

