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MARCH 6, 1989

FROM: DISCIPLINE LEADER - PRESSURE EQUIPMENT - DEER PARK MANUFACTURING COMPLEX

TO: J. L. NEWLIN - FUELS - OPERATING SUPERINTENDENT - DEER PARK MANUFACTURING COMPLEX

SUBJECT: INCIDENT REPORT - FAILURE OF V-1320, HEAVY OIL SURGE VESSEL, DUBBS 9, DECEMBER 22, 1989

PLAINTIFF'S EXHIBIT
SH-2682

DESCRIPTION OF INCIDENT

At 10:10 A.M. on December 22, 1989, the Heavy Oil Surge Vessel (feed surge drum), V-1320, for Dubbs 9 collapsed while in operation. Approximately 30 seconds later, pitch from the torn inlet pipe and vessel caught fire. The fire alarm was sounded at 10:11 A.M. and the all clear was sounded at 11:38 A.M. There was one personal injury to an operator as a result of a slip and fall while running to fight the fire. The operator was treated and returned to work the same shift. Damage was limited to the immediate area of the vessel which was a complete loss. The vessel, which was not designed for vacuum service, collapsed because the nitrogen purge, which was to prevent formation of a vacuum, was inoperable as it was plugged with pitch. The unit was restreamed January 2, 1989 after making piping changes that bypassed V-1320 and essentially used the bottom of the Fractionating Column for feed surge.

BACKGROUND

The Dubbs 9 unit is normally manned by a primary and a secondary operator. The primary operator has the responsibility for the Heavy Oil Surge Vessel (HOS), V-1320. The unit was operating in the mode where excess pitch was being sent to a Pitch Storage Tank, K-310. Unit feed consisted of pitch from the HOS and lube bottoms from storage. Under this mode of operation, the lube bottoms was a swing flow used to maintain the level in the Main Fractionator. Excess pitch can also be bypassed to 6-oil when needed. The bypass valve to accomplish this was closed. Operations indicated this was the normal lineup since the valve has a tendency to leak. To maximize the amount of pitch processed by the unit, the valve is closed.

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The HOS vessel was designed for 66 psi maximum allowable working pressure. It was not designed for vacuum service. The carbon steel vessel was 22'-8" T-T by 132" I.D. X .375" and was installed in the unit

in 1970. It was protected by pressure relief valve RV-1676 set to relieve at 50 psig. Both the vessel and the pressure relief valve had been inspected in June of 1988 and were found to be in good condition.

The HOS was to be protected from vacuum by the nitrogen purge system. Nitrogen flow to the vessel was controlled by vessel internal pressure. Nitrogen flow was to be provided whenever vessel pressure was below 15 psi. The nitrogen purge system instrumentation is field mounted with no pressure indication or alarms in the control room.

In 1985-86, the original level transmitter oil purge was replaced with a nitrogen purge because of unreliable oil supply. The installation, however, had been troubled by a noisy level measurement from time to time according to feedback received from operations as well as instrument support personnel. In addition, cool nitrogen may have contributed to localized pitch solidification and plugging.

INVESTIGATION

There was general agreement on statements taken from two pipefitters and a crane operator who were working on E-1205, an exchanger located Northwest of the failed Heavy Oil Surge Vessel. They stated that they heard a boom accompanied by dust and insulation flying about. At that point they noticed the HOS vessel was badly distorted. They did not observe any fire at the vessel when it first collapsed. It appeared the fire started 30 seconds to a minute after the vessel collapsed.

Analysis of the level recording controller, LRC-307, strip chart revealed that the level of the HOS had started climbing when the flow of excess pitch to the K-tanks was stopped. The level climb lasted for 45 minutes and the high level (overfill) existed for another 30 minutes before feed to the unit was increased. The HOS high level alarm did sound. The alarm was acknowledged but was then probably ignored as the the level transmitter was periodically spiking and continued to set off the high level alarm. (An Instrument Inspector had been notified and was looking into the problem.) About 37 minutes later, the HOS collapsed.

A careful visual examination was made December 23, 1988 of the nitrogen instrumentation. The following was found:

- Nitrogen regulator PCV-421, which controls nitrogen flow to the HOS, showed signs of downward adjustment to the setting as evidenced by the fresh rust on the threaded part of the adjustment screw handle. It is speculated that the adjustment was made during the fire when operations tried to secure the vessel.

- Nitrogen controllers PC-412 and PC-411 were checked. PC-412, the nitrogen makeup controller, showed approximately 13 psig output. Furthermore, the controller showed a set point of 15 psig on the adjustment scale.

- Controller PC-411, the HOS vent controller, showed full output. The controller set point was 45 psig on the controller scale.

- Controllers PC-412 and PC-411 are both blind controllers meaning neither controller will show actual process pressure on the controller face.

