

## North Hobbs Unit CO2 Flood Project Risk Management

### Understanding of Potential Risk

Quantitative Risk Assessment by Det Norske Veritas

- ROE calculations
- Probability analyses
- Suggested mitigation items

### Production Well

- Alarm and artificial lift shutdown on flow line low pressure
- Alarm and artificial lift shutdown on flow line high pressure

### Production Satellite

- Production vessel high level alarm, callout, and shuts satellite ESD and shifts well out of test
- Production vessel low level alarm, callout, and shuts satellite ESD and shifts well out of test
- Production vessel high-pressure alarm
- Test separator high liquid level alarm and shift well out of test
- Test separator low oil level alarm and shift well out of test
- Test separator high pressure alarm and shift well out of test
- Test separator low water level alarm and shift well out of test
- Liquid gathering line high pressure alarm, callout, shut ESD and shifts well out of test
- Blowdown tank high level alarm and callout
- Blowdown tank high high alarm, callout, shut satellite ESD, and shift well out of test
- ASME Code Vessels with pressure relief valve on each vessel
- ESD on satellite inlet
- Relief tank to contain liquid relief
- Internal coatings and special metallurgy to prevent corrosion where needed
- Signage
- Fail-safe valve positions
- Site fencing and lighting

### Field Piping (fit for purpose by piping system)

- Internal coatings and special metallurgy to prevent corrosion where needed
- Check valves
- Block valves to isolate portions of systems
- Buried piping
- Bedding
- Cathodic protection
- Selective routing

- Pipeline markers
- Marker tape
- Phone numbers on signs
- Cased road crossings (road and bar ditch)
- Vented road crossing casings
- Surveys and maps

### **Central Facilities**

- LP compressor shutdown alarm and callout
- Pressure relief valve on each vessel
- High and low vessel level alarms
- High vessel pressure alarm
- Internal coatings and special metallurgy to prevent corrosion where needed
- Signage
- Fail-safe valve positions
- Site fencing and lighting
- Flare system
- Vapor recovery compression
- Windsocks
- H2S monitors

### **Reinjection Facility**

- Flare knockout drum high level alarm and start pump #1
- Flare knockout drum high high level alarm, callout, and start pump #2
- Moisture analyzer to detect moisture level in gas
- Flare and relief system
- Check valve at compressor facility discharge
- ASME Code Vessels with pressure relief valve on each vessel
- Vessel high and low level alarms
- High and low pressure alarms throughout process
- Internal coatings and special metallurgy to prevent corrosion where needed
- Equipment shutdowns for vibration, lube oil level, bearing temperatures, etc.
- Relief valves on each compression stage
- Fail-safe valve positions
- Site fencing and lighting
- Windsocks
- Signage
- H2S monitors
- Various sensors tied into automation/callout system and continuously monitored

## **Injection Manifold and Well**

- Flowrate control mode has tubing pressure override which causes choke to modulate in flowrate, and is limited by pressure setpoint
- Pressure control mode has flowrate override which causes choke to modulate, and is limited by flowrate setpoint
- Injection line low pressure alarm and callout
- Injection line high pressure override of choke
- Injection line low pressure alarm, callout, shut choke
- Casing high pressure alarm
- Casing high high pressure alarm, callout, shut choke
- Casing high high high pressure alarm, callout, disk rupture
- Internal coatings and special metallurgy to prevent corrosion where needed
- Positive isolation of injection water from injection gas
- Check valve at surface to prevent well back flow
- Rupture disk and vertical blowdown piping on tubing-casing annulus of produced gas injection wells
- Signage
- Site fencing (close proximity wells (cprox))