Engineering Safety Improvements for Platforms and Production Facilities

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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
- 1999 – Venoco began a multi-year effort to improve safety and reliability
  - ✓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

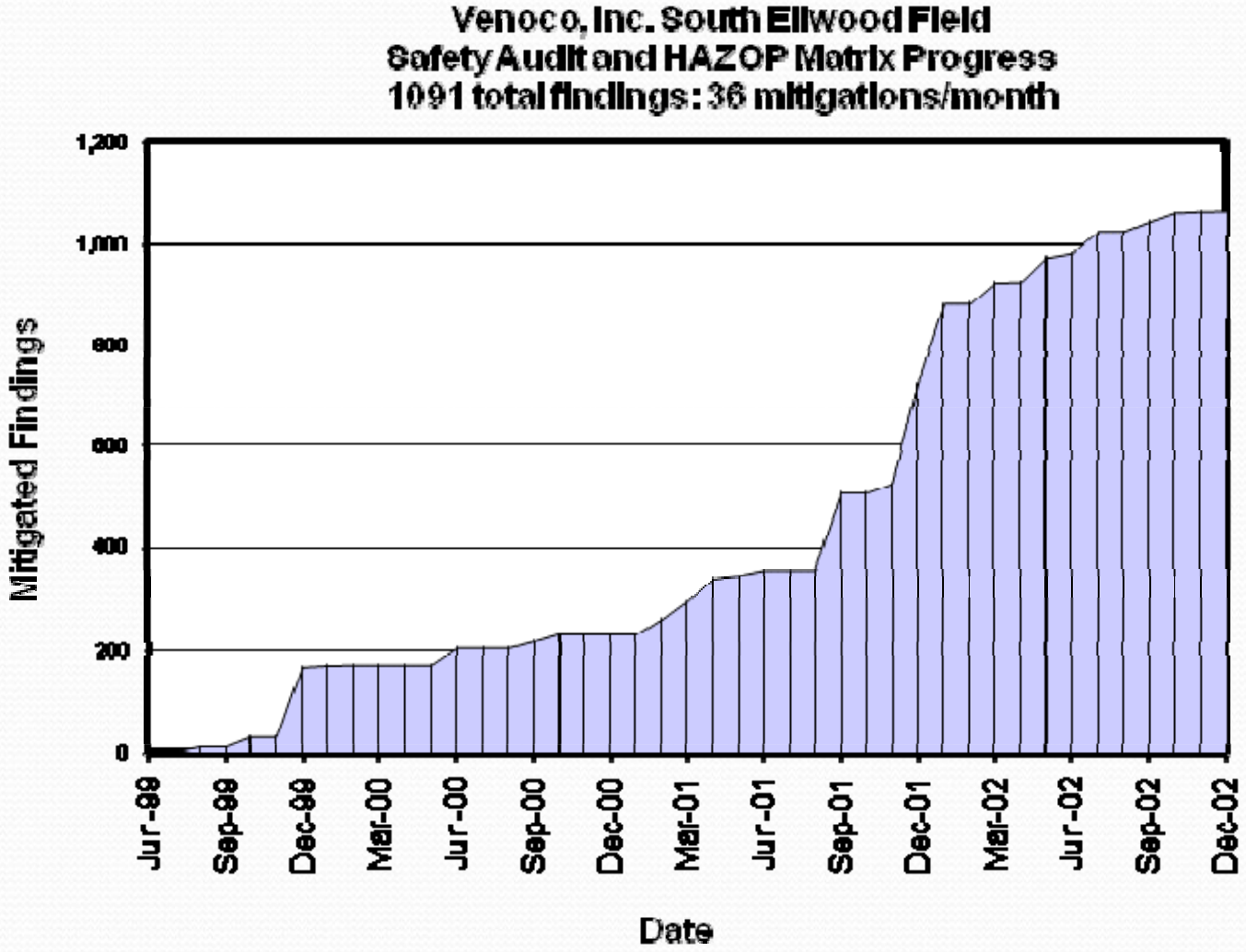
List of regulatory citations referenced in the audits

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

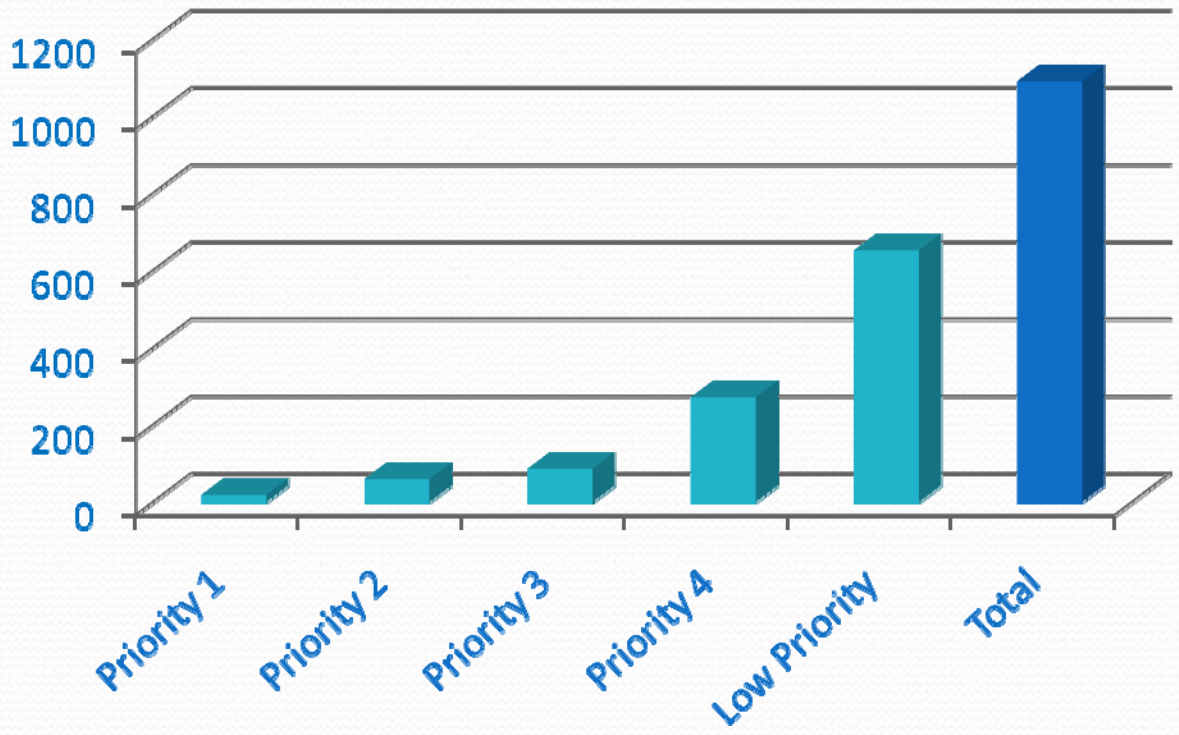
Item	Deficiency Description	Technical Reference	Priority	Recommendation(s)	Status	When	Who	Mitigation Proposed	Mitigation Accepted, SLC	Mitigation Accepted, SSRRC	Mitigation Done
1	The south door on the electrical room is blocked. The room requires multiple exits per NEC 110-16(c). This door is required to be clear for use.	NEC 110-16(c)	1	Clear doorway	Done	Jul-99			12/30/99	12/30/99	Jul-99
2	CSO (Car Seal Open) sensing lines for all PSV sensing line and critical devices.		1		Done	Jul-99			12/30/99	12/30/99	Jul-99
3	PSV- 131 is out of service . Replace this PSV as soon as possible		1		Done	Jul-99			12/30/99	12/30/99	Jul-99
4	PSV-125 is overdue for service.		1	Service the PSV	Done	Aug-99			12/30/99	12/30/99	Aug-99
5	Venoco does not have a well defined, comprehensive preventive maintenance program.		1	Establish a preventive maintenance program.	Done	Dec-99	Dennis H.		12/30/99	12/30/99	Dec-99
6	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.	ASME, API RP 521	1	Correct as necessary. Update the P&ID to reflect the correct as built.	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&ID and Safe Charts update.	Dec-99	Bob V.		12/30/99	12/30/99	Dec-99
7	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.	NEC 501	1	Provide all required seals and supports.	Done. Conduit support and seals are substantially complete. Some items remain. This item is moved to Priority 4.	Feb-00	Mike H.		12/30/99	12/30/99	Dec-99

