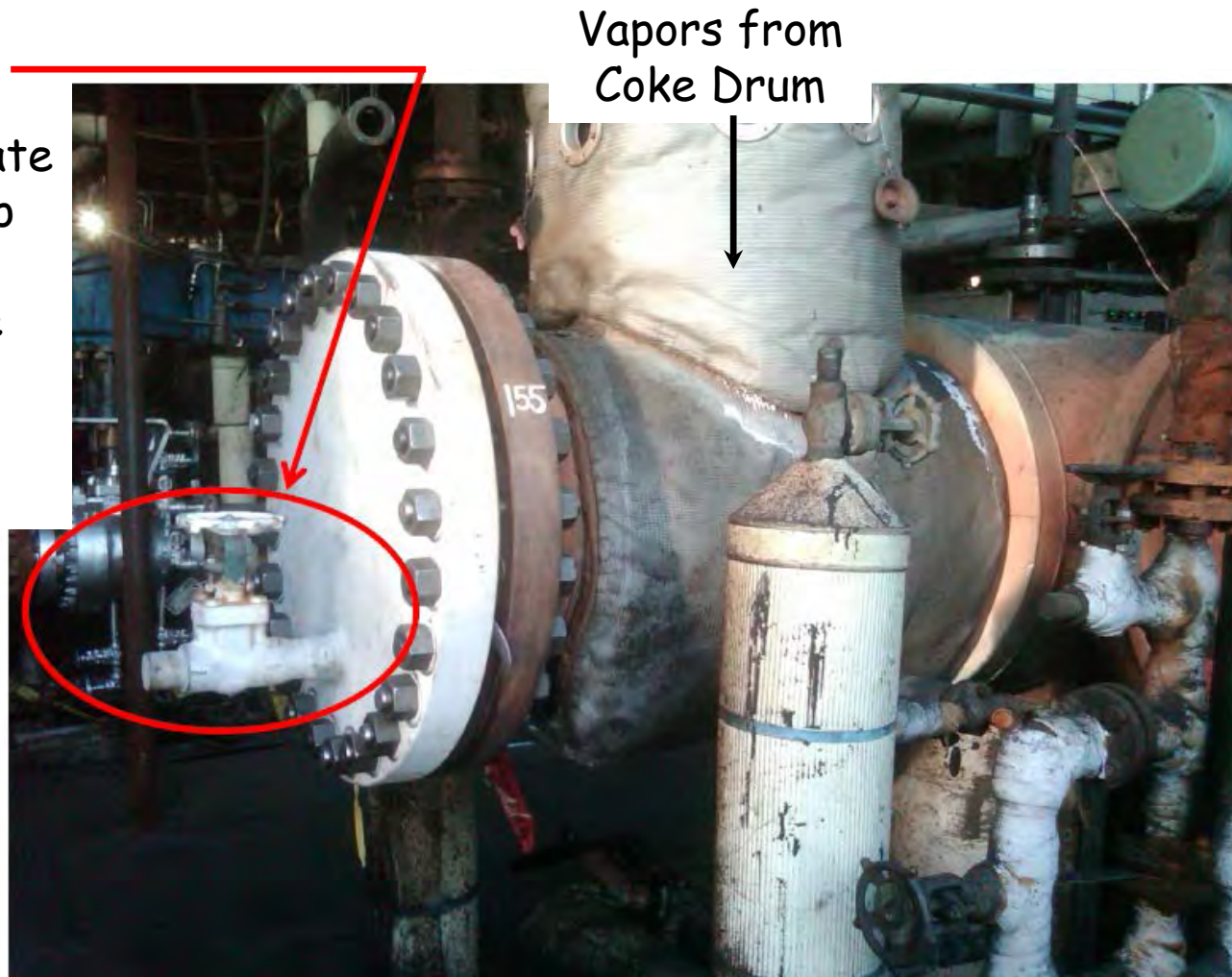
Water at temperatures of greater than 150°F can result in deep 2nd degree burns after only three seconds of contact with skin. Boiling water will cause instantaneous 3rd degree burns.

