Engineering Safety Improvements for Platforms and Production Facilities

Bob Van Nostrand, P.E., Venoco, Inc.
South Ellwood Field Short History

- 1966 - Platform Holly was set, and began production of sweet oil and gas.
- Late 70’s – Platform Holly was reconfigured to produce sour crude oil and gas.
  - The Ellwood Onshore Facility was also reconfigured at the same time.
- 1997 – Venoco purchased Platform Holly, associated onshore facilities and pipelines.
  - SLC commissioned API 14C audit.
  - APCD required safety audit of facilities.
  - Venoco performed facility-wide HAZOP.
  - Venoco also commissioned a Quantitative Risk Assessment (QRA).
Audit Findings Tracking

- A multipage master matrix was prepared by CSLC
  - Used to track status of the findings of the various audits, HAZOPs and QRA
- Venoco proposed and completed mitigations against this matrix
- CSLC and SSRRC had independent buyoff authority for each mitigation
- SSRRC is the **Systems Safety and Reliability Review Committee**, Santa Barbara County
  - Composed of representatives from
    - Santa Barbara County Planning and Development
      - Energy Division
      - Building and Safety Division
    - Santa Barbara County APCD
    - Santa Barbara County Fire
      - Office of Emergency Services
      - Protection Services Division
List of regulatory citations referenced in the audits

API – 14C, 14F, 520, 521, 550, 650, 653, 750, 2000, 2010, 2510A
ASME – Section 8
ANSI – B31.3, B31.8
NEC – 110, 210, 215, 250, 334, 346, 351, 376, 450, 500, 501
NFPA – 25, 30, 70B, 110, 704
OSHA – PSM 1910.119
PRC 4292
CCR Article 5, 6, 7
NFC
SPCC
Manufacturer Recommendations
Industry Standard
<table>
<thead>
<tr>
<th>Item</th>
<th>Deficiency Description</th>
<th>Technical Reference</th>
<th>Priority</th>
<th>Recommendation(s)</th>
<th>Status</th>
<th>When</th>
<th>Who</th>
<th>Mitigation Accepted, SLC</th>
<th>Mitigation Accepted, SSRRC</th>
<th>Mitigation Done</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The south door on the electrical room is blocked. The room requires multiple exits per NEC 110-16(c). This door is required to be clear for use.</td>
<td>NEC 110-16(c)</td>
<td>1</td>
<td>Clear doorway</td>
<td>Done</td>
<td>Jul-99</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>CSO (Car Seal Open) sensing lines for all PSV sensing line and critical devices.</td>
<td></td>
<td>1</td>
<td></td>
<td>Done</td>
<td>Jul-99</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>PSV-131 is out of service. Replace this PSV as soon as possible</td>
<td></td>
<td>1</td>
<td></td>
<td>Done</td>
<td>Jul-99</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>PSV-125 is overdue for service.</td>
<td></td>
<td>1</td>
<td></td>
<td>Done</td>
<td>Aug-99</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Venoco does not have a well defined, comprehensive preventive maintenance program.</td>
<td></td>
<td>1</td>
<td></td>
<td>Establish a preventive maintenance program.</td>
<td>Done</td>
<td>Dec-99</td>
<td>Dennis H.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>The relief system discharge header seems to be compromised. Six PSVs with up to 4” discharge relieve into a 3” header which further reduces to 2”. Perform an engineering analysis to confirm the adequacy of the relief system.</td>
<td>ASME, API RP 521</td>
<td>1</td>
<td>Correct as necessary. Update the P&amp;ID to reflect the correct as built.</td>
<td>Done. Engineering review. Perform analysis. Analysis indicates maximum relief load can be handled by header. There is no 2” section downstream of the 4” PSVs. A new priority 4 item is added under the P&amp;ID and Safe Charts update.</td>
<td>Dec-99</td>
<td>Bob V.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Conduits need to be upgraded and repaired to meet code. Conduit seals are required at Area Class Boundary per the area class drawing. Seals are required on conduits entering enclosures containing switches or wiring devices unless they are factory sealed. Perform seal-off inspection at the same time the corrosion inspection is completed. Support conduit bodies and flexible cable per code.</td>
<td>NEC 501</td>
<td>1</td>
<td>Provide all required seals and supports.</td>
<td>Done. Conduit support and seals are substantially complete. Some items remain. This item is moved to Priority 4.</td>
<td>Feb-00</td>
<td>Mike H.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Example section of tracking matrix used to track 1091 mitigations
This example shows all 7 Priority 1 Deficiencies found on Holly completed by the end of 1999
Venoco, Inc. South Ellwood Field
Safety Audit and HAZOP Matrix Progress
1991 total findings: 36 mitigations/month
The following slides show examples of lessons learned and overall improvements made to ensure the safety and operability of Platform Holly and its related onshore facilities.

Some of the examples are from the multiple audits conducted in 1999, while others are additional insights gained by Venoco during operation of the lease.
When Venoco purchased Platform Holly, it had a vent stack instead of a flare. Relief events released sour gas to the atmosphere.
Flame Arrester in Vent Line was a potential restriction for relief events.
Venoco installed a flare on Holly in 1999 to replace the vent stack. This included replacement of the flame arrester with a purge gas system designed per API guidelines.
Pilot Operated Pressure Relief Valve
Pilot Operated Pressure Relief Valve

Advantages:
Tolerant of Backpressure
Tight seal up to 90% of Set Point
Vibration can cause failure of the PSV tubing. Use conventional PSV, or pilot style without tubing in vibrating service.
This photograph shows a mechanic’s “good idea”, implemented by a prior operator to capture fugitive emissions from compressor distance pieces and crankcases.

Venoco implemented corrective action on this independent of the safety audit.

What’s wrong with this setup??
Air operated diaphragm pump. Plastic. Air on one side of diaphragm, gas on other side.

This photograph shows a mechanic’s “good idea”, implemented by a prior operator to capture fugitive emissions from compressor distance pieces and crankcases.

Venoco implemented corrective action on this independent of the safety audit.

What’s wrong with this setup??
Nitrogen Purged Packing replaced air operated diaphragm pump.

Nitrogen purge reduces gas emissions and routes packing leakage to VRU.

Nitrogen replaces sour gas in distance pieces.
Nitrogen purge control panel on Holly
Cracked Compressor Valve Cover caused by over-tightening.

Use manufacturer recommended maintenance procedures including the use of recommended torque values.
Small 1” x 2” PSV protecting large NGL Vessel
Need 4” x 6” PSV for Fire Case relief load
Applied 2” fireproofing to vessel to lower fire case relief
Poorly Presented Documentation Leads to Confusion
More Simplified; Leads to Better Understanding
One of five drawings that replaced previous drawing.
When Venoco purchased the South Ellwood Field in 1997, the processes were controlled in the field, using local indicators and controllers.

Venoco has been upgrading the process control systems since 1999, with a large portion of the control now done through PLC control.

We now have more than a dozen PLC’s controlling our processes.

The following slides show original control and alarm panels versus our new computer controlled systems.
Control Room Alarm Panel
Local compressor panel
Control Room with PLC Displays and Centralized Control Functions
Old style local controller

New style transmitter sends information to PLC for centralized control functions