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

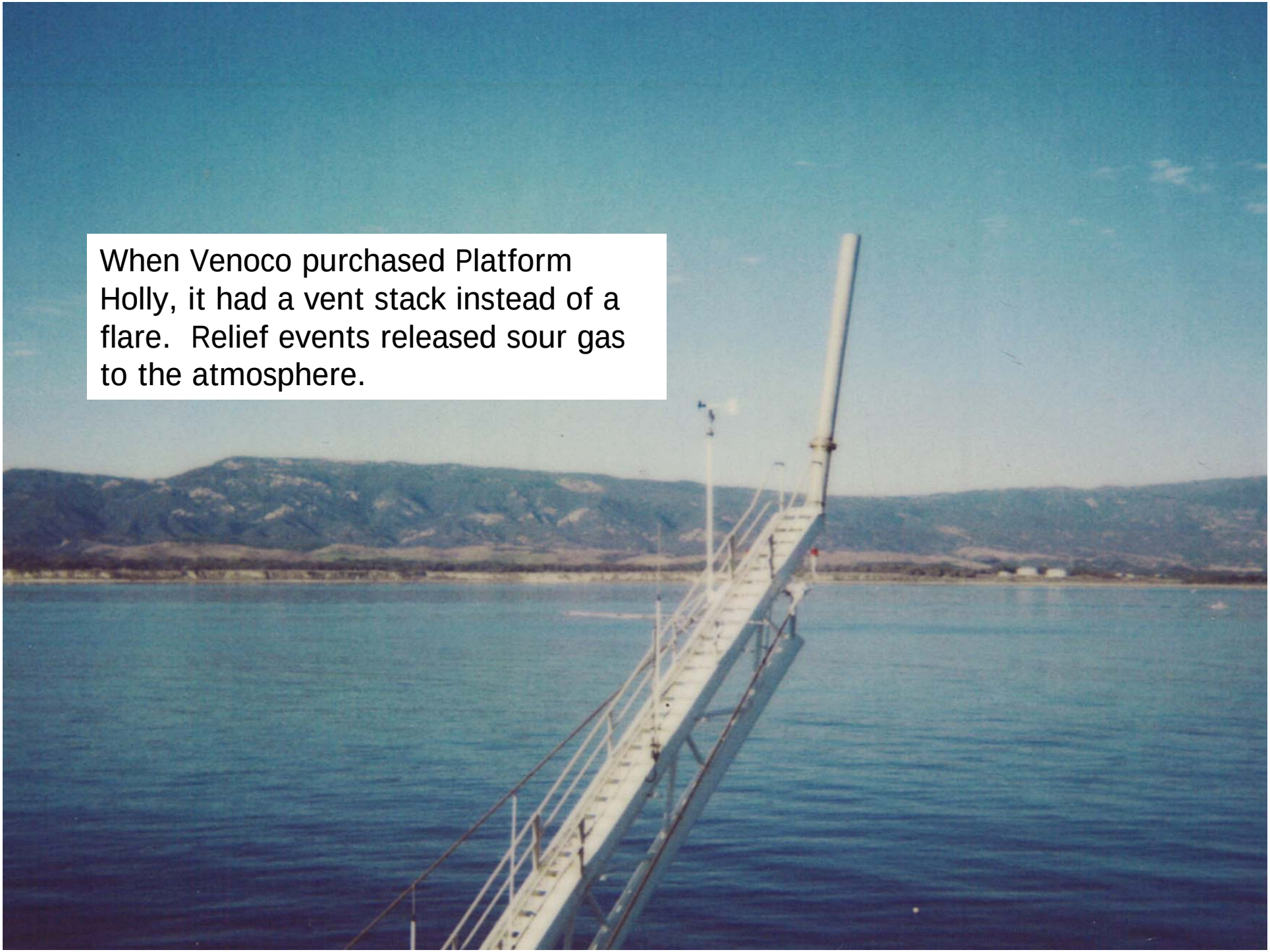

Venoco, Inc. South Ellwood Field
Safety Audit and HAZOP Matrix Progress
1091 total findings: 36 mitigations/month
Mitigated Findings
1,200
1,000
800
600
400
200
0
Jun-99
Sep-99
Dec-99
Mar-00
Jun-00
Sep-00
Dec-00
Mar-01
Jun-01
Sep-01
Dec-01
Mar-02
Jun-02
Sep-02
Dec-02
Date

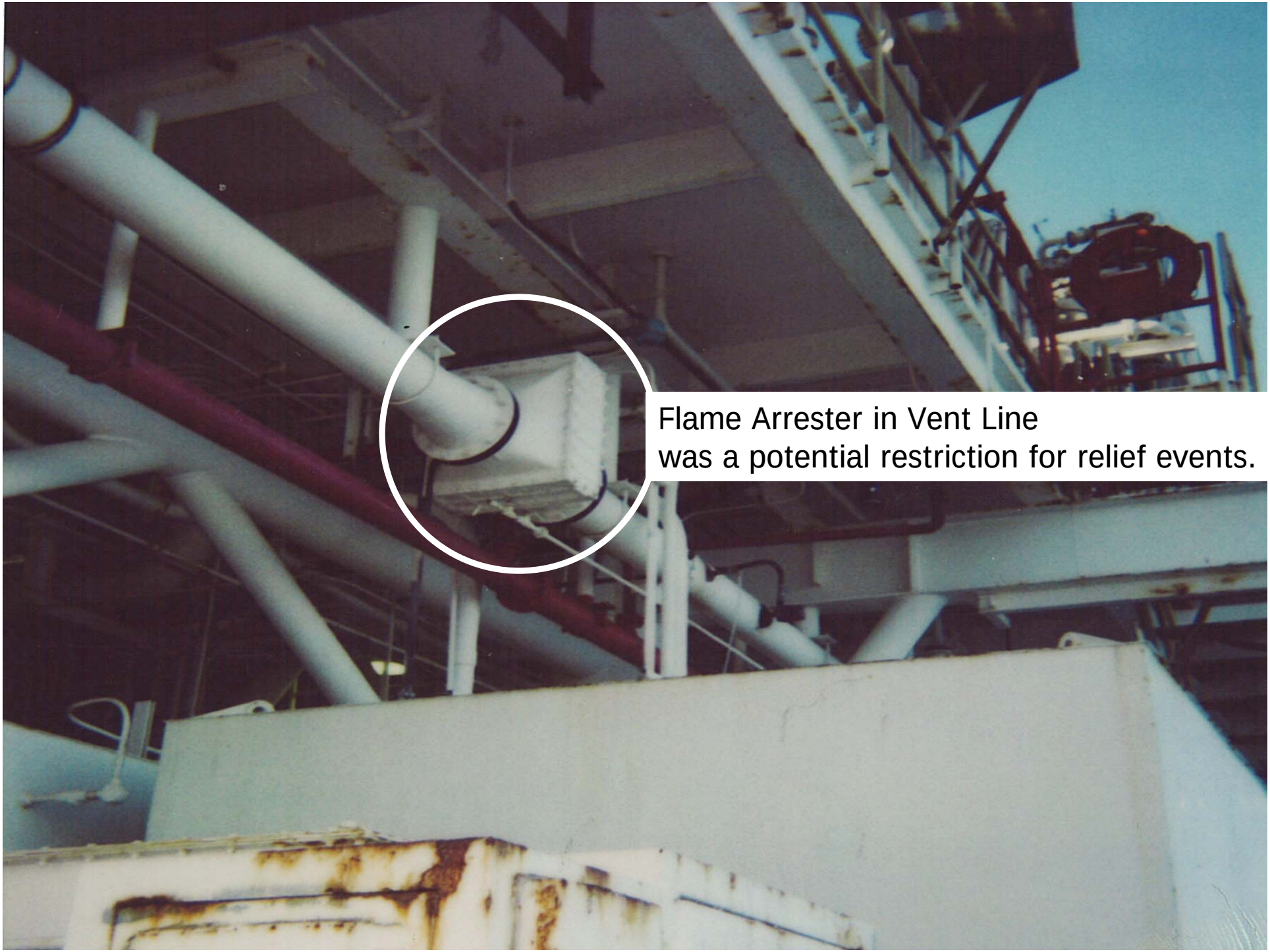
Venoco, Inc. South Ellwood Field
1999 Safety Audit, HAZOP and QRA
Findings by Priority

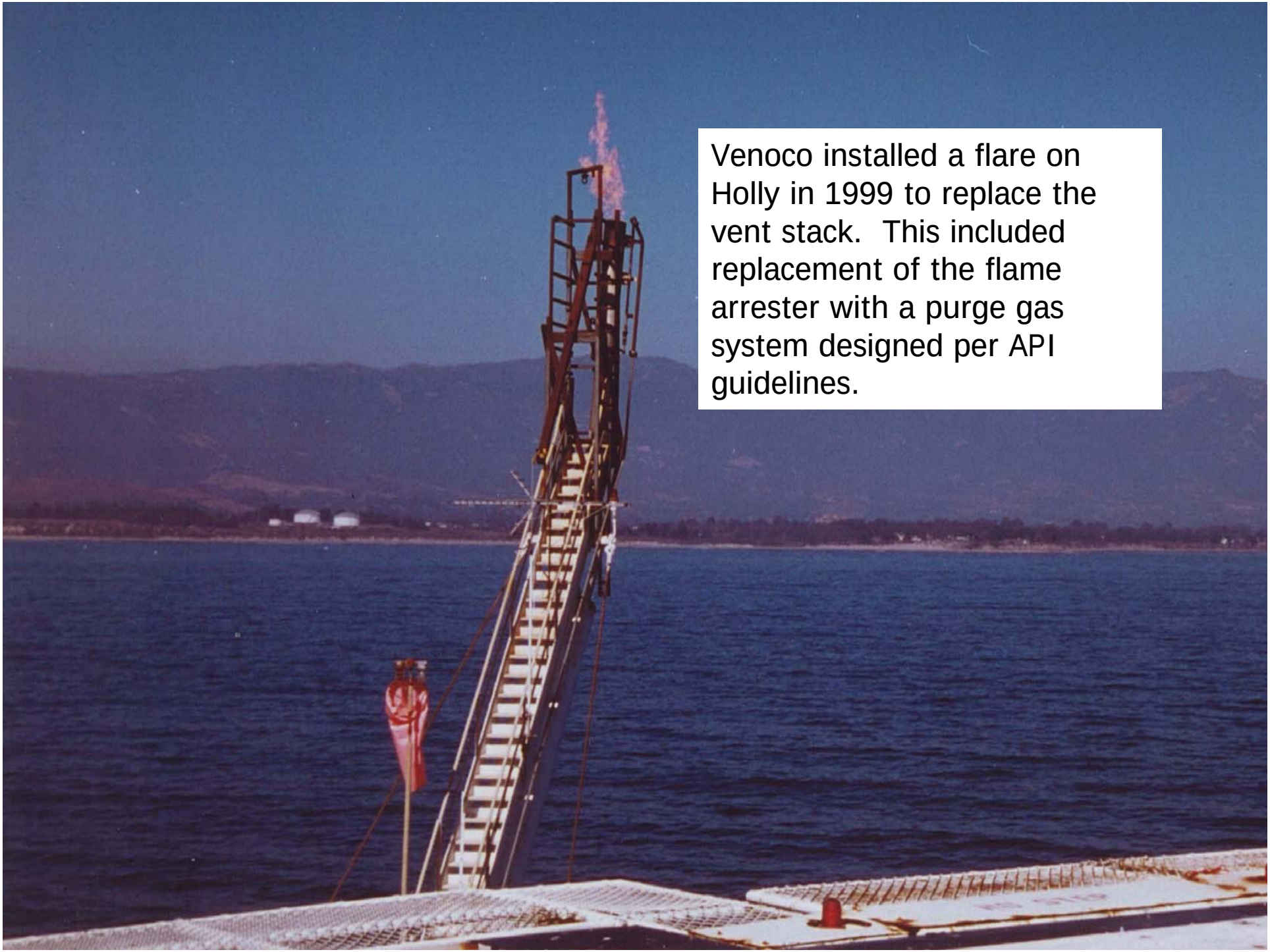


The following slides show examples of lessons learned and overall improvements made to ensure the safety and operability of Platform Holly and its related onshore facilities.

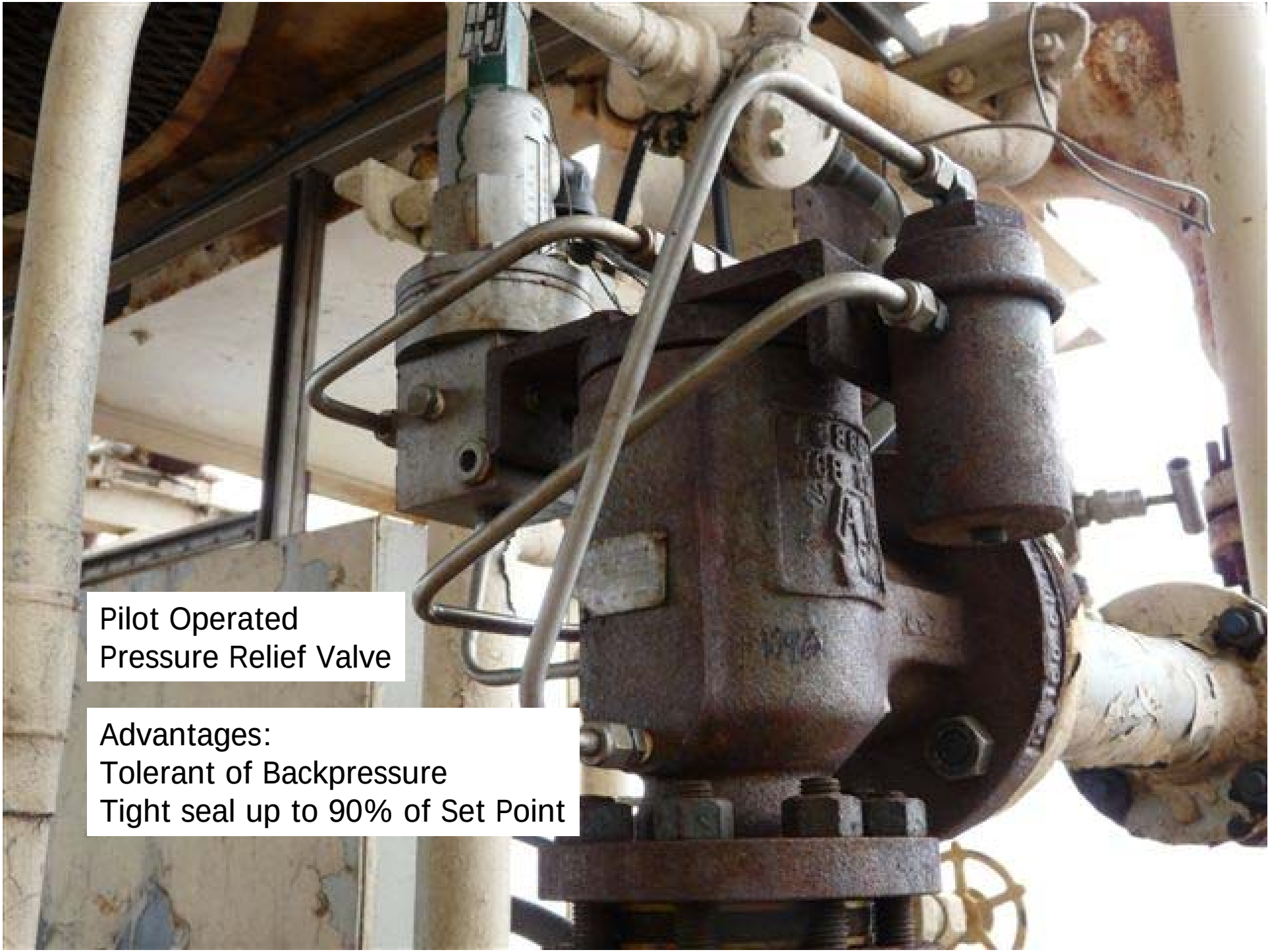
Some of the examples are from the multiple audits conducted in 1999, while others are additional insights gained by Venoco during operation of the lease.

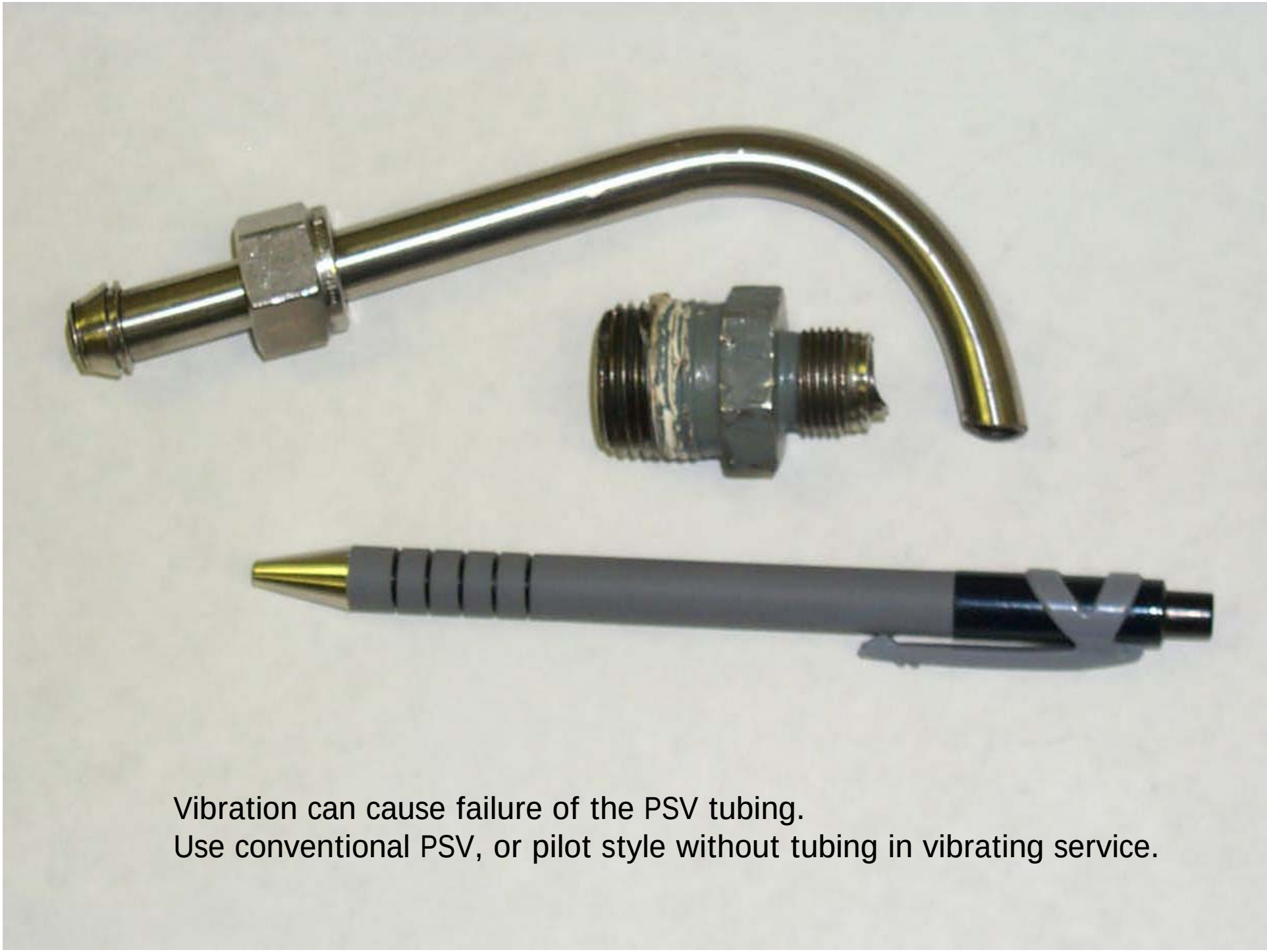

When Venoco purchased Platform Holly, it had a vent stack instead of a flare. Relief events released sour gas to the atmosphere.


Flame Arrester in Vent Line
was a potential restriction for relief events.

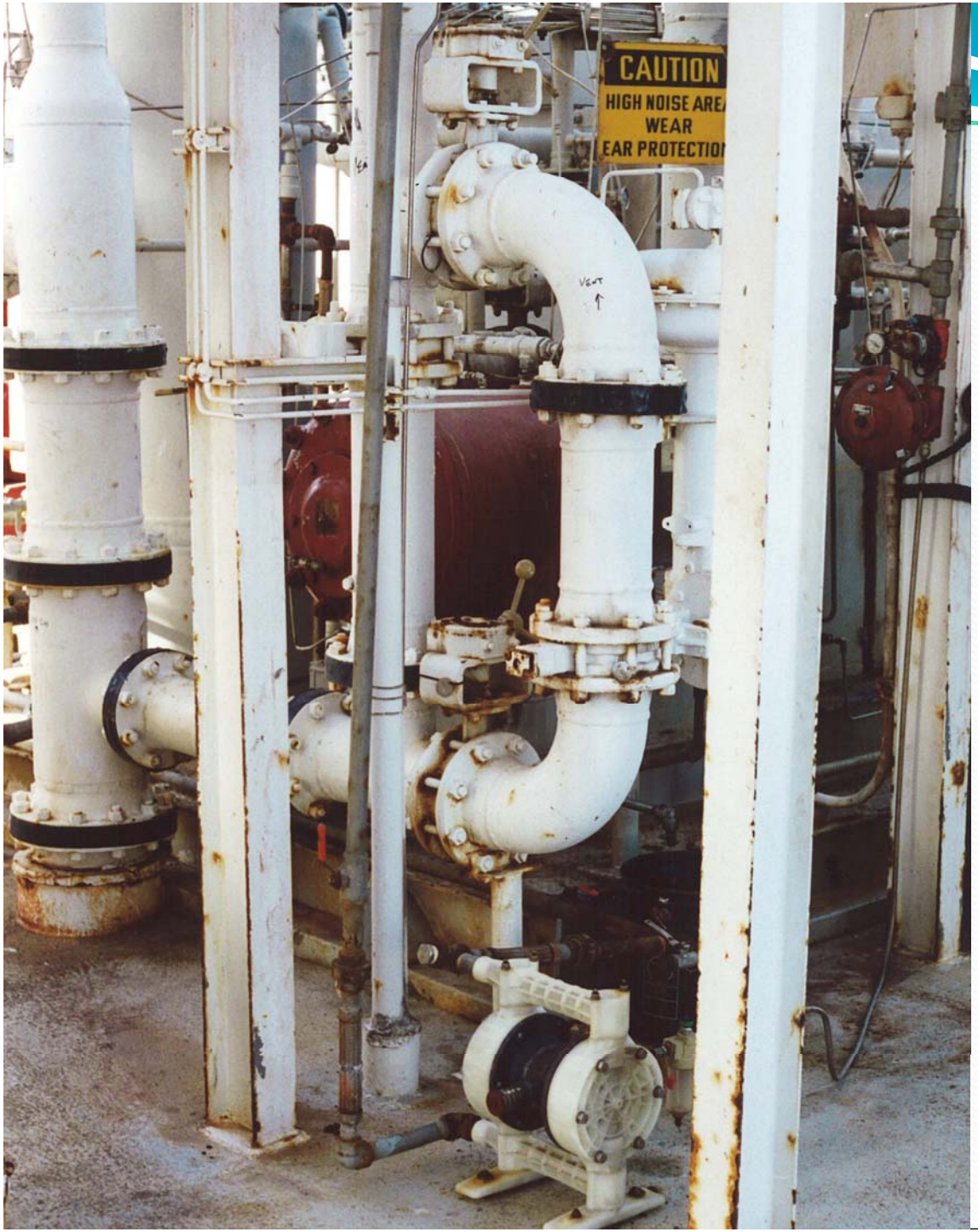

Venoco installed a flare on Holly in 1999 to replace the vent stack. This included replacement of the flame arrester with a purge gas system designed per API guidelines.