Delayed Coker Structure Safety during SD's Vapor Line Cleaning - Sister Drum Coking



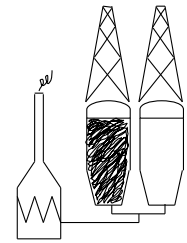
Vapor Line Header Drain Valve

- ✓ Prevents condensate build-up during top head work
- ✓ Allows condensate draining prior to removing flange plate



Delayed Coker **Structure Safety during SD's**

Vapor Line Cleaning - Train Out of Service



Can involve removal of a “coke donut” near the outlet of coke drum vapor line, as well as cleaning of some portion of the vapor line

- After coke bed cutting is completed, the flange end plates (or plates) are removed to provide access for high-pressure water lancing of the donut

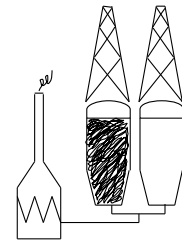
Preferred Approach is to Blind at the Main Fractionator Entrance

- Automatic Blind in combination with a block valve
- Platform to allow Slip Blind installation

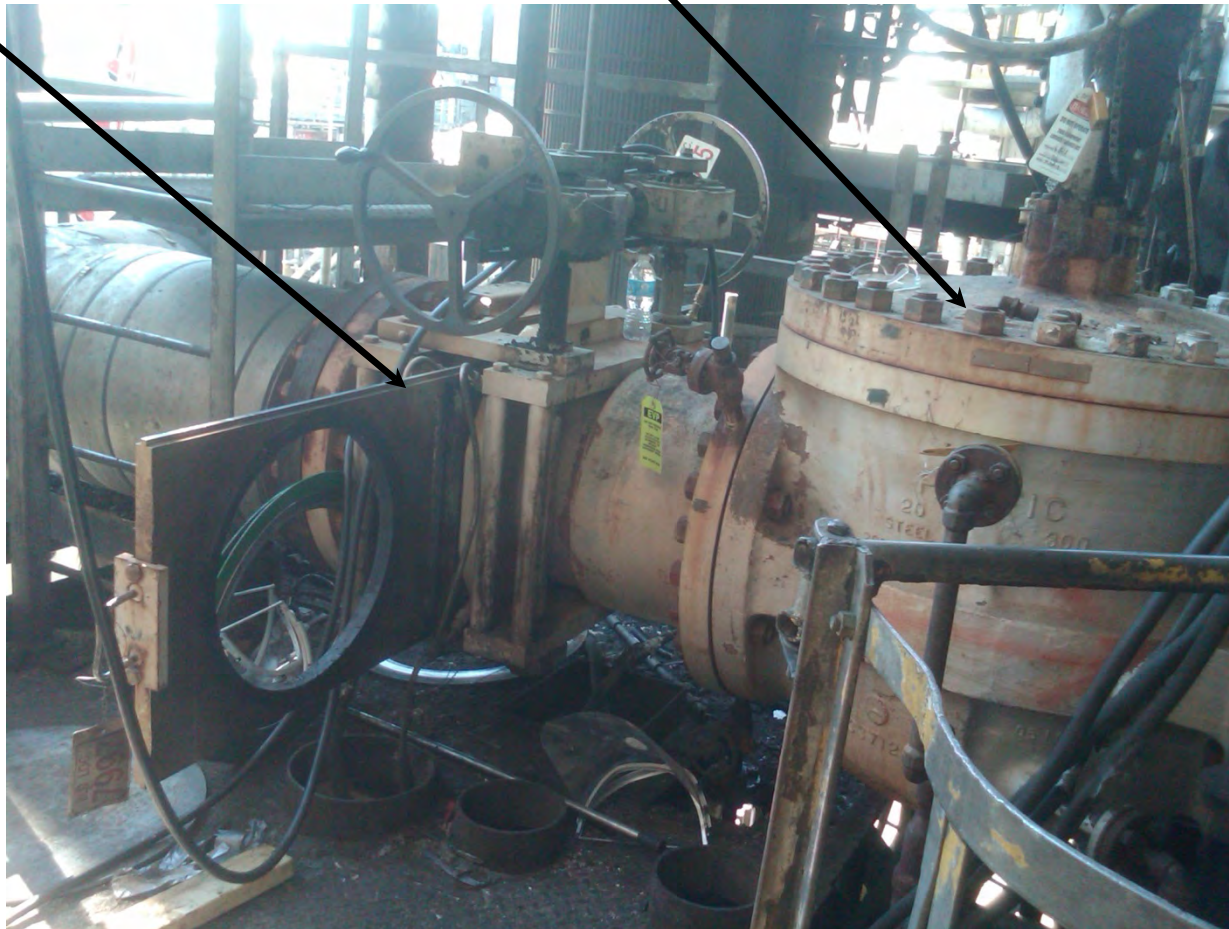
Secondary Approach is to slip blind at Vapor Valve Platform (Blowdown and Main Fractionator Valves):

- Gas check, prior to opening piping, to ensure there is no residual cracked gas
- Low point bleeder valve is open down at vapor block valve level to ensure there is no build-up of hot condensate that could create a geyser
- Proper PPE : Full 2-Piece Slicker Suit with Hood equivalent to Bunker Gear, Rubber Boots, Dual-layer Rubber Gloves, Complete Face Shield

Delayed Coker **Structure Safety** during SD's Vapor Line Cleaning - Train Out of Service

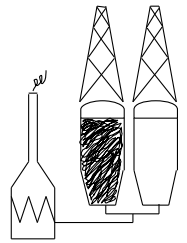


Automatic Blind in Combination with a Block Valve at Main Fractionator Entrance



Delayed Coker **Structure Safety during SD's**

Vapor Line Cleaning - Coker Out of Service



Can involve removal of a “coke donut” near the outlet of coke drum vapor line, as well as cleaning of some portion, if not all, of the vapor line

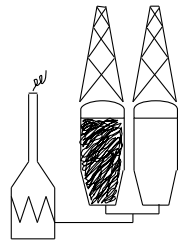
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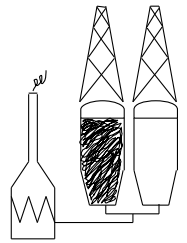
De-Energize all Steam and Safely Drain Steam Condensate

Delayed Coker Structure Safety during SD's Turnarounds - Chemical Cleaning



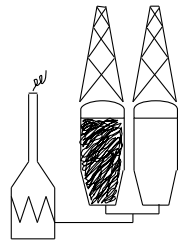
**CHEMICAL CLEANING REQUIRES THE USE OF MANY PIPING
HEADERS & HOSES**

Delayed Coker Structure Safety during SD's Turnarounds - Chemical Cleaning



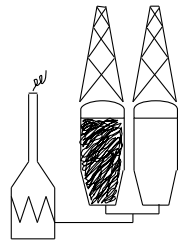
**CHEMICAL CLEANING REQUIRES THE USE OF
TEMPORARY PUMPS**

Delayed Coker Structure Safety during SD's Turnarounds - Chemical Cleaning



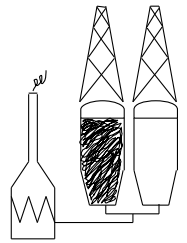
CHEMICAL CLEANING HOSE CHRISTMAS TREE

Delayed Coker Structure Safety during SD's Turnarounds - Chemical Cleaning

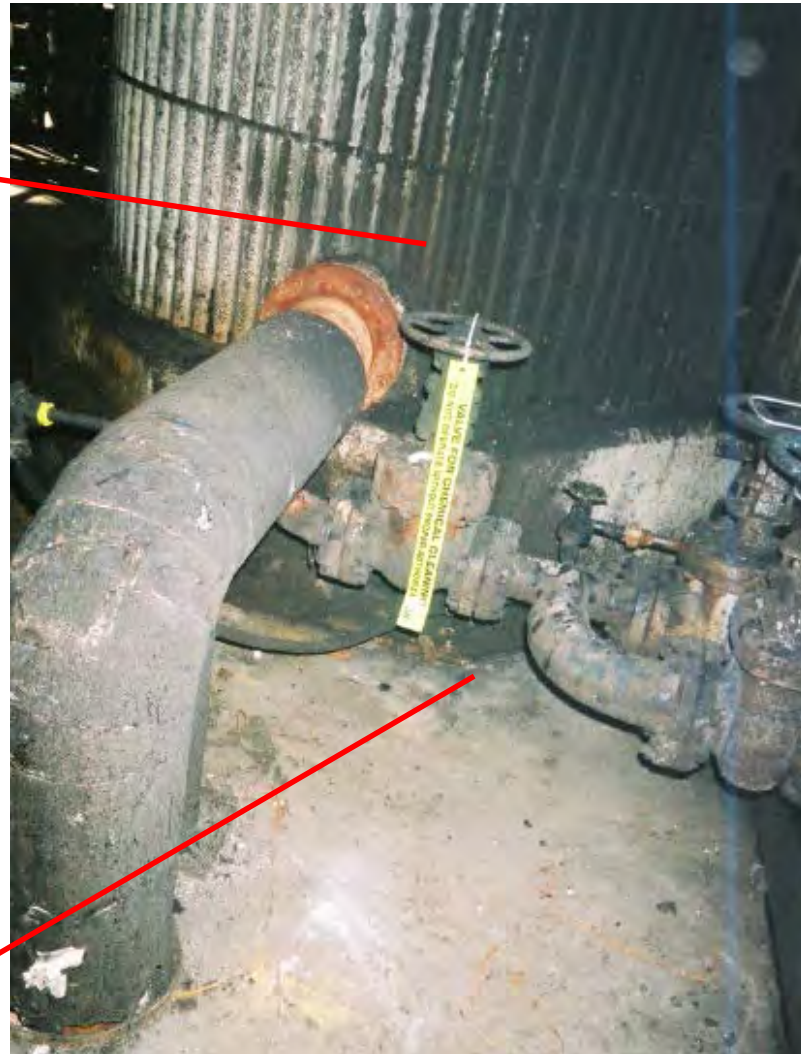


CHEMICAL BARRELS & INJECTION PUMP

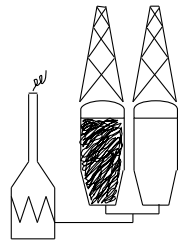
Delayed Coker Structure Safety during SD's Turnarounds - Chemical Cleaning



PROPER TAGGING



Delayed Coker **Structure Safety** during SD's Turnarounds



PROPER VALVE ENERGY ISOLATION TAGGING

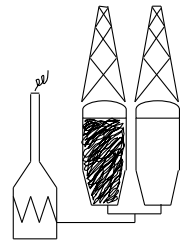
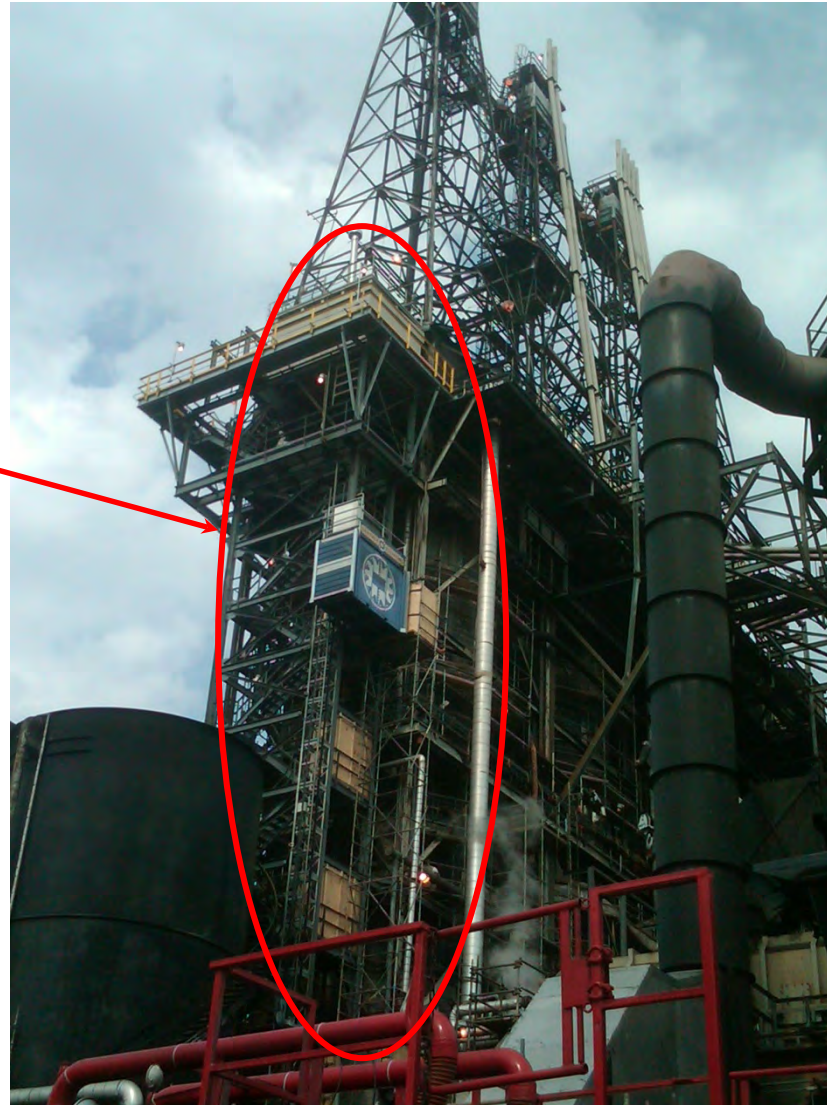


Delayed Coker Structure Safety during SD's

Turnarounds

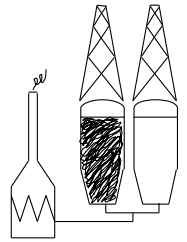
ELEVATOR SAFETY

Temporary
Turnaround Elevator
for Contractors
working the
Structure



Delayed Coker Structure Safety during SD's

Turnarounds



ELEVATOR SAFETY (cont'd)

Proper Signage on
Company Elevator



Delayed Coker Structure Safety during SD's

Turnarounds

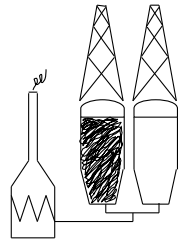
ELEVATOR SAFETY (cont'd)

RESTRICTIONS



Delayed Coker **Structure Safety** during SD's

Turnarounds



Provision of platform communication with

- => Main Fractionator
- => Blowdown System
- => Furnaces

Advantages:

- Safety
- Productivity

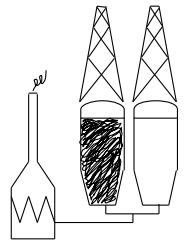
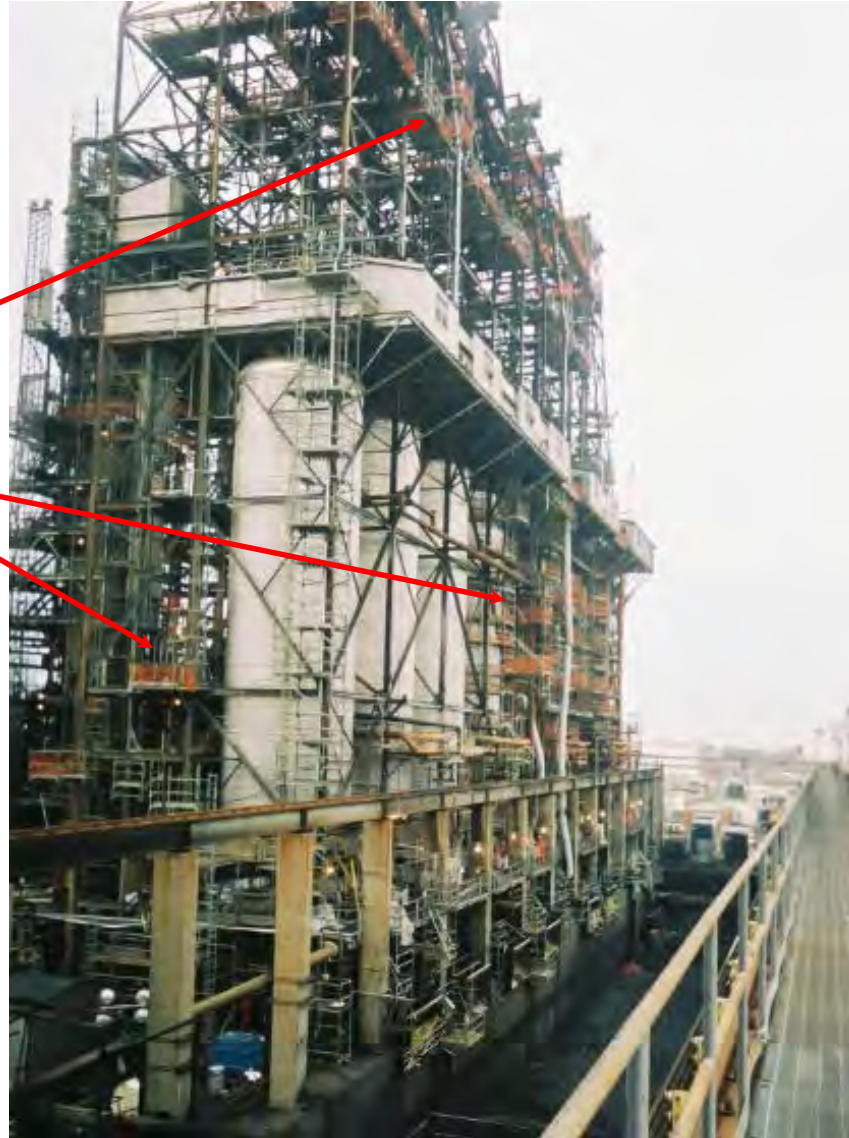
Delayed Coker Structure Safety during SD's

Turnarounds

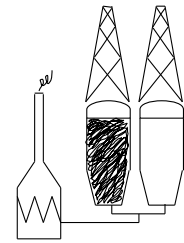
Stacked Work Guidelines

Use of plastic netting to prevent falling objects from hitting workers and equipment.

Netting mesh should be ≤ 2.5 cm and extend 1.5 meters beyond work area perimeter



Delayed Coker **Structure Safety during SD's**



Turnarounds

Stacked Work Guidelines

Mechanical Foreman or Mechanical First Line Supervisor (FLS) should lead a Job Safety Review for "stacked work"

- Mechanical FLS should sign the permit for stacked work
- Operations Technician must conduct a falling objects analysis as part of the Job Safety Review and as part of issuing permits to different crews in the same location

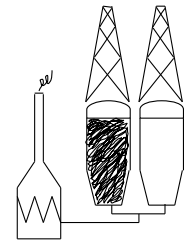
Access to work areas subject to falling objects should be controlled, as possible. Red tape can be used to restrict access under areas of overhead work where possible, without impeding structure work ingress/egress

Tethering of tools (< 2 kgs) to workers or to structure (>2 kgs)

For work directly beneath other work, a hard barrier (platforming or temporary plywood) is needed extending 1.5 meters beyond work area

Intermittent valve operation with wrenches above work areas should be assessed and controlled (tethering preferred)

Delayed Coker **Structure Safety during SD's**



Turnarounds

Falling Objects - Site 2 Incident

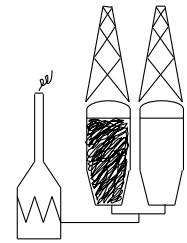
Contract worker chipping refractory was lowering a 35# rivet buster to a scaffold below. While in the process, the rivet buster fell ~5ft, glancing off a nearby contract scaffold builder's hard hat & left shoulder.

- ☐ Worker was lowering the rivet buster by the hose instead of rope as required by overhead stacked work practices.
- ☐ Communication between contract workers inside of vessel was less than adequate.
- ☐ Worker did not identify the risk/hazards of the tool falling.
- ☐ The injured scaffold builder was wearing a hard hat, which minimized the severity of the injury.
- ☐ Line of Fire hazards from overhead work were not addressed by work crews inside the vessel.



Delayed Coker **Structure Safety** during SD's

Turnarounds Falling Objects - Site 2 Incident (cont'd)



Reminders / Learnings:

- ☐ All tools **MUST** be tied off to avoid inadvertent dropping when not in use. (tool lanyards required on tools <5lbs).
- ☐ Only use approved lifting techniques to raise and lower tools greater than 5lbs. (i.e. rope, bucket, etc.).
- ☐ Multi-level work will not be allowed without proper barricades, netting, hazard watch or endorsed mitigation steps documented on JHA.
- ☐ Use the SCAN process to identify Line of Fire and Overhead Work hazards within your work area.



Delayed Coker Structure Safety during SD's

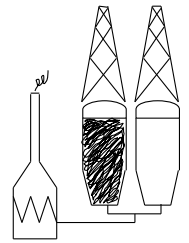
Turnarounds

SCAN Process



Delayed Coker Structure Safety during SD's

Turnarounds

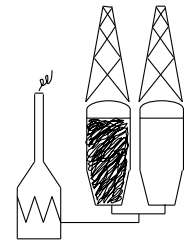


TEMPORARY BARRIERS

Cutting Deck
required temporary
ladder fencing until
work in area could
be completed and a
proper scaffolded
work platform put
in place in the
opening



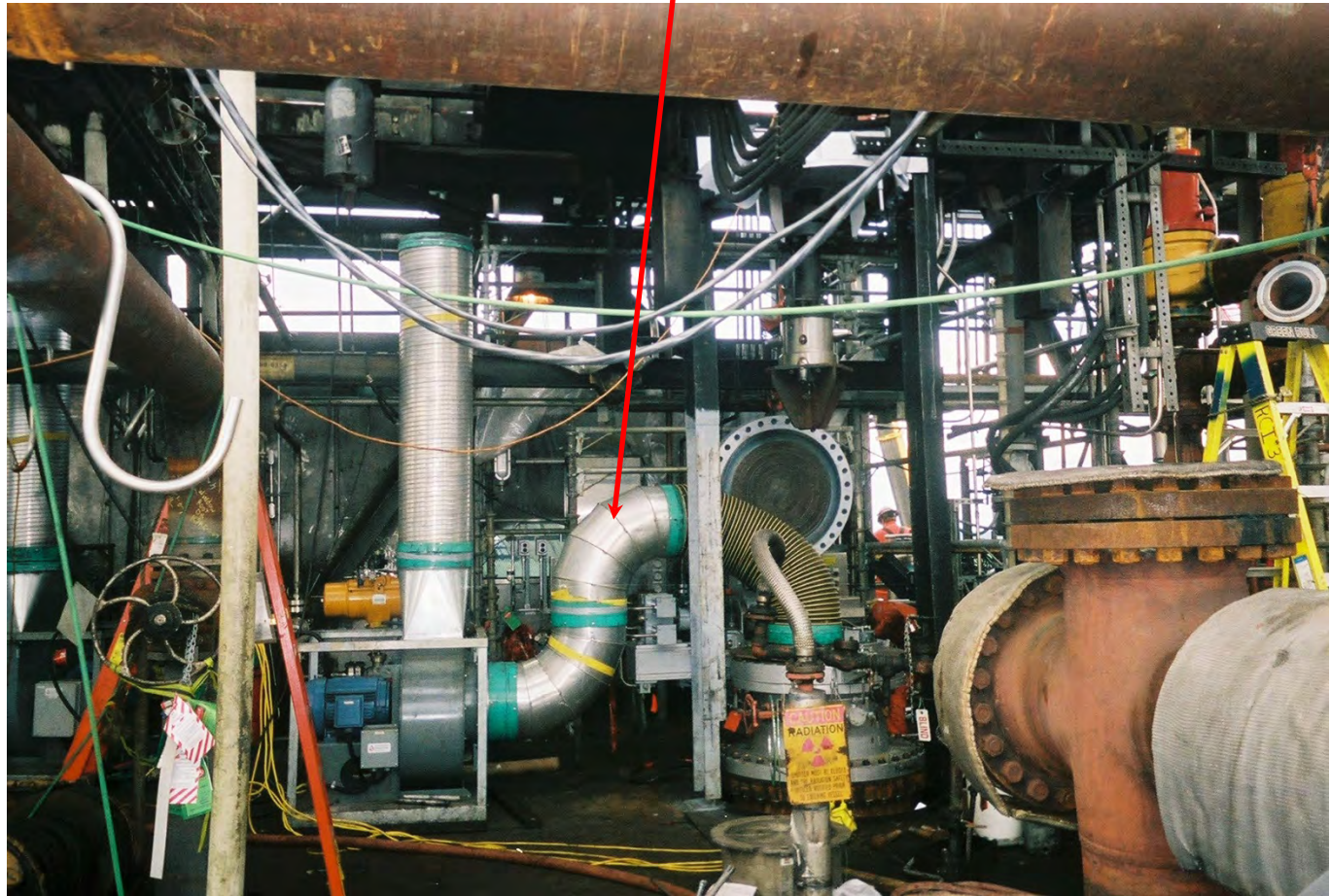
Delayed Coker **Structure Safety** during SD's



Turnarounds

Coke Drum Ventilation

Coke Drum weld repairs require proper Ventilation and Summertime Air Conditioning



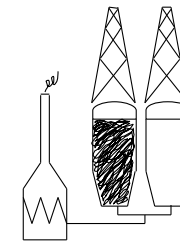
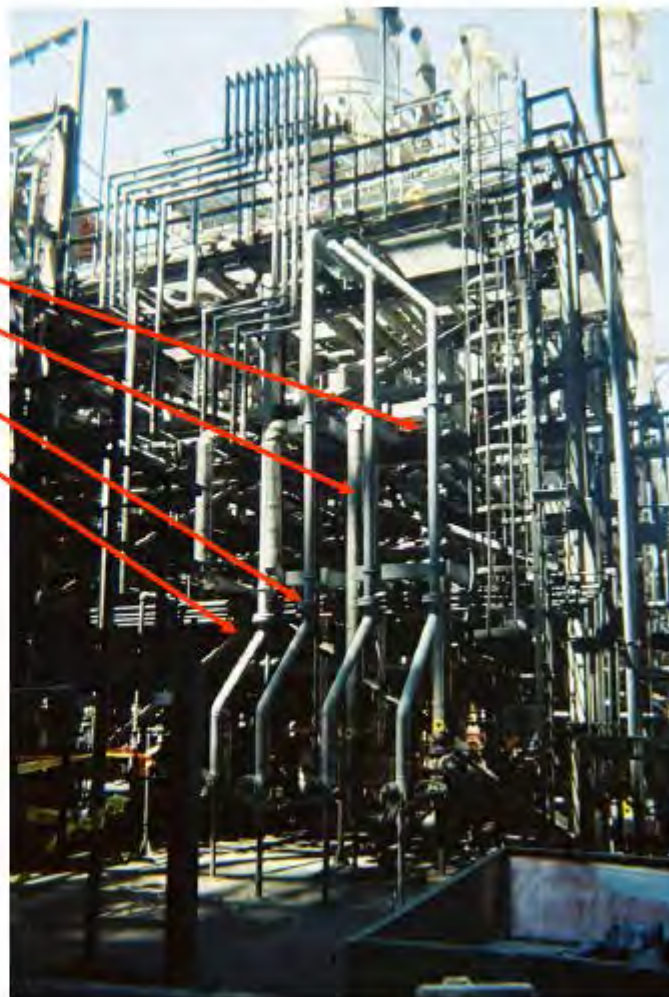
Delayed Coker Structure Safety during SD's

Turnarounds

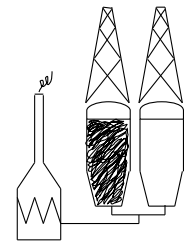
Pigging

Bringing Convection
Inlet to Grade

=> Here is piping provided
at the Jose Upgrader in
Venezuela



Delayed Coker Structure Safety during SD's



Turnarounds

Pigging

Pig Launchers / Catchers on the Outlet Platform

=> Restricted space
can be an issue

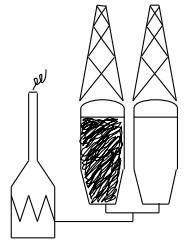
These launchers
can jump off their
blocks due to
hydraulic surge.

Worker access
should be
controlled to this
area during pigging

=> Control Access with
Barriers and Red
Access Tape



Delayed Coker Valve Operations Integrity



**Back-Up
Information
Details**

Delayed Coker Valve Operations Integrity

Typical Foster-Wheeler Coke Drum Valve Schematic:

