The relationship between Quality and Safety in the Oil and Gas Industry

March 18 2013
Algerian LNG Plant Explosion - 2004

Physical evidence of boiler explosion (i.e., badly distorted boiler tubes) - QA Processes lacking

Management of Change Procedure (incomplete)

800 million dollars of damages to replace three LNG trains

22 causalities

To eliminate concerns about LNG hazards and public safety risks and fostering distrust of government and industry, Proper Risks Assessments, QA Program and Information Management is an Asset to safeguard Operability and Maintenance of the Facility
SEATTLE  Tesoro Corp. has confirmed through an internal report that a hydrocarbon explosion and fire killed seven workers at its Anacortes, Wash., refinery in April of 2010.

The company says a “high temperature hydrogen attack” ruptured a heat exchanger. A hydrogen attack happens when hydrogen mixes with carbon.

Among the new safety initiatives, the company says new heat exchangers will be designed to minimize the risk of hydrogen attacks.

The state Department of Labor and Industries had previously concluded that Tesoro failed to inspect cracks that had developed in the nearly 40-year-old heat exchanger that ruptured. Tesoro was fined $2.39 million by the state.

(Source:http://engineeringfailures.org)
Deepwater Horizon

Deepwater Horizon offshore drilling rig on April 20, 2010, and the subsequent oil spill in the Gulf of Mexico, which claimed 11 lives, a sea-floor oil gusher flowed unabated for three months in 2010. The gushing wellhead was not capped until after 87 days, on 15 July 2010. The total discharge is estimated at 4.9 million barrels.

Eight key incidents that led to the accident have emerged:

Through a review of rig findings and maintenance records, the investigation team found indications of potential weaknesses in the testing regime and maintenance management system

(Source: Deepwater Horizon Accident Investigation Report September 8, 2010)
Knoxville Tennesse US – February 9, 1999 (Brittle Fracture, 15 evacuated, USD 8,100,000)

A pipe failed releasing 53,500 barrels of diesel fuel. The pipe was 10-inches in diameter, API 5L X-42 SMYS 42 kpsi, electric resistance weld (ERW) carbon steel and with 0.25 inches in thickness. Circumferential crack was found at the failed segment. **The possible cause for cracking was noted by the low toughness of the manufactured pipe material.** The pipe was constructed in 1962 when there was no adequate toughness requirement from available pipe code and design. National Transportation Safety Board had already given recommendation for toughness requirement to Department of Transportation Research and Special Administration Agency (RSPA) when a similar failure occurred in 1994 in New Jersey. In 2000 responding the request from RSPA, American Petroleum Institute (API) added minimum toughness requirements to API Specification 5L. [Source]
Petrobras P-36

Petrobras 36 (P-36) was at the time the largest floating semi-submersible oil platform in the world prior to its sinking on 20 March 2001.

The incident was initiated by the rupture of the Emergency Drain Tank (EDT) in the starboard aft column due to excessive pressure at 00:22 on 15 March 2001. The rupture caused damage to various equipment and installations, leading to the flooding of water, oil and gas into the column. Emergency Firefighting Service was sent to the area. After 17 minutes, the dispersed gas caused fire, causing a major explosion which killed 11 crew. The explosion also resulted in serious physical damage to the platform.

Of the 175 people on board, 165 were successfully evacuated including a person who was seriously burned and died 1 week later. The continuous flooding finally destabilised the P-36 and it sank five days later.

To learn more about the relationship of Quality and Safety in the Oil and Gas Industry please come to the breakout presentation
Presumed Causes of Failures

Primary Causes of Engineering Failures

The primary causes of engineering disasters are usually considered to be

• human factors (including both 'ethical' failure and accidents)
• design flaws (many of which are also the result of unethical practices)
• materials failures
• extreme conditions or environments, and, most commonly and importantly
• combinations of these reasons
Bow-Tie Diagram

SCE's
- e.g. Process Upset with potential to escalate
- e.g. Loss of Containment
- e.g. Instrumentation Failure

Initiating Event 1
- e.g. Loss of Containment

Initiating Event 2
- e.g. Process Upset with potential to escalate

Escalation Factor
- e.g. Instrumentation Failure
- e.g. Blow down timing

Barriers to eliminate & prevent causes of accident event

Mitigations to limit consequences & effects

Consequence 1
- e.g. Fatalities
- e.g. environmental damage > 1 yr recovery

Consequence 2
- e.g. Adjacent Equipment Damage

Escalation Factor
- e.g. Additional Release from adjacent equipment

Risk Management Hierarchy
- Release offsite

INITIATION
PREVENTION
DETECTION
MITIGATION
EMERGENCY
Verification Scheme Components

1. Hydrocarbon Containment
2. Primary Structure
3. SMS
4. ESD
5. F & G Systems etc etc
6. SCE Register
7. Performance Standards
8. Verification Work Instructions

Narrative, Verification Process Description, Reporting Requirements etc.
Performance Standards

Performance Standards must meet all of the following criteria:

Specific
   It must be clear as to exactly which parts of the SCE the performance standard applies

Measurable
   The SCE should be easily assessed for achievement of its performance target in a consistent and predictable way

Achievable
   That the SCE will be demonstrated to meet the specified criteria, given industry practice

Relevant
   That the SCE is directly linked to one or more of Major Accident Events for that SCE, i.e. achievement of the performance standard directly contributes to preventing, detecting, controlling, mitigating or responding to a Major Accident Event

Timebound
   That it is clear to exactly when the SCE is required to achieve the performance requirement and for how long
Common Challenges & Pitfalls

Safety Critical Elements (SCE’s)
• Link between SCE’s and major accident events unclear
• Contents/limits of each SCE unclear
• Overlapping contents of SCE’s
• SCE listing at a lower level than “standard/best practice” (leading to extra SCE’s are listed)

Performance Standards
• Criteria loosely defined; not measurable
• Based on project/asset specifications rather than what the SCE needs to do
• Divorced from risk assessments
• Over-specify “how” the PS is to be achieved rather than set the goal
The Quality group provides oversight of the contractor to ensure that:

- Technical integrity of the design through review and assessment of processes for:
  - Design control
  - Design review
  - Design verification
  - Design validation
- Asset Integrity Management
  - Initiate the development of an Asset Integrity Register that includes tagging philosophy and SCE’s
- RAM Analysis carried out to identify the weak links and mitigation measures undertaken to support
  - Reviews performed at FEED are often aimed at evaluating critical equipment which may lead to production losses
- Qualification of Sub-Contractors and Suppliers is vigorous and evaluations can be supported with objective evidence.
  - Development of Approved Vendor List by FEED contractor that is supported by an evaluation process that AMA 1 Quality can support
  - Vendor assessments throughout the design, procurement and manufacturing process
Quality Assurance

- Dedicated Quality Managers embedded in the FEED Contractors design and procurement offices
  - Review of the contractors quality plans and procedures
  - Ensure that sufficient review, assessment and verification of the design process
  - Development of a Procurement Quality program to ensure that the quality deliverables are clearly defined to the supplier
  - Pre-Fabrication and Pre-Inspection meetings are formally managed to ensure that procurement quality is accomplished (where applicable)
  - Change control is formally tracked with EHS, Quality and Engineering input
Decision Process and Expectations
“It ain’t Rocket Science”
Questions?