Pilot Operated
Pressure Relief Valve


Pilot Operated
Pressure Relief Valve
Advantages:
Tolerant of Backpressure
Tight seal up to 90% of Set Point



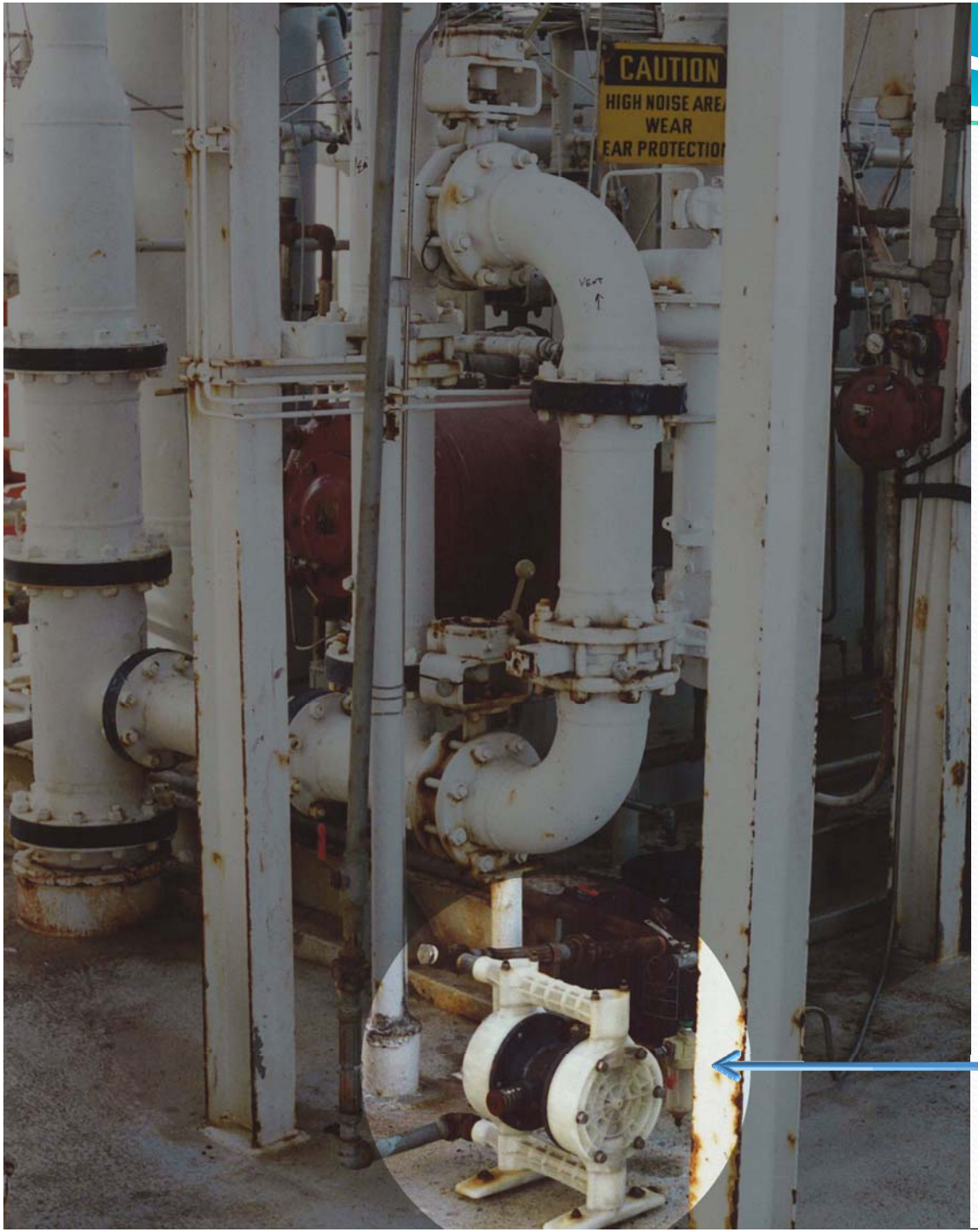
Vibration can cause failure of the PSV tubing.
Use conventional PSV, or pilot style without tubing in vibrating service.



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??



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.

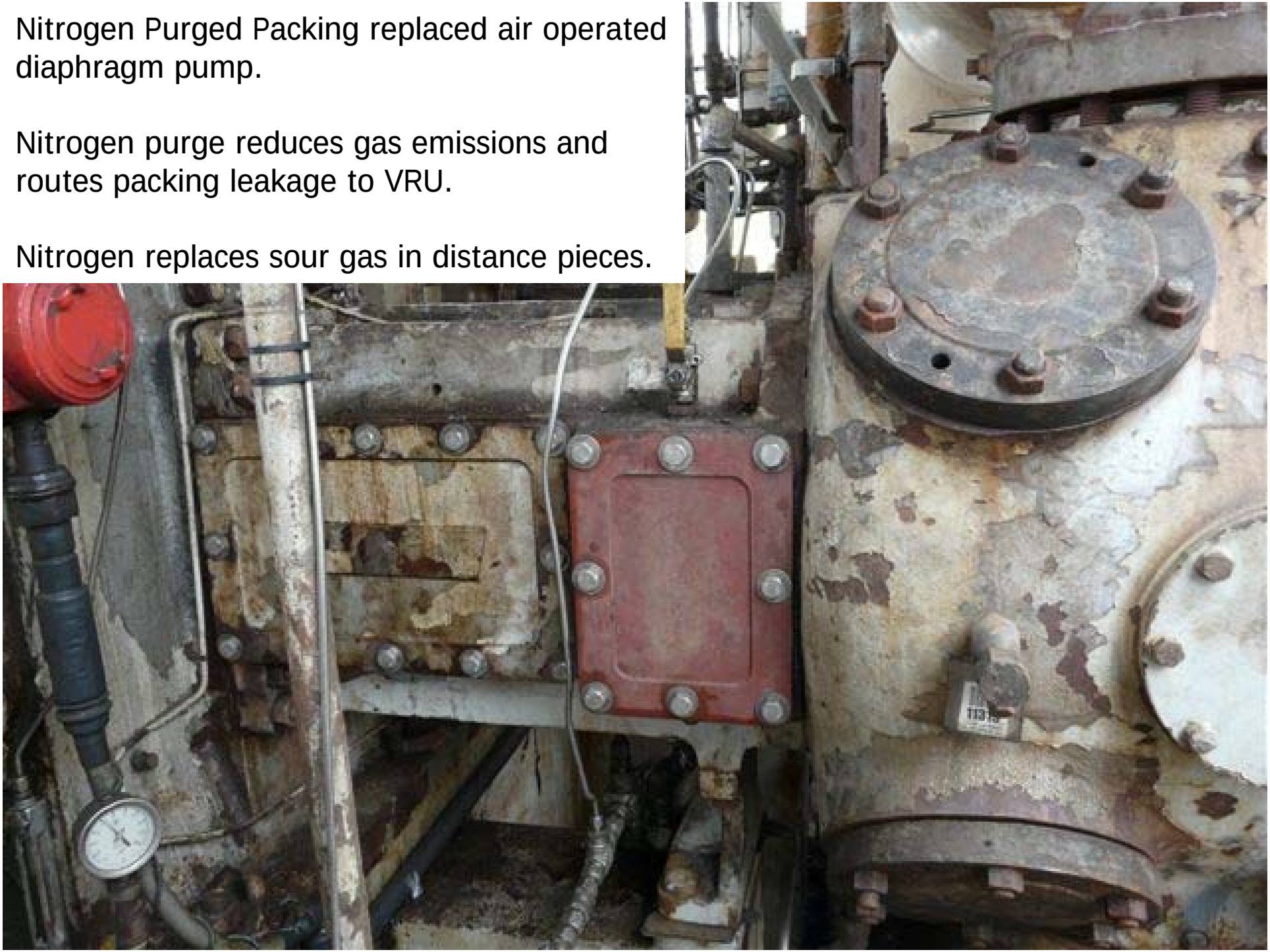
What's wrong with this setup??

Air operated diaphragm pump.
Plastic.
Air on one side of diaphragm, gas on other side.

Nitrogen Purged Packing replaced air operated diaphragm pump.

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

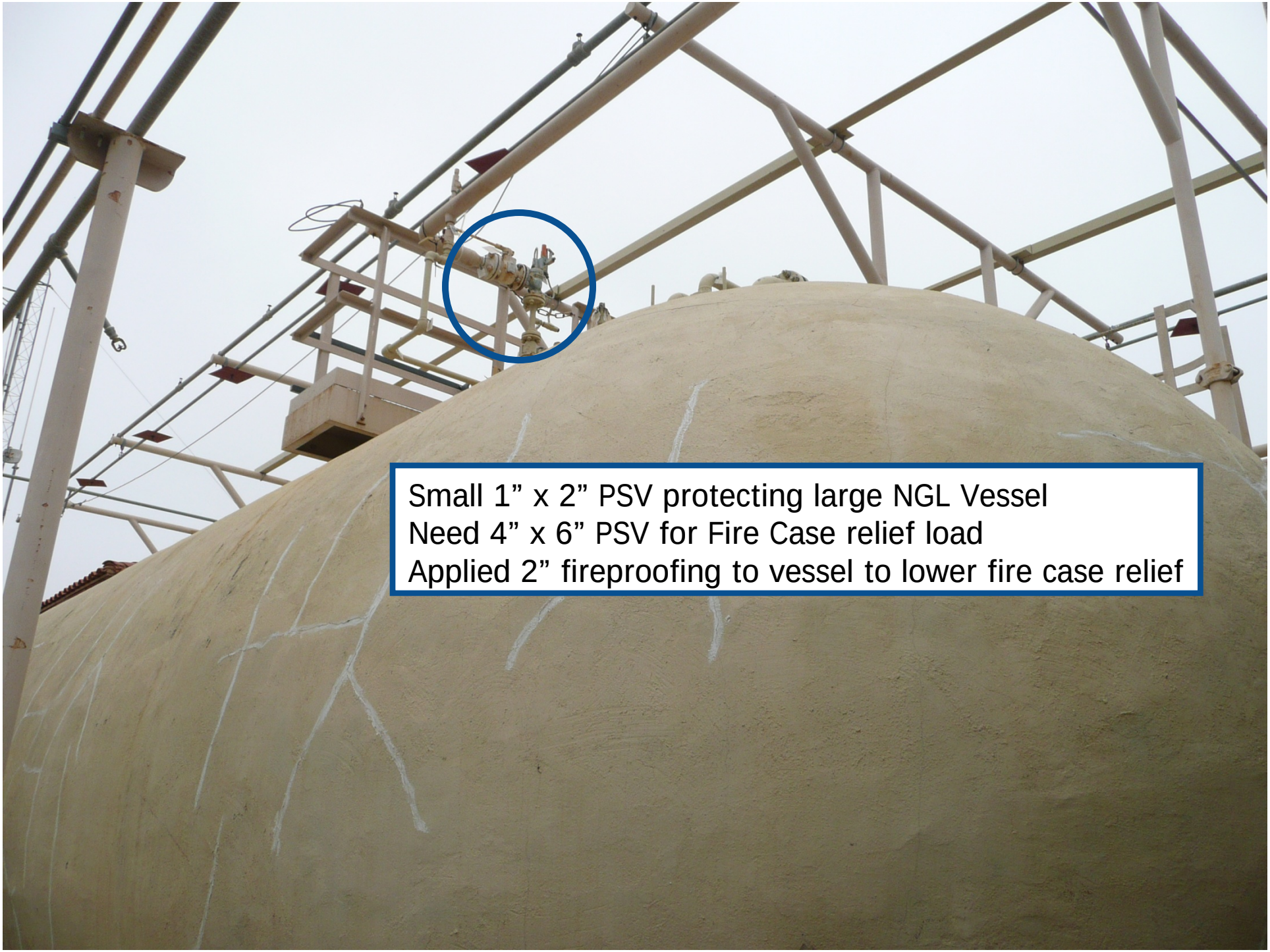
Nitrogen replaces sour gas in distance pieces.



