U. S. Chemical Safety Board

SONAT INVESTIGATION

Catastrophic Vessel OVERPRESSURIZATION
(4 Deaths)
INTRODUCTION

- March 4, 1998, near Pitkin, LA
- Startup of Oil / Gas Separation Equipment
- Natural Gas Purge of Vessels and Pipeline
- Oil / Gas Separator Overpressurized
- Catastrophic Vessel Failure
- Four Operators Killed
INTRODUCTION

KEY ISSUES:

• DESIGN & HAZARD REVIEWS
• PRESSURE-RELIEF DEVICES
• OPERATING PROCEDURES
Block Flow Diagram of the Separation Process

- **Well**: Natural Gas
- **Gas Cooler**: Natural Gas
- **Scrubber**: Natural Gas
- **Gas Meter**: Gas Sales Pipeline
- **Gas Compressor**: High-pressure Fluid (Oil, Natural Gas & Water)
- **First Stage Separator**: Natural Gas
- **Second Stage Separator**: Natural Gas
- **Third Stage Separator**: Third Stage Separator
- **Oil Cooler**: Water (brine)
- **Oil Storage Tanks**: Crude Oil Sales (via tank truck)
- **Water Storage Tanks**: Water Disposal (via tank truck)
- **Filter**: Water (brine)
- **Water Disposal Well**: Water Disposal Well
Intended Valve Positions after the Final Alignment

24-1 Well

- Closed Ball Valve
- Open Ball Valve
- Pneumatic Valve
- Closed Roof Hatch
- Open Roof Hatch
- Choke Valve
- Relief Valve
- Pressure Gauge

22-1 Well

- Manifold & Header
- First Stage Separator
- Oil Cooler
- Second Stage Separator
- Third Stage Separator

Test Train

- Oxygen Test Vent
- 8" pipeline (apprx. 2 miles)

Oil Storage Tanks

- Gas Compressor
- Oil Outlet Line
- Gas Outlet Line
- Oil Outlet Line
- Oil Outlet Line
- Oil Outlet Line
- Bypass Line
- E

Water Storage Tanks

- 8" pipeline (apprx. 270 feet)

not to scale
Sonat referred to the failed vessel as a “Vapor Recovery Tower” or storage tank.

CSB determined that the vessel actually fit the definition of an oil and gas separator.
• Separator had a single inlet line for oil/gas mixture but two separate outlet lines

• Separator was not designed for permanent oil storage

• Separator was positioned upstream of the storage tanks in series with the 1st and 2nd stage separators
Third Stage Separator Schematic

- Liquid Level Sensor
- Mist Extractor
- Gas Outlet Line
- Oil Inlet Line
- To Oil Storage Tanks
- To Gas Compressor
- Oil Outlet Line
- Bypass Line
- Sight Glasses
- To Drain Line
- Automatic Liquid Level Control Valve and Two Ball Valves

not to scale
Intended Valve Positions after the Final Alignment

- Open Pneumatic Valve
- Closed Ball Valve
- Open Ball Valve
- Closed Roof Hatch
- Open Roof Hatch

Diagram:
- Gas Compressor
- Oil Storage Tanks
- Water Storage Tanks
- Third Stage Separator
- Bypass Line
Comparison of Valve Alignments as “Planned” and as “Found”
Damaged Vehicles and Storage Tanks
Damaged Water Storage Tank
The vessel that failed, a third stage separator, lacked an inlet valve and could not be isolated from an adjacent bypass line, which at the time of the incident contained high-pressure purge gases.
At the time of the incident, two outlet block valves on the separator were closed, as were two block valves on the bypass line downstream of the separator. Accordingly the high-pressure purge gases could not be vented and the separator overpressurized.
The third-stage separator was only rated for atmospheric pressure service (0 psig). The purge gas stream to which the separator was exposed had a pressure potentially as high as 800 psig.
The separator was not equipped with any pressure-relief devices, and overpressurization caused the separator to fail catastrophically.
The CSB could not conclusively determine the timing of the closure of the two bypass line block valves or establish any reason for this action.
The facility was designed and built without effective engineering design reviews or hazard analyses.
Workers at the facility were not provided with written operating procedures addressing the alignment of valves for purging operations.
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KEY FINDINGS

Sonat operated third-stage separators that lacked adequate pressure-relief systems at other oil and gas production facilities for over a year prior to the incident.
OSHA’s PSM Standard contains elements that are relevant to this incident, such as process hazard analysis and written operating procedures. However, PSM does not currently apply to oil and gas production facilities.
Sonat management did not use a formal engineering design review process or require effective hazard analyses in the course of designing and building the facility.
Sonat engineering specifications did not ensure that equipment that could potentially be exposed to high-pressure hazards was adequately protected by pressure-relief devices.
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CONTRIBUTING CAUSE

Sonat management did not provide workers with written operating procedures for the start-up and operation of the facility.
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RECOMMENDATIONS

Paso Production Company
(formerly Sonat Exploration Co.)

Institute a formal engineering design review process for all oil and gas production facilities, following good engineering practices and including analyses of process hazards.
Paso Production Company

Implement a program to ensure that all oil and gas production equipment that is potentially subject to overpressurization is equipped with adequate pressure-relief systems, and audit compliance with the program.
Paso Production Company

Develop written operating procedures for oil and gas production facilities and implement programs to ensure that all workers, including contract employees, are trained in the use of the procedures. Ensure that the procedures address, at a minimum, purging and start-up operations and provide information on process-related hazards.
Develop and issue recommended practice guidelines governing the safe start-up and operation of oil and gas production facilities. Ensure that the guidelines address project design review including hazard analyses, written operating procedures, employee and contractor training and pressure-relief requirements for all equipment exposed to hazards.
Communicate the findings of this report to your membership.
CSB on the WWW

www.chemsafety.gov

The SONAT REPORT is available at the CSB web site in a variety of formats.