- At the process connection of controller PC-411 & 412, there is a pressure gage which showed negative pressure. (The indicating needle was resting against the bottom scale stop.

- Control valves PV-411 and PV-412 were found to have full signal air pressure on the control valve diaphragm.

- Level transmitter LT-307 had been in the fire and was not inspected.

Following visual inspection, the instrumentation was exercised to ascertain its working condition. The following was found:

- Controllers PC-411 and PC-412 were removed from the piping. Both were full of solidified pitch. The internal 1/8-inch tubing, bourdon tubes and 1/4-inch process connections could not be cleared of pitch. The controllers could not be function checked.

- Control valve PC-412 (makeup control valve) was removed from the piping and found to be clear of pitch and fully functional.

- Control valve PC-411, vent valve, was removed from the piping and found to be full of solidified pitch. The valve would not stroke and was not functional.

- The pressure gage from the controller process connection point was removed. The small piping leading up to the gage was plugged but the gage itself was clear of pitch. The gage indication upon removal changed from indicating a negative pressure to an indication of 2 psig. The pressure gage was tested over its full 60 psig range and was found to indicate constantly 2 psig high.

- The 2-inch nitrogen supply piping to the vessel was removed from the top of the vessel all the way to the check valve in the supply piping (point A on drawing E-45492) including the tee section just upstream of the check valve. The vertical section of this piping was manually cut to facilitate removal. This section was found to have a heavy coating of pitch on the wall. However, the center of the pipe was open. The deposited pitch showed layering much like the seasonal growth rings of a tree.

  Several other portions of the nitrogen supply piping were plugged, particularly near the flanges and in the lower portion of the piping.

DISCUSSION

The pattern of concentric layers of pitch found deposited on the nitrogen supply piping indicates that the pitch built up over a period of time possibly as a result of previous incidences of vessel overfilling. Exactly when the piping completely plugged (following, during, or preceding the last overfill) is subject to question. However, the physical evidence supports that plugging likely occurred over a period of time and preceded the incident.

Whether nitrogen failed to reach the vessel due to nitrogen supply piping plugging or some other reason, such as a failed makeup controller, is difficult to substantiate since the makeup controller was full of pitch and could not be function checked. However, the makeup control valve was found wide open during visual inspection indicating that the controller was calling for nitrogen. The most logical conclusion, therefore, is that pipe plugging caused the absence of nitrogen to the vessel.

For many shifts, the operator had entered a vessel pressure reading in the shift log of 2-5 psig. (The vessel pressure is only read and recorded every four hours.) This recorded pressure is very near the pressure the gage, point B on drawing E-45492, indicated as atmospheric pressure. (The fact that the pressure gage indicated a negative pressure during the post-fire visual inspection can be explained as being the result of pitch contraction upon cooling.) The operator apparently did not question this pressure nor did he recognize that the nitrogen purge should have provided 15 psig of pressure in the vessel which is equal to the set point of the nitrogen makeup controller, PC-412.

The level controller on the vessel showed a very erratic level on the day of the incident. The operator had to silence the high level alarm many times since the level was occasionally spiking upward. The accuracy of the level measurement is suspect since the level transmitter had given problems with "spiking" in the past. Instrument personnel had worked on the transmitter two days earlier when level measurement problems were experienced.

Once the operator recognized that the vessel was in an "overfill" condition he went to the field and confirmed it by feeling heat from the tail spool of the HOS pressure relief valve. Returning to the control room, he increased the outflow dropping the level in the HOS. (The operator likely did not realize that a vacuum could occur in the HOS.) A vacuum did develop as a result of the increased outflow and lack of inflow of nitrogen and the vessel collapsed.

A review of the HOS system and the vessel itself uncovered several faults:

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1. The HOS vessel instrumentation is Class 1 where by today's standards it should be Class 4.

2. The pressure control system on the HOS is inadequate especially when the vessel is not designed for full vacuum.

   The pitch originates from Vacuum Flasher 3 and is sub-cooled with practically no vapor pressure. Even though some thermal cracking may occur on the way to Dubbs 9, the rate should be insignificant at 550°F. A first order failure, i.e., a failure of the nitrogen purge system could potentially result in a vacuum condition inside the vessel.

3. The nitrogen purge system for the HOS vessel was inadequate.

   a. The pressure sensing element was located at grade. The nitrogen piping then traveled upward about 25 feet which had the potential to be filled with pitch.

   b. The nitrogen vent line was pocketed which also had the potential to be filled with pitch.

   c. The pressure indication and controller were local instruments with no high or low pressure alarm in the control room.

4. The HOS vessel, V-1320 was not designed for vacuum service. Three vacuum support rings and an additional 1/4-inch in wall thickness would have provided needed vacuum protection. Shell EGGS do not specify when vessels such as V-1320 should be designed for vacuum service. However, it is the consensus opinion that the nitrogen purge system was not reliable enough to prevent a vacuum from developing. The vessel, therefore, should have been designed for vacuum service since the additional cost to do so was marginal.

5. The investigating team normally reviews operating procedures for equipment and systems involved in an incident. However, no operating procedures could be found for the feed system and, in particular, V-1320.

RECOMMENDATIONS:

If the current operating mode of using the bottom of the Fractionator for feed surge proves unacceptable and the HOS is to be replaced, then the following recommendations need to be considered:

1. Replacement vessel must be designed for full vacuum and pressure rated for the same conditions as the fractionator (refer to item 5). Instrumentation cannot provide the required vacuum protection since it is subject to failure.

2. Vessel pressure should be recorded in the control room and, as a minimum, alarms should be installed indicating failure of pressure instrumentation.

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3. Redundant level transmitters are needed on difficult applications such as pitch measurement.

4. If a reliable oil source can be found, level transmitter purges must be converted to oil purge. Nitrogen is a good alternate purge medium but it must be heated to prevent localized plugging.

5. The pressure relief protection for the HOS should be provided by the Fractionator. The confidential Royal Dutch publication, Thermal Cracking Process Guide, Volume 1, section 3.1 and 3.2 states: "The usual practice is to connect the vessel (HOS) top to the fractionator vapor space with a line size which will not cause the pressure in the surge drum to rise above the design pressure at the maximum feed rate even if the surge drum is completely full of liquid ..... Under this condition no relief valve is required." Item 5.2 of the Guide contains suggested design details for this equalizing line.

6. Operating procedures should be written for the current operating mode of using the Fractionator for feed surge if they do not exist.

L. E. Abrahamson for Investigating Team

Attachment

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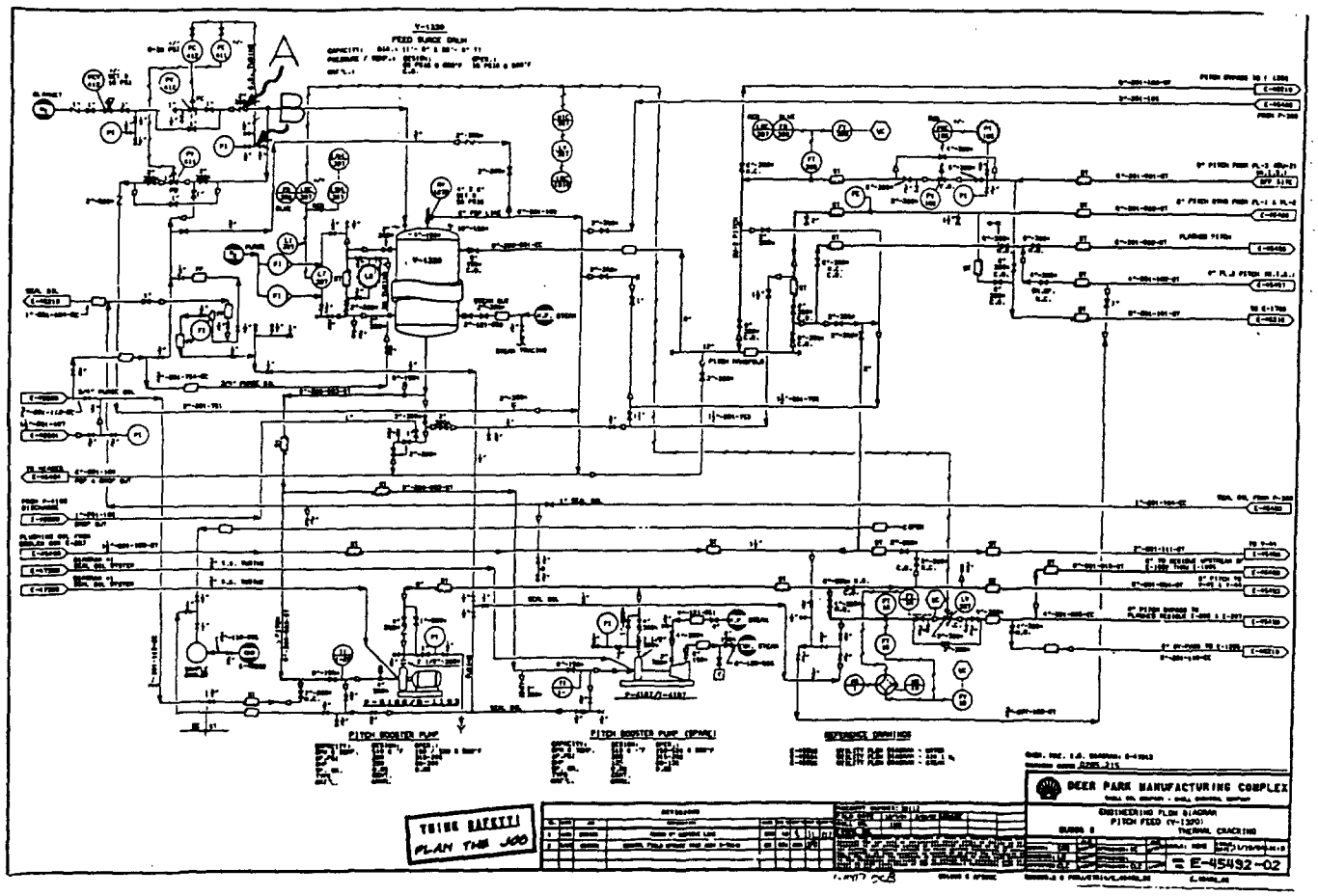
Equipment File V-1320
S/ADM Satellite

LAM 011077



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MOST CONFIDENTIAL

ATTACHMENT

FLASHER 3 FIRE
FEBRUARY 21, 1989

SUMMARY

The fire alarm was sounded for the Flasher 3 fire at 5:42 p.m. on Tuesday, February 21, 1989. Flasher 3 had been down nearly two weeks when a leak developed between Vacuum Flasher 1 and Flasher 3 and a fire occurred. Immediate response by the operators on the unit using a turret nozzle and two 1-1/2 inch hard rubber hose reels extinguished the fire while still in its initial stage. Responding fire crews layed additional hand lines for backup and cooling. Recall was sounded at 6:59 p.m. Damage was limited to insulation and minor electrical equipment. The total cost of the damage is not available.

An early review for asbestos contamination was conducted and found to have negative impact to area personnel. No injuries were reported.

DESCRIPTION OF THE INCIDENT

The unit had been down and blocked in for nearly two weeks. Leakage through the block caused the liquid level in the column to increase to the point that flow into the transition piping to the furnace allowed draining through a warped flange on an expansion joint. Material feel to grade and a possible source of ignition was a nearby heater.

CONCLUSION

The apparent cause of the leak was a flow of HFD from VF-1 into FL-3 through a set of closed valves. A third valve was used to shut off the flow. The level in the FL-3 column rose above the flange that had been leaking before the unit was shut down, causing HFD to flow to the pad below. There is no readily identifiable source of ignition in the area. It is thought the fire started away from the column and propagated toward the column. The operators at the scene witnessed ground fires closer to the furnaces before the flame wall "climbed" the column. Additional investigation is being done to identify any other source of hydrocarbon.

RECOMMENDATIONS

Need to re-emphasize the importance of constant operator surveillance of operating equipment even though the unit is shut down.

The critique of the incident indicated the rapid response by the on-shift operators using fixed fire fighting equipment limited the losses to minor damage.

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MOST CONFIDENTIAL

INCIDENT QUESTIONAIRE

1. Incident Description: BEU Fire 10-25-80

2. Activity associated with incident (Start-up, Shutdown, etc.)
Normal Operations

3. Incident occurred during normal operation (Yes/No) or unit upset, if unit upset, describe:

4. Incident occurred during maintenance (Yes/No)?
NO

5. Incident occurred after maintenance (Yes/No)?
NO

6. How long after maintenance?

7. Final failure event occurred in containing equipment (pump seal, flanges, vessel, etc.) (Yes/No)?
Packing gland leak - heat Medium valve -

8. Type of contains equipment: Hvy Sweet Gas o.l

9. As a result of this incident, were there any injuries (Yes/No)? If yes, contract or Shell employee? If contract, do not answer rest of questionaire.
NO

10. Second order failure event (instrumention failure, human error, etc.)
None

11. Third order failure event (wrong parts used in previous maintenance, procedural problem, etc.)
None

12. Fourth order failure event (purchasing problem, failure to properly communicate procedure, etc.)
None

13. Probable ignition source:
Auto

14. Comments:

No damage - "Knocked out" flame with steam line
Tighten packing gland & continued to run

LAM 011080

(PLEASE FORWARD COMPLETED COPY TO SAFETY SECRETARY AND FIRE CHIEF.)

DPMC-07458

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P-t ... Book

INCIDENT QUESTIONAIRE

1. Incident Description: BEU Fire 10-25-80

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11. Third order failure event (wrong parts used in previous maintenance, procedural problem, etc.)
    None

12. Fourth order failure event (purchasing problem, failure to properly communicate procedure, etc.)
    None

13. Probable ignition source:
    Auto

14. Comments:

No damage - "Knocked out" flame with steam line
Tighten packing gland & continued to run

LAM 011081

DPMC-07459

(PLEASE FORWARD COMPLETED COPY TO SAFETY SECRETARY AND FIRE CHIEF.)

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ATTACHMENT

FLASHER 3 FIRE
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LAM 011082