BP Gulf of Mexico disaster (20-04-2010)

Broken barrier- and TRIPOD analysis

The BP investigation report (8 September 2010) of the Horizon disaster shows that eight safety barriers have been broken. See the picture below. This broken barriers have been used for a Tripod analysis.

Underlying Factors ref. BP (Latent Failures):
- Responsibilities not clear
- Competence of leaders not adequate
- Procedures and Engineering instructions problematic
- Risk Management and MOC procedure not adequate
- Several procedures not adequate
- HAZOP practice not good
- SIL concept (IEC 61511) not implemented
- BP in company knowledge of Blow-out Preventers (BOP) insufficient
- Practice of emergency planning and drilling not adequate.

The barrier concept
Incidents occur because one or more safety barriers have been broken. That concept is published by James Reason, perfectly described in his book: ‘Managing the Risks of Organizational Accidents’. He describes how the underlying factors should be addressed. He introduced the term ‘Latent Failures’ in the organization. That is the basis for the TRIPOD method (www.tripodincidentanalysis.com). From experience, SSC know that TRIPOD is a powerful tool to help address the Latent Failures and to make a step change in Safety. From the lessons learned.
On the basis of the BP report, SSC performed a TRIPOD analysis, with the same 8 broken barriers. The Latent Failures mentioned above show the underlying organizational problems of BP. The Tripod analysis diagram below gives an insight on the Tripod reasoning from broken barriers to latent failures in the organisation. You will find the BP reports here.
Tripod Analysis of the BP Horizon disaster (for illustration/ training purposes)

1. Cement between wall and pipe
   - Responsibilities are not clear
   - Organisational issues
   - Risk management and MOC procedure not adequate
   - Procedures and engineering practices problem

2. Mechanical barriers
   - Not designed for it, does not vent to safe location
   - Procedures and engineering practices problem

3. Pressure test
   - Gas detection fails to stop the ventilation of the engine rooms
   - Criteria for successful test was missed
   - Potential failure modes: not yet further investigated

4. Well monitoring
   - Competence of leading and workers
   - System integrity (SIL) not adequate, vulnerable for human error
   - Wrong action: riser fluid to separator iso to the sea

5. Well control
   - Influx not seen timely
   - Oil and gas in reservoir (high pressure)
   - Hydrocarbons

6. Separator tank as buffer
   - Wrongly interpreted
   - Preconditions could not be investigated by BP
   - No well control/hydrocarbons to separator

7. Fire & gas system
   - Configuration pits difficult to monitor
   - HAZOP practice not adequate
   - Design well was not closed
   - Gas release at platform/explosion, fire/11 fatalities, large environmental damage
   - Recommended practice (API) does not exist

8. Blow out preventer (BOP)
   - Organisation
   - Failure of non-return valves ('float collar')
   - Risk analysis not adequate design/test/quality check failures
   - Well monitoring procedure not adequaat
   - Procedures and engineering practices problem
   - Brittle cement: nitrogen blow out
   - Procedures and emergency planning and drilling defences

HAZOP not performed