

Tragedy on the Deepwater Horizon: When holes in the layers of the safety management system line up

Paraphrased from Deep Water – The Gulf Oil Disaster and the Future of Offshore Drilling

“Complex Systems Almost Always Fail in Complex Ways”

1. Operator was 4th biggest corporation in the world. Reputation for having a lot of experience, resources, and attention to safety.
2. Rig was arguably the top performing offshore rig in the world. No LTA in 7 years. Top performing rig for the largest, most respected, drilling contractor in the world.
3. Incident occurred right after the casing was run and the cement job was deemed a success.
4. On the day of the accident, 4 VPs arrived to meet with the crew to thank them for their accomplishment and to try to identify what made the rig special.
5. Toolpusher overseeing the operation had been with the rig since it came out of the yard. Was considered a well control expert. This was his last scheduled hitch on the rig. He was being assigned a new position to teach well control in town. He perished in the tragedy.
6. Decisions that led to the Incident occurred during/right after 6PM crew change.
7. VIPs were on the rig floor when one of the critical decisions was being discussed.
8. Company Man, Toolpusher, Driller ignored abnormal drill pipe shut in pressure. They “explained away” the abnormal pressures and failed to understand the context that abnormal pressures could indicate a lack of well control or well integrity.
9. Operator and contractors cut corners in well plan to save time/money.
 - a. Ignored concerning results of cement lab tests
 - b. Ignored float equipment design/ratings
 - c. Critical test procedures were not provided in writing
 - d. Combined two steps during displacement of OBM (one of their well control barriers)
 - e. High concentration LCM pill was used as a spacer so they didn’t have to pay to dispose of it. It later created a barrier in the kill line which led to the misinterpretation of the well building up pressure
 - f. Removed well control barrier (heavy mud) from well due to a preference of setting cement plug in water
10. Driller, derrickman, and mud engineer did not keep track of pit volume/gain/flowrate out during displacement when pumps were held constant.
11. After the blowout, the generators “ran out” due to natural gas getting into engine air intakes.

12. BOPs and automatic disconnect failed to work as designed, possibly due to improper maintenance.
13. The crew failed to close the blind shear ram in the 6 minutes from the time the mud blew out to the first explosion. They closed the annular and then the VBR.
14. Evacuation/muster procedures completely broke down during crisis.
15. 11 people died from the explosion/fire, including everyone on the rig floor and on the pits.
16. BP's Macondo well spilled 4 million barrels of oil into the Gulf of Mexico. It cost \$20 billion dollars to clean up. That is 20,000 x \$1 million.

A Few Lessons Learned

1. Complacency will cost you your life.
2. Take your emergency/safety critical training seriously, it may save your life.
3. Do not let your guard down after the cement job is finished. The well is not yet secure. Keep the well shut in, flow check before ND and/or removing cement head. Understand that cement has a transition time; it will go from a normal fluid hydrostatic to a hydrostatic of water as it transitions from liquid to solid.
4. Do not pay attention to VPs or visitors to the rig floor. Focus on your job responsibilities, period. If they are distracting, politely ask them to leave the rig floor due to ongoing critical operations. The same applies to any 3rd parties on the rig floor who don't need to be there during critical ops.
5. Do not ever hesitate to question an experienced toolpusher, company man, etc. If one floorhand would have been able to identify and speak up about the abnormal pressure, or if one derrickman noticed the abnormal flow, they could have saved everyone's life.
6. Act on weak signals of trouble (abnormal pressure, flow, etc.) Remember, you'll always find evidence that everything is okay when you really want things to be okay. Don't hesitate to call "all stop" to think and talk things through.
7. Do not let operator or anyone else influence you to cut corners when it comes to safety critical steps.
8. Company Man, Toolpusher, Driller should always completely understand the well control barriers that are in place, and the well control procedures that they need to follow in a crisis.
9. BOP equipment and gas detection system in generator house must be maintained under the context that all of our lives depend on it.

10. Driller, derrickman must always maintain an accurate pit volume and pit gain. Always set alarms.
11. Do not let your guard down during crew changes. You need to be even more focused before/during/after.
12. If you find yourself in a crisis, fall back to the fundamentals of your training.

One day in the future, somewhere in the Permian Basin: Float equipment will fail, cement will channel, an offset frac job will hit a rig, a saltwater injection zone will bring up a bubble of gas, BOPs will fail, a company man will try to cut corners. **Will you be prepared? Will you have the courage to speak up?**

Highly Reliable Organizations:

Credit to Chuck Mallory for this entire section

Definition: an organization that has succeeded in avoiding catastrophes in an environment where accidents can be expected due to risk and complexity.

- They operate in unforgiving environments (social, political)
- Their purpose/mission/technology is risky and presents the potential for error
- The scale of possible consequences from errors or mistakes precludes learning through experimentation or chance

7 Recommendations for Leaders

1. **Check for distractions and verify alertness**
“are they in the game?”
2. **Think about what’s going on, know and confirm the situation**
consider the unconsidered
“what haven’t we thought about?”
3. **Grow and listen to an inner voice, act on weak signals of trouble**
“this doesn’t seem right”
“we need to check this out”
4. **Don’t over-commit to an outcome**
“get ‘er done gets us in trouble”
5. **Remember: you’ll always find evidence that everything is okay when you really want things to be okay**

6. Challenge by the crews should be encouraged and rewarded

“STOP the Job” is a right and a responsibility

7. Ask for and use stories to highlight risks and hazards

“Let’s talk about what could happen if...”

Creating High Reliability

- **Develop teams and organizations that have Resiliency**
 - *ability to adapt to the unexpected/unlikely/unwanted*

- **Ensure that bad news can travel upwards**
 - *your people have to be comfortable doing this*
 - *when people are afraid to bring you bad news, you have a big problem*

- **Avoid complacency; stay uneasy, stay humble**
 - *in a complex world, the absence of bad things happening in the past is a very poor predictor of bad things not happening in the future*

- **Establish and maintain safe operating margins, verify in real-time**
 - *make sure you’re not operating on the “knife edge”*
 - *don’t drive a 20 ton truck over a 20 ton bridge*

- **Identify and understand Safety Critical human tasks**
 - *tasks where human factors can enable disasters & catastrophes*
 - *we must ensure that people can perform these tasks reliably*