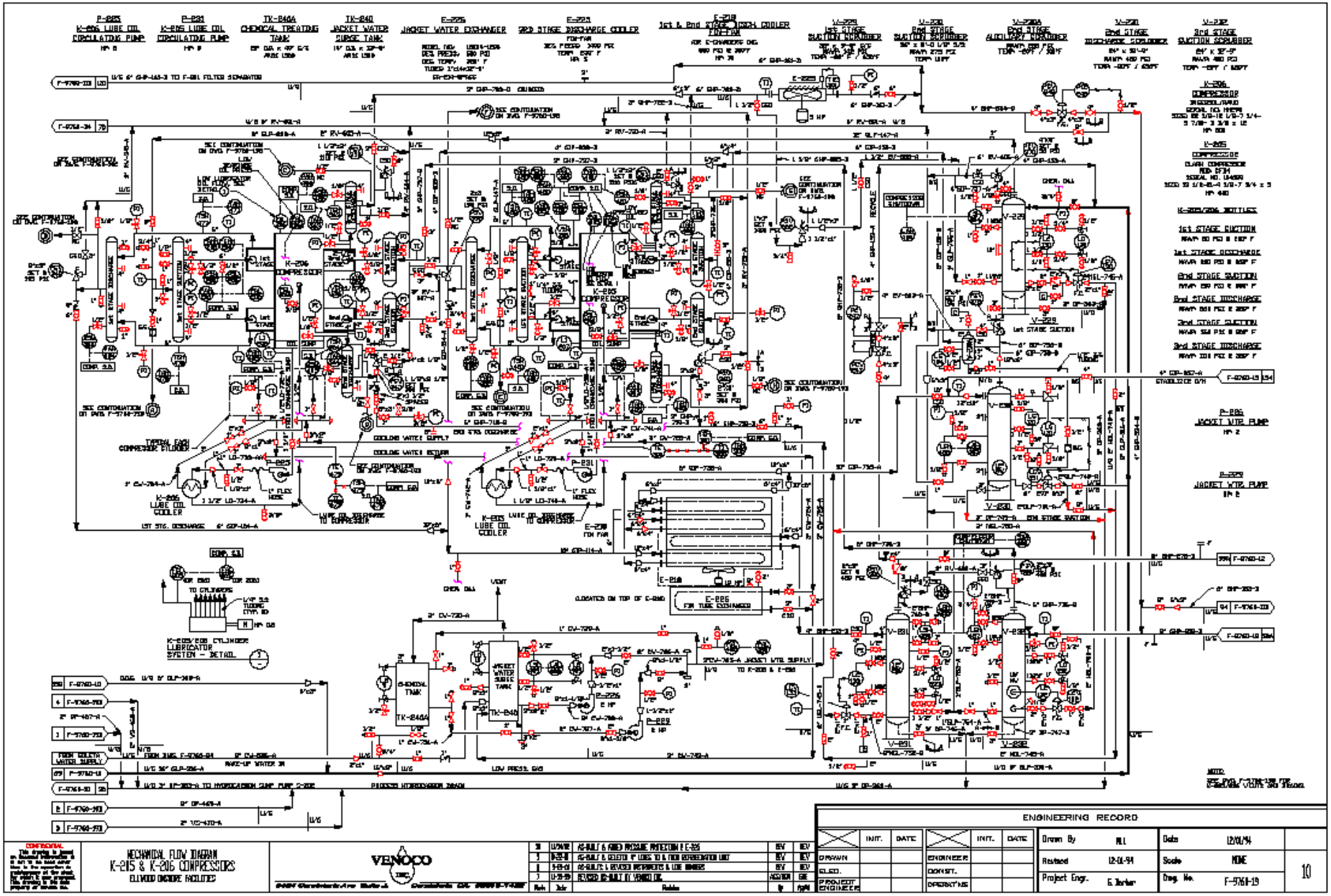

Nitrogen purge control panel on Holly

Cracked Compressor Valve Cover caused by over-tightening.

Use manufacturer recommended maintenance procedures including the use of recommended torque values.

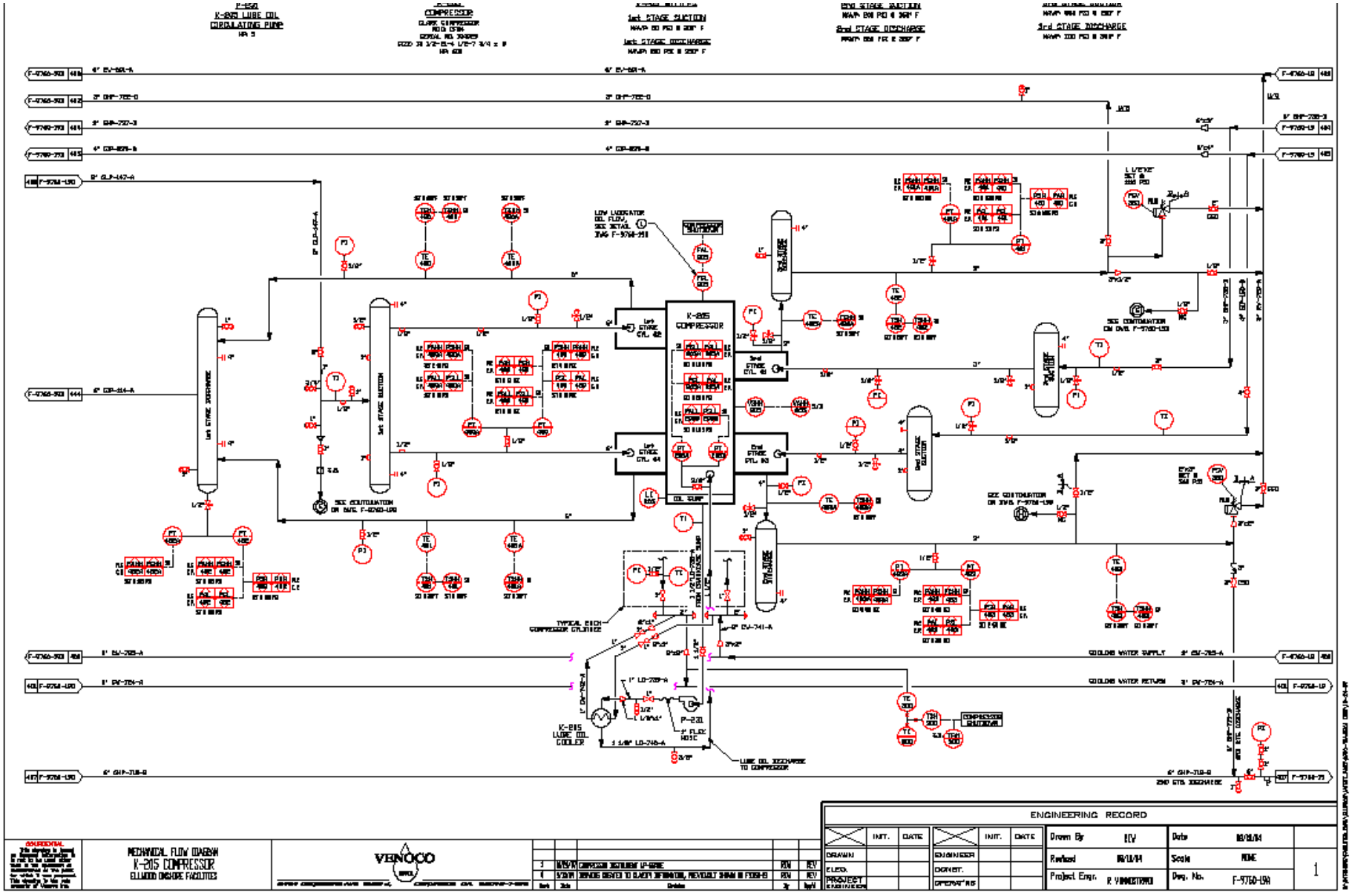

Small 1” x 2” PSV protecting large NGL Vessel
Need 4” x 6” PSV for Fire Case relief load
Applied 2” fireproofing to vessel to lower fire case relief

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.

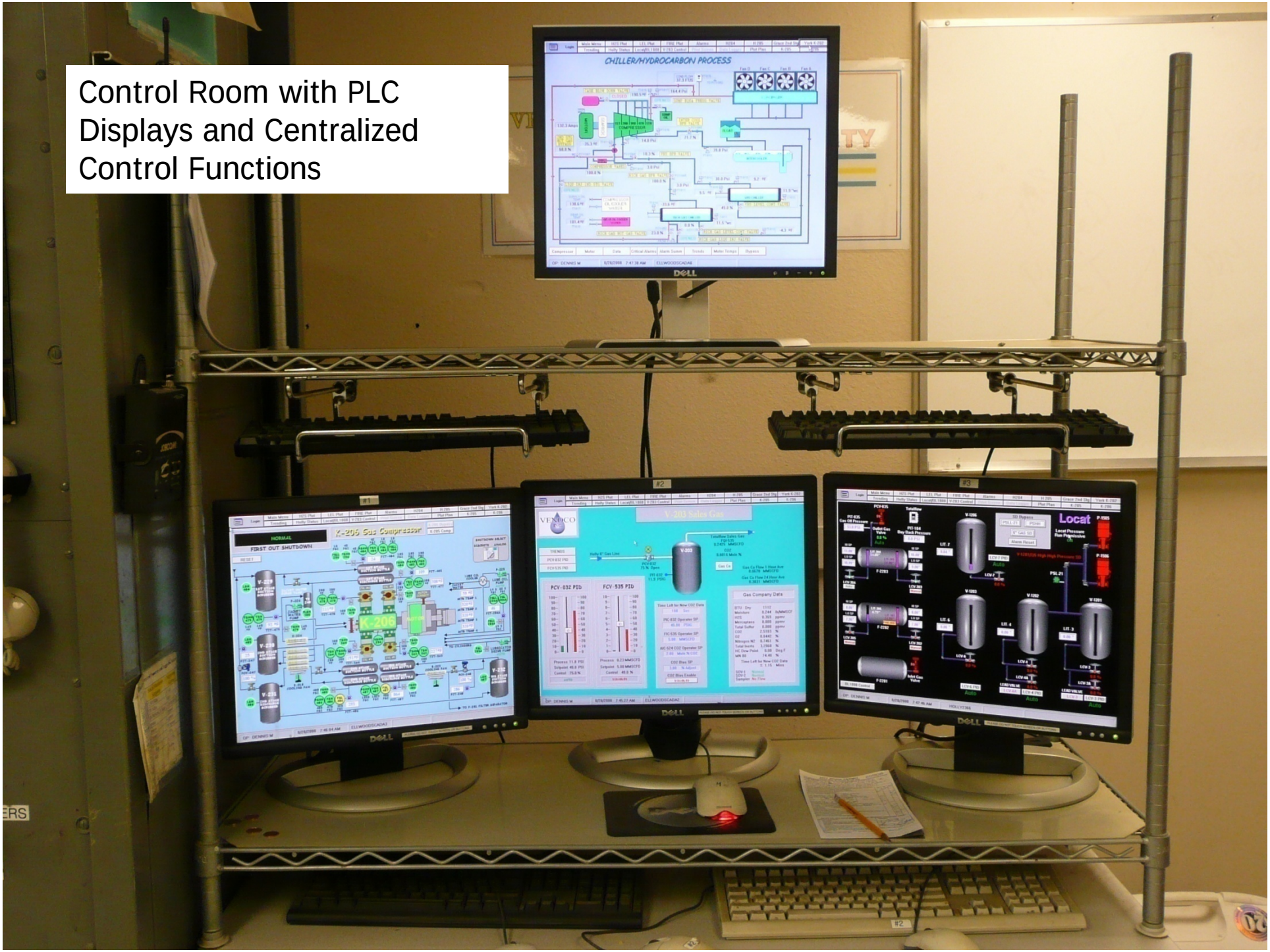
Venoco has been upgrading the process control systems since 1999, with a large portion of the control now done through PLC control.

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

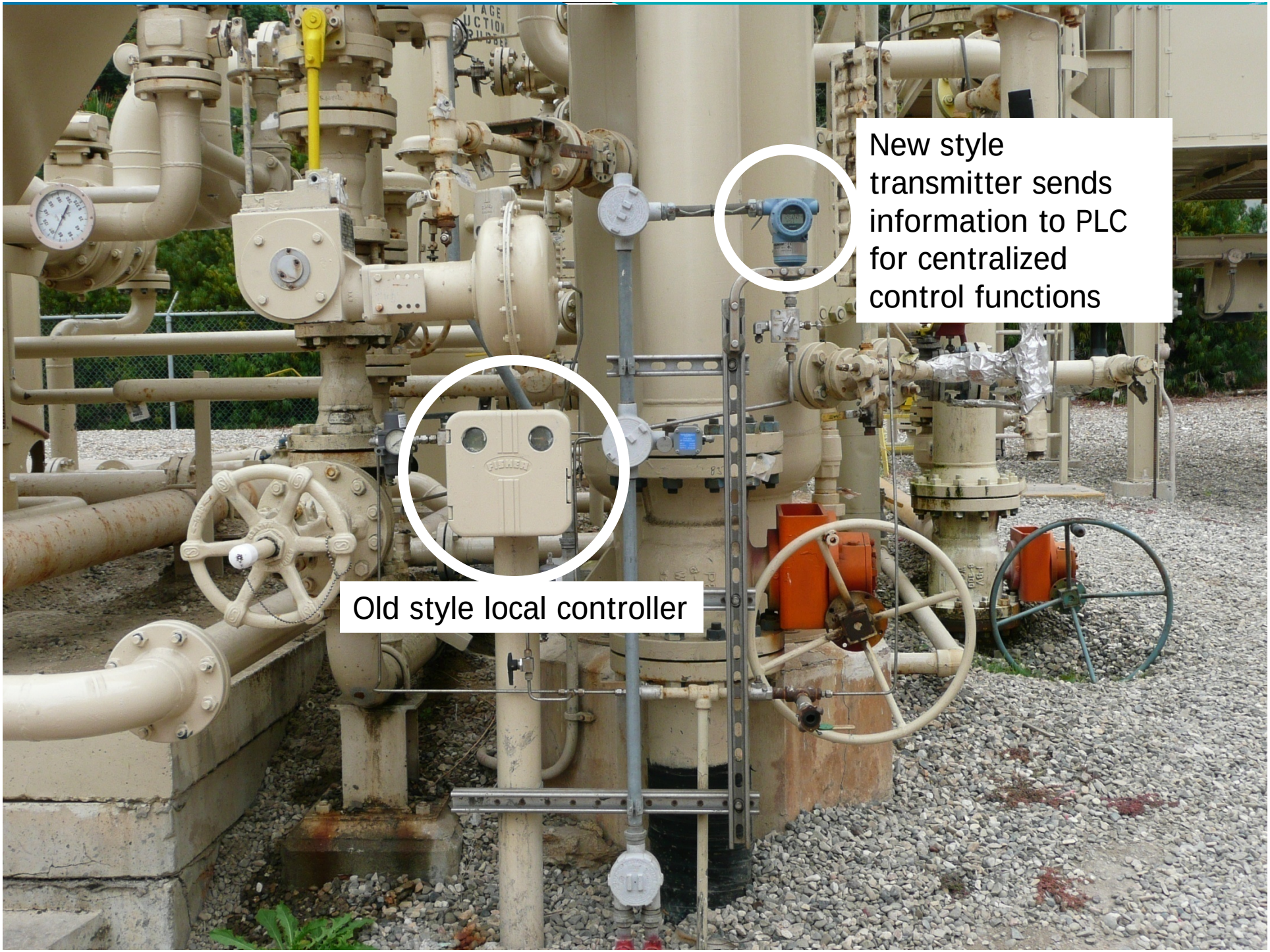
The following slides show original control and alarm panels versus our new computer controlled systems.

