# Equilon Refinery Accident
# Anacortes, WA

Leadership ViTS Meeting
1 August 2005

James Lloyd, Deputy Chief
Office of Safety and Mission Assurance

# Accident Timeline

**Place: Equilon Refinery, Anacortes, WA**

**Accident Date: November 25, 1998**

**Events leading to accident:**

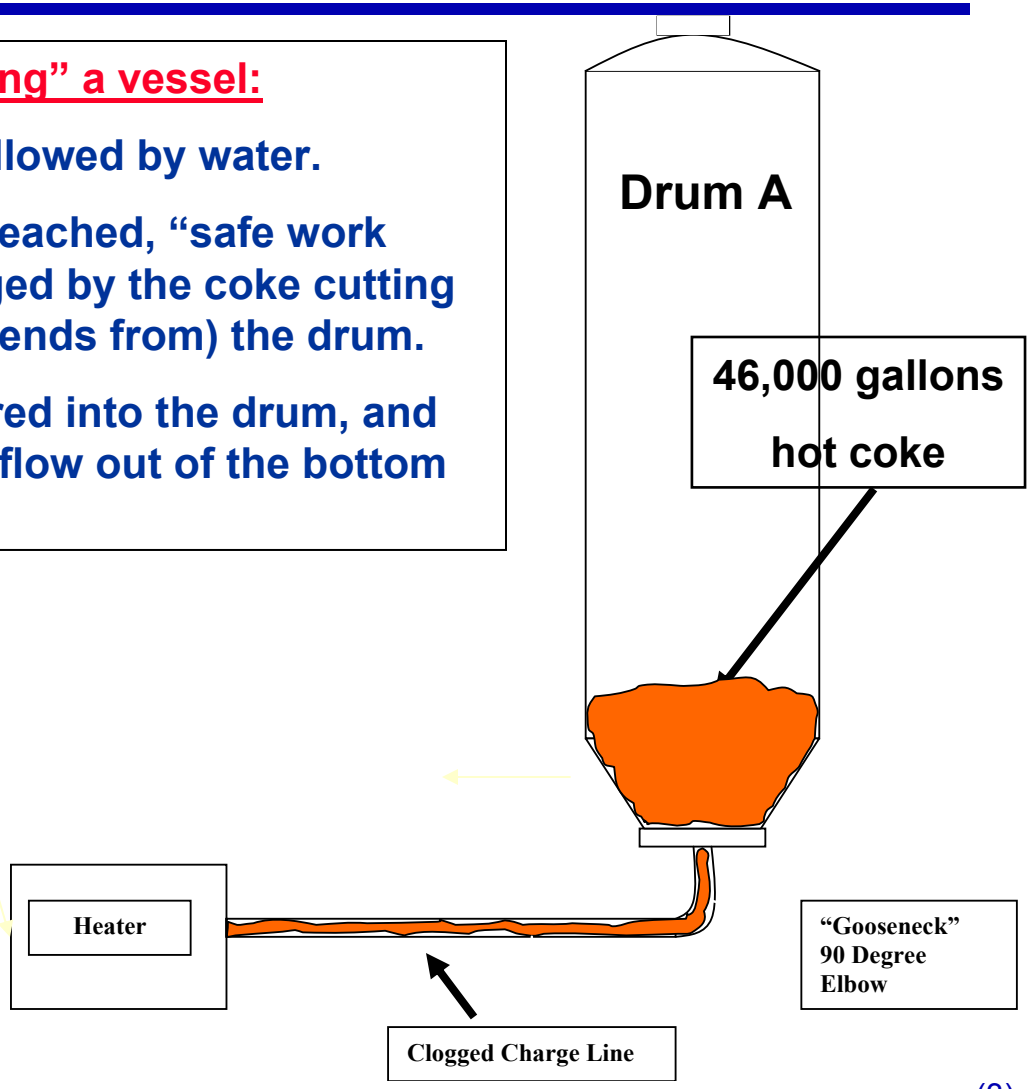
- On Tuesday, Nov. 24, 1998, high winds cause power outage resulting in complete refinery shutdown.
- A large processing vessel known as "Drum A" was about 1 hour into a routine charging cycle.
- 46,000 gallons of hot coke hydrocarbons @ 900 degrees F became trapped in Drum "A"
  - Coke is a heavy, dense, black, high carbon material similar to charcoal briquettes that is a residue remaining from crude oil processing.

# Accident Pre-conditions

**Under Normal Conditions for "unheading" a vessel:**

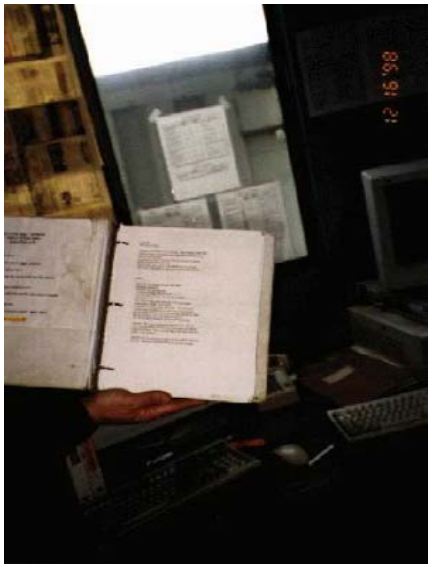
- Drum A is cooled first with steam followed by water.
- When acceptable temperatures are reached, "safe work permits" are issued and acknowledged by the coke cutting contractor to "unhead" (remove the ends from) the drum.
- A high pressure water wand is lowered into the drum, and the coke is "cut" into chunks which flow out of the bottom of Drum A into a pit below.

When a normal cycle is interrupted workers need to remove the coke from the vessel. However, in this situation the line was clogged with coke material that had cooled and hardened during the power outage and they could not move any steam or water through the charge line ("DCU" line) to cool the hot coke in the bottom of the drum.

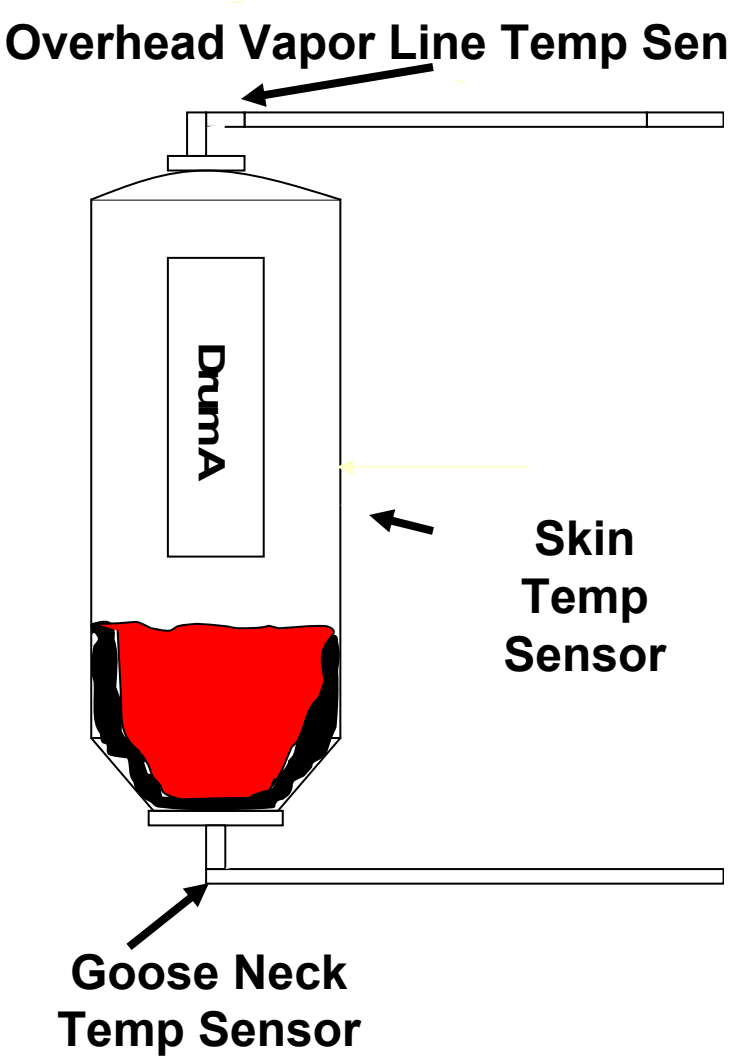


# Pre-Accident Events

- Attempts were made to clear the DCU heater lines when power and then steam was restored around 10:00 AM.
- Operators believed, without verification, that steam made its way through the heater and up into the bottom of the "A" drum.
  - Instead, it was likely that the pressure relief valves were lifting and simply diverting steam to their blowdown system.
- The unit foreman wrote the night orders and discussed the situation at a 3 PM managers' the afternoon of the outage.
- He said "…drum is cooling without water. Do not put water into drum. Day shift will un-head Wednesday morning."
- Next morning, additional attempts were made to clear the line into the drum without success.



# Actual temperature of hot coke unknown

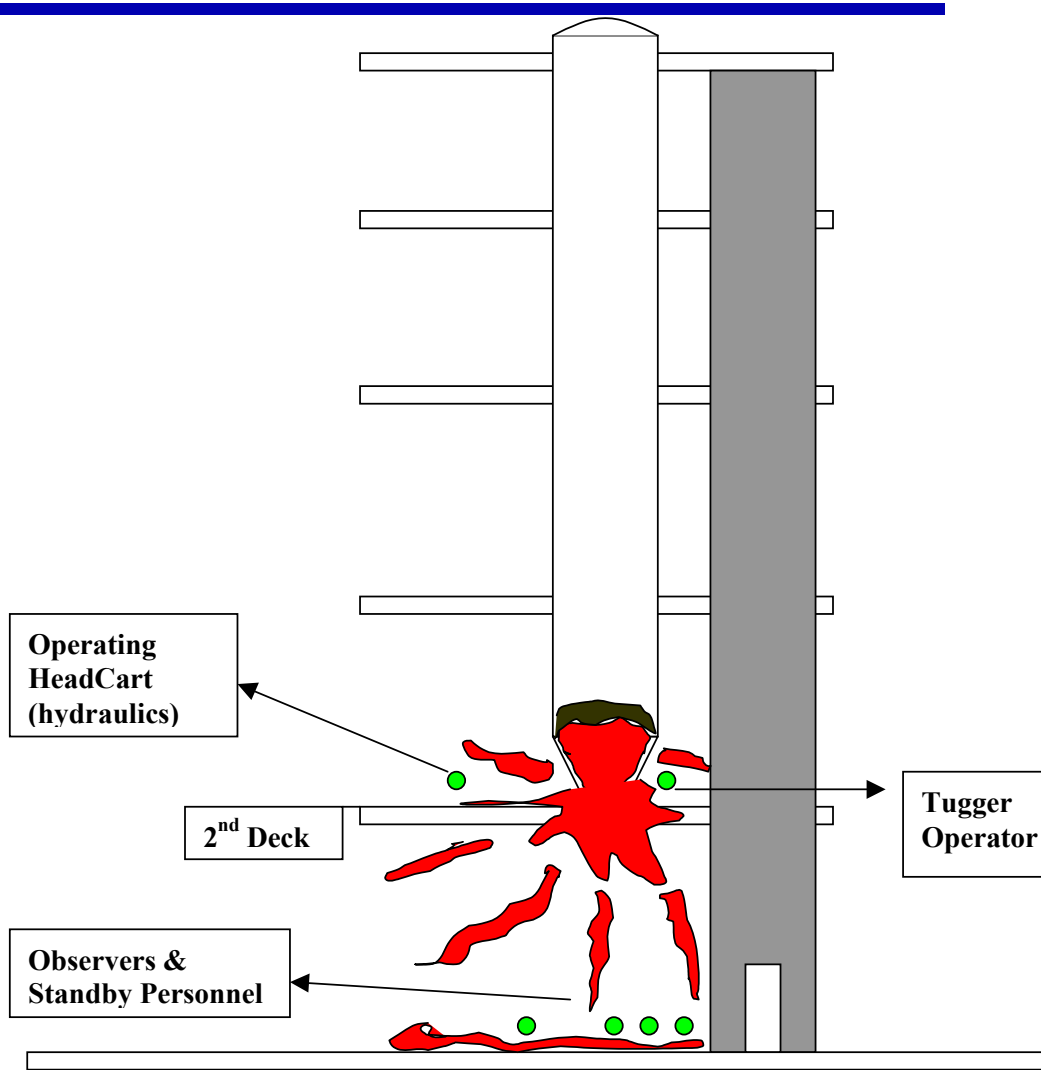



- There were 3 temperature sensors as shown in the sketch.
  - The sensors were not positioned to indicate the temperature of coke inside the drum.
- Employees had no direct way to determine the temperature of the material in the drum.
  - No assistance was requested to determine the temperature since hazard not recognized.
- Later estimates indicate it would have taken 200 days to cool the coke to a safe temperature.

# Events Associated with Proximate Cause

- A foreman and operators reviewed the drum temperature sensors and concluded that the drum contents had sufficiently cooled to un-head.
- So, the top head of drum A was removed without incident or any further indication of the temperature of the coke at bottom of Drum A.
- Using hydraulic controls, employees lower the bottom head of the vessel.
- In a matter of 6 seconds, 46,000 gallons of coke, still at auto-ignition temperature spewed out in all directions from the bottom of the drum.
- The coke ignited, engulfing 6 observers and standby workers in flames.

= employees



# Accident Impact – tangible and intangible

- Six Lives Lost
- Equipment damage
- Production lost
- Citations from WISHA (Washington Industrial Safety and Health Administration)
- Third party lawsuits
- Lowered worker morale
- Affected community standing

WISHA citations ultimately cost the company 4 million dollars in the form of a settlement agreement. The cost of lost production and equipment damage estimated at 10 to 20 million dollars. Third party lawsuits estimated at an additional 45 million dollars.

# Root Causes and Lessons Learned for NASA

- **Permit Systems**: In this case, the work permit system was seriously flawed. It was falsely determined that drum parameters were adequate for unheading when there really was no way of knowing the temperature of the material in the drum.

  **Lesson**: Have you performed a thorough hazard analysis to identify all credible failure conditions and scenarios? Do you have a method and means established for detecting these scenarios if they occur?

- **Procedural Development**: Procedures were not adequate

  **Lesson**: Are your procedures current, complete and accurate? Do procedures include conceivable and credible emergency procedures?

- **Operator Training**: Operators did not know the true hazards of the processes they were operating under unusual conditions.

  **Lesson**: Have all procedures, including emergency procedures, been effectively communicated to operations personnel? Are operators adequately trained to recognize and deal with hazards? Does your training include operating in unusual situations? Does your training simulate the troubleshooting procedures for all credible emergency situations?

- **Management of Changes**: At the first suggestion for a procedural change, the "change management process" should have been triggered but it was not.

  **Lesson**: It is not enough to just have a system to manage changes. The system must have discipline and rigor. Audit your own programs to ensure you can manage changes (this includes equipment, procedures and skills considerations)