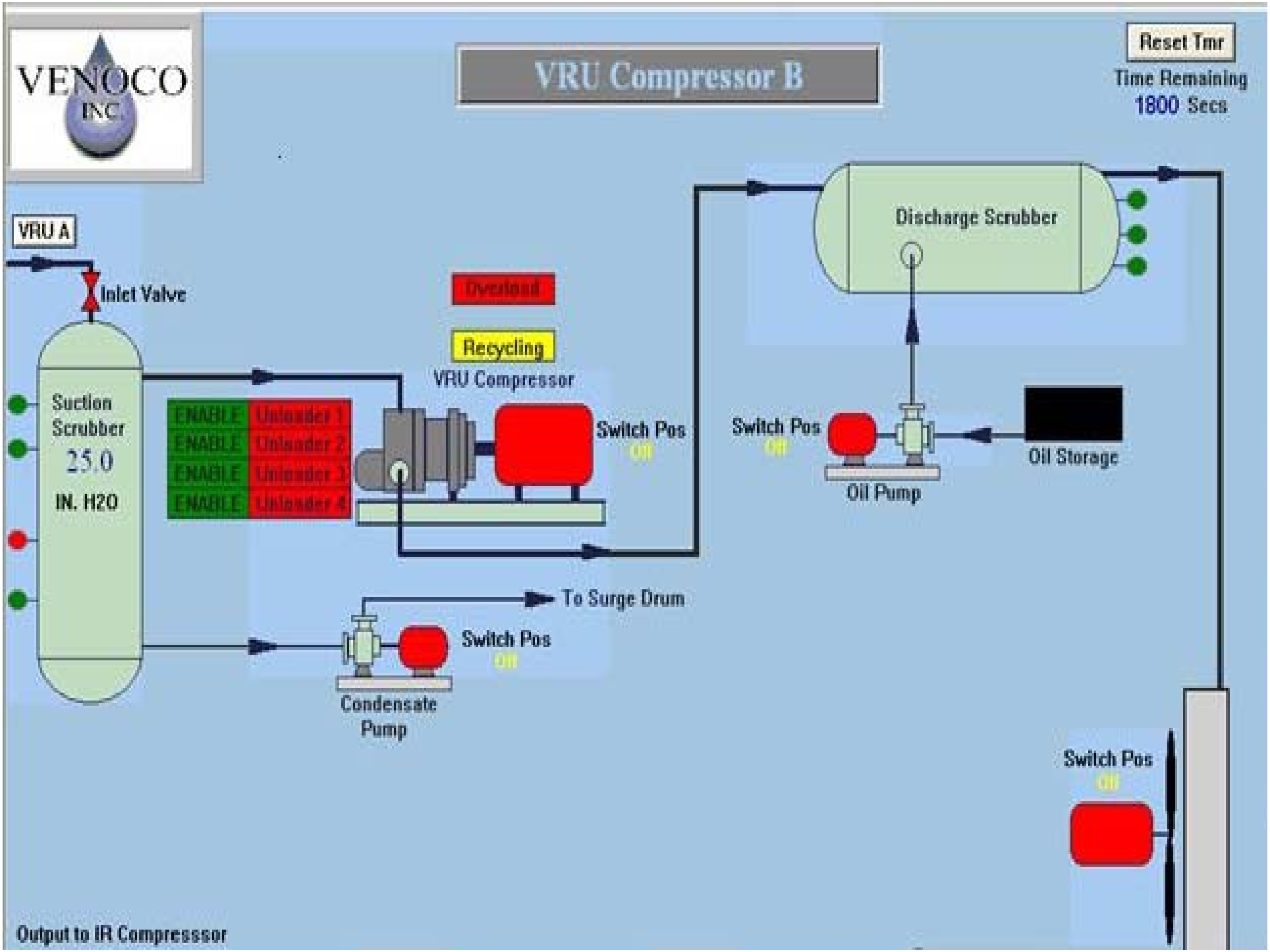
Control Room Alarm Panel

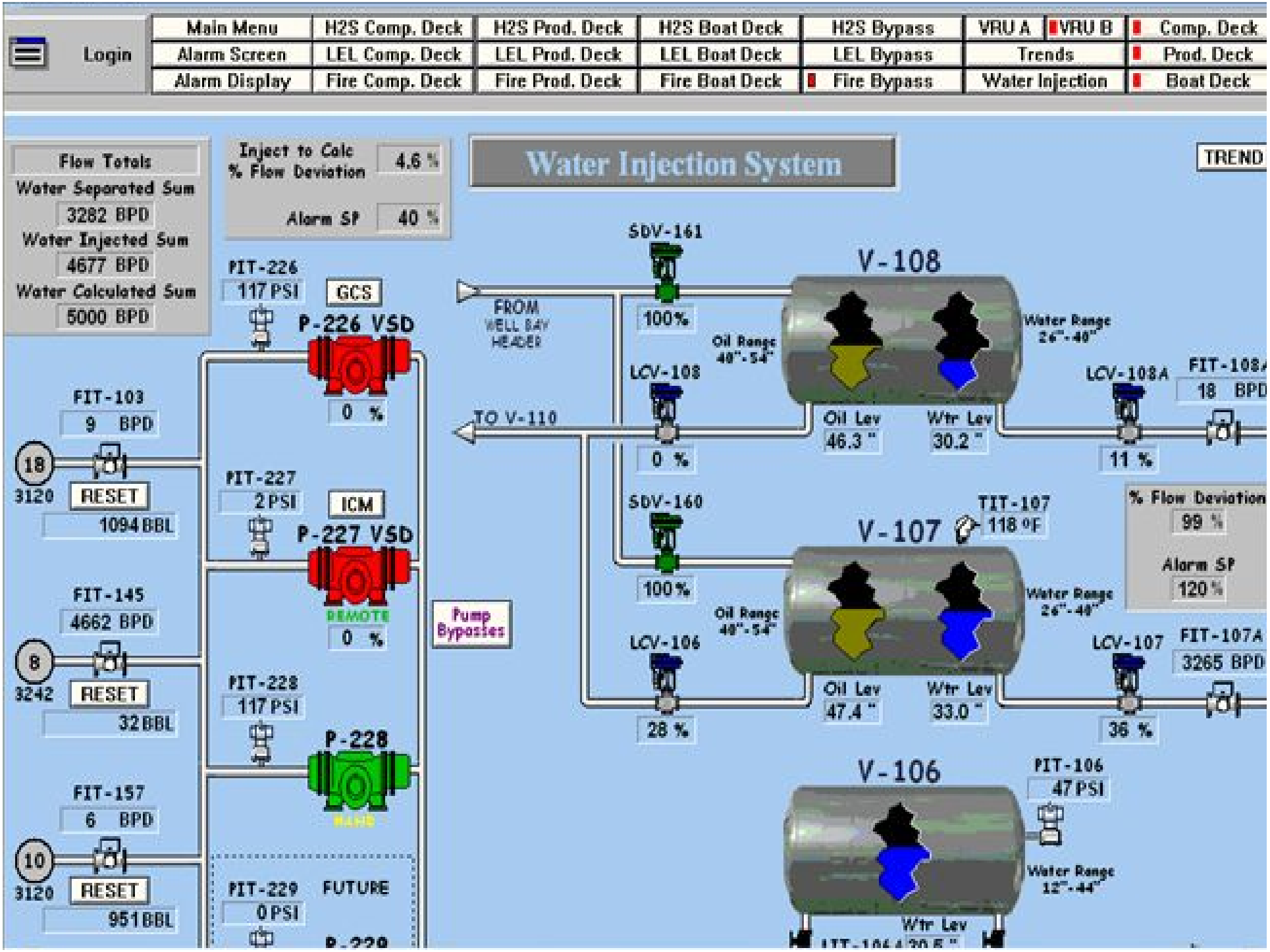
Local compressor panel

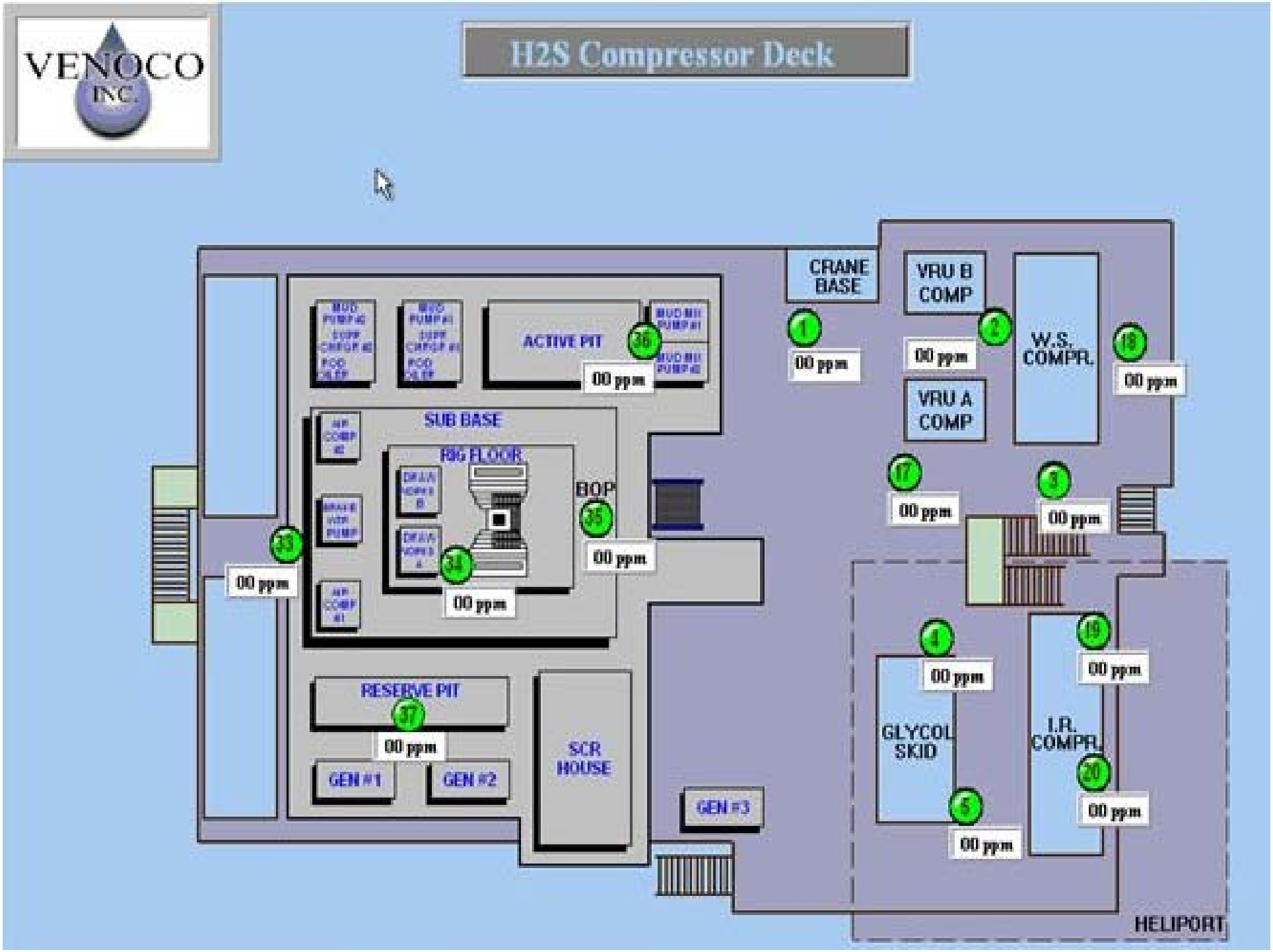


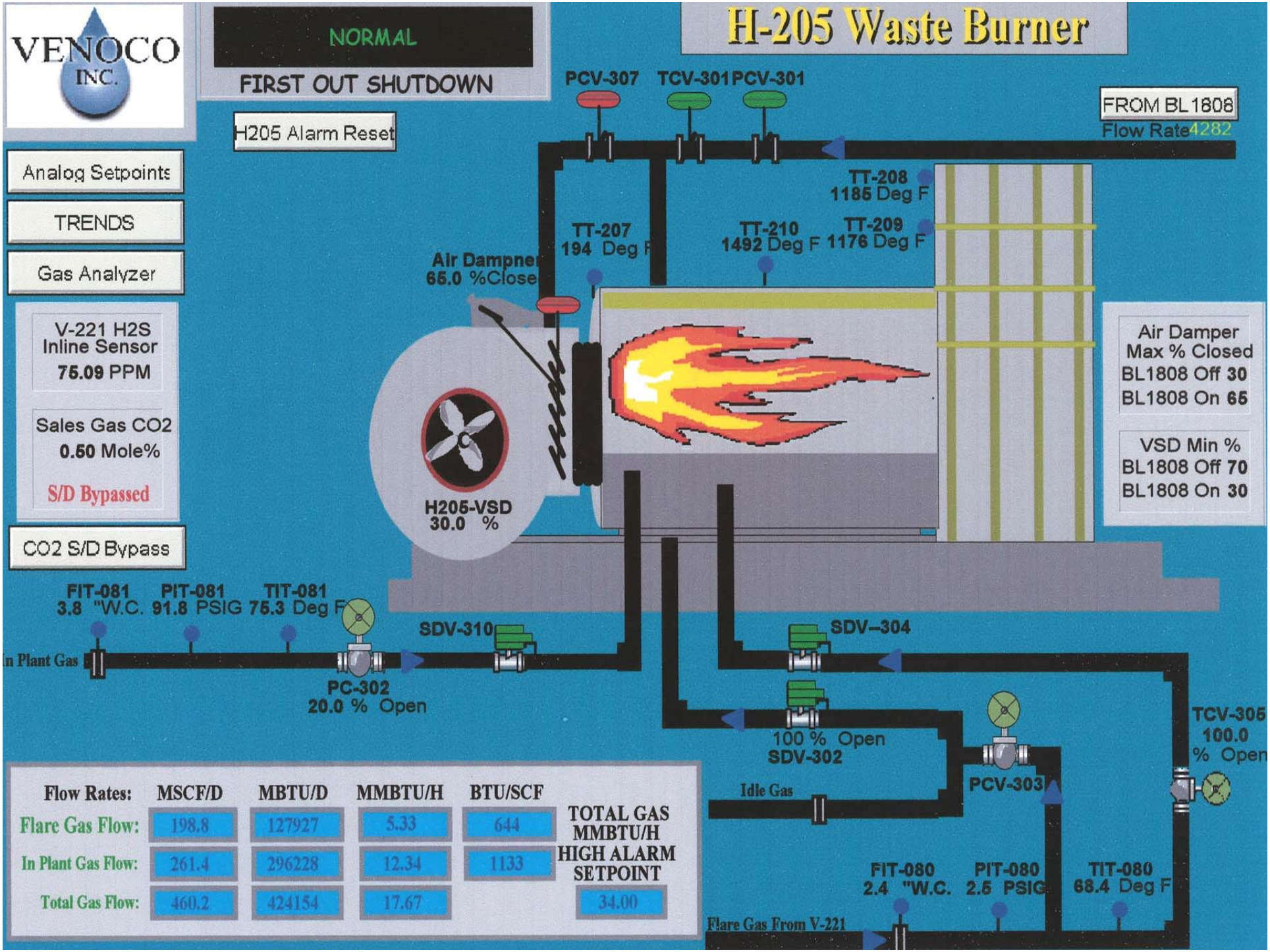
Control Room with PLC Displays and Centralized Control Functions

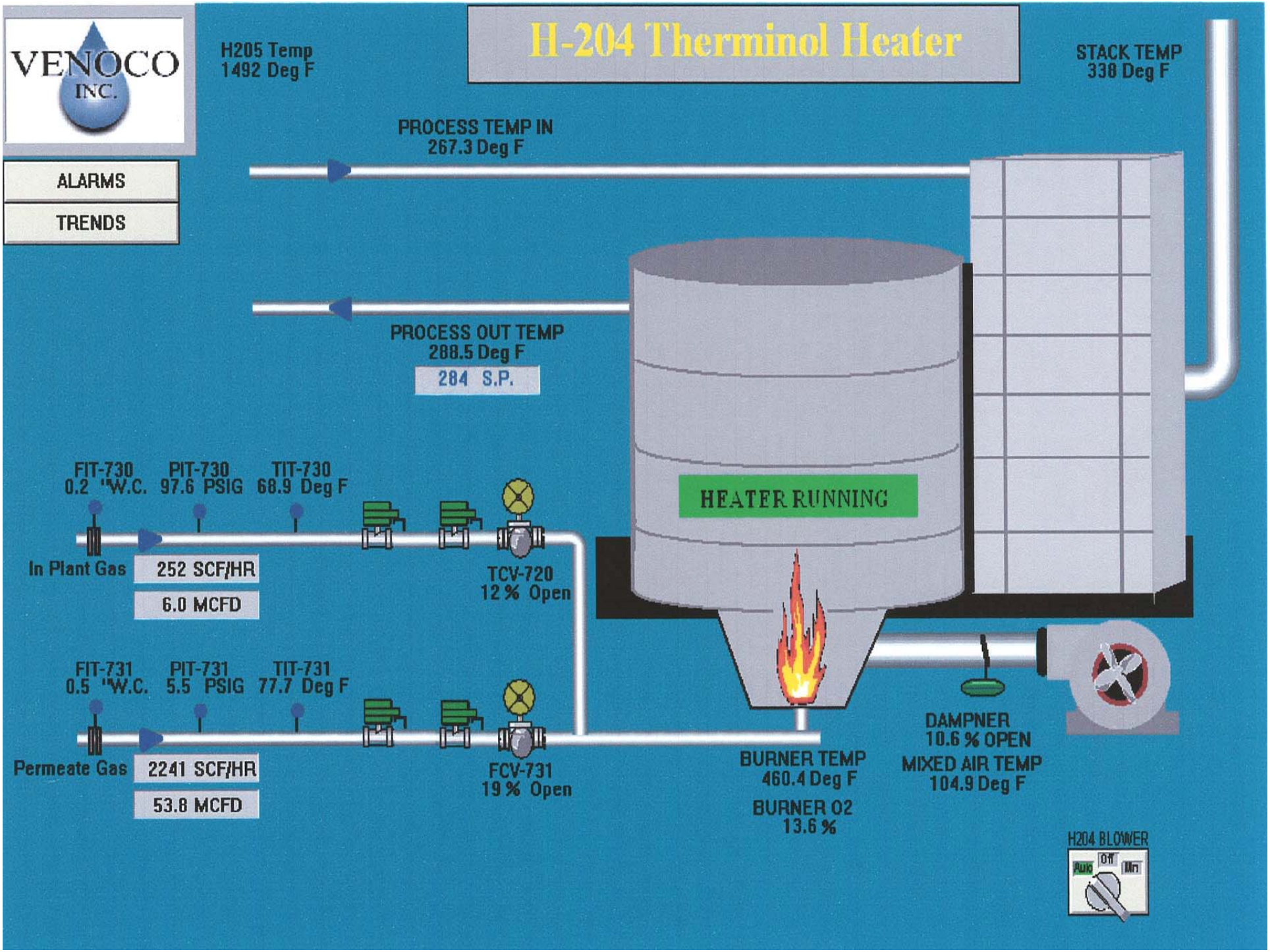

New style transmitter sends information to PLC for centralized control functions
Old style local controller


VENOCO INC
VRU Compressor B
Reset Tmr
Time Remaining
1800 Secs
VRU A
Inlet Valve
Overload
Recycling
VRU Compressor
Discharge Scrubber
Suction Scrubber
25.0
IN. H2O
ENABLE Unloader 1
ENABLE Unloader 2
ENABLE Unloader 3
ENABLE Unloader 4
Switch Pos
Off
Switch Pos
Off
Oil Pump
Oil Storage
To Surge Drum
Switch Pos
Off
Condensate Pump
Switch Pos
Off
Output to IR Compresssor


Login
Main Menu
H2S Comp. Deck
H2S Prod. Deck
H2S Boat Deck
H2S Bypass
VRU A
VRU B
Comp. Deck
Alarm Screen
LEL Comp. Deck
LEL Prod. Deck
LEL Boat Deck
LEL Bypass
Trends
Prod. Deck
Alarm Display
Fire Comp. Deck
Fire Prod. Deck
Fire Boat Deck
Fire Bypass
Water Injection
Boat Deck
Flow Totals
Water Separated Sum
3282 BPD
Water Injected Sum
4677 BPD
Water Calculated Sum
5000 BPD
Inject to Calc
% Flow Deviation
4.6 %
Alarm SP
40 %
Water Injection System
TREND
SDV-161
100%
V-108
FROM
WELL BAY
HEADER
Oil Range
40"-54"
Water Range
24"-40"
LCV-108
0 %
Oil Lev
46.3 "
Wtr Lev
30.2 "
LCV-108A
11 %
FIT-108A
18 BPD
TO V-110
PIT-226
117 PSI
GCS
P-226 VSD
0 %
FIT-103
9 BPD
18
3120
RESET
1094 BBL
PIT-227
2 PSI
ICM
P-227 VSD
REMOTE
0 %
SDV-160
100 %
TIT-107
118 °F
V-107
Oil Range
40"-54"
Water Range
24"-40"
LCV-106
28 %
Oil Lev
47.4 "
Wtr Lev
33.0 "
LCV-107
36 %
FIT-107A
3265 BPD
% Flow Deviation
99 %
Alarm SP
120 %
Pump
Bypasses
FIT-145
4662 BPD
8
3242
RESET
32 BBL
PIT-228
117 PSI
P-228
HAND
V-106
PIT-106
47 PSI
Water Range
12"-44"
Wtr Lev
FIT-157
6 BPD
10
3120
RESET
951 BBL
PIT-229
0 PSI
FUTURE
P-229


VENOCO INC.
H2S Compressor Deck
CRANE BASE
1
00 ppm
VRU B COMP
2
00 ppm
W.S. COMPR.
18
00 ppm
VRU A COMP
ACTIVE PIT
36
00 ppm
SUB BASE
RIG FLOOR
BOP
35
00 ppm
33
00 ppm
34
00 ppm
17
00 ppm
3
00 ppm
4
00 ppm
19
00 ppm
GLYCOL SKID
I.R. COMPR.
20
00 ppm
5
00 ppm
RESERVE PIT
37
00 ppm
GEN #1
GEN #2
SCR HOUSE
GEN #3
HELIPORT


VENOCO INC.
NORMAL
FIRST OUT SHUTDOWN
H205 Alarm Reset
H-205 Waste Burner
Analog Setpoints
TRENDS
Gas Analyzer
V-221 H2S Inline Sensor
75.09 PPM
Sales Gas CO2
0.50 Mole%
S/D Bypassed
CO2 S/D Bypass
PCV-307
TCV-301
PCV-301
FROM BL1808
Flow Rate4282
TT-208
1185 Deg F
TT-207
194 Deg F
TT-210
1492 Deg F
TT-209
1176 Deg F
Air Dampner
65.0 %Close
H205-VSD
30.0 %
Air Damper
Max % Closed
BL1808 Off 30
BL1808 On 65
VSD Min %
BL1808 Off 70
BL1808 On 30
FIT-081
3.8 "W.C.
PIT-081
91.8 PSIG
TIT-081
75.3 Deg F
In Plant Gas
SDV-310
SDV-304
PC-302
20.0 % Open
100 % Open
SDV-302
Idle Gas
PCV-303
TCV-305
100.0
% Open
FIT-080
2.4 "W.C.
PIT-080
2.5 PSIG
TIT-080
68.4 Deg F
Flare Gas From V-221
Flow Rates:
MSCF/D
MBTU/D
MMBTU/H
BTU/SCF
Flare Gas Flow:
198.8
127927
5.33
644
In Plant Gas Flow:
261.4
296228
12.34
1133
Total Gas Flow:
460.2
424154
17.67
TOTAL GAS MMBTU/H HIGH ALARM SETPOINT
34.00


VENOCO INC.
H205 Temp
1492 Deg F
H-204 Therminol Heater
STACK TEMP
338 Deg F
ALARMS
TRENDS
PROCESS TEMP IN
267.3 Deg F
PROCESS OUT TEMP
288.5 Deg F
284 S.P.
HEATER RUNNING
FIT-730
0.2 "W.C.
PIT-730
97.6 PSIG
TIT-730
68.9 Deg F
In Plant Gas
252 SCF/HR
6.0 MCFD
TCV-720
12 % Open
FIT-731
0.5 "W.C.
PIT-731
5.5 PSIG
TIT-731
77.7 Deg F
Permeate Gas
2241 SCF/HR
53.8 MCFD
FCV-731
19 % Open
BURNER TEMP
460.4 Deg F
BURNER O2
13.6 %
DAMPNER
10.6 % OPEN
MIXED AIR TEMP
104.9 Deg F
H204 BLOWER
Auto
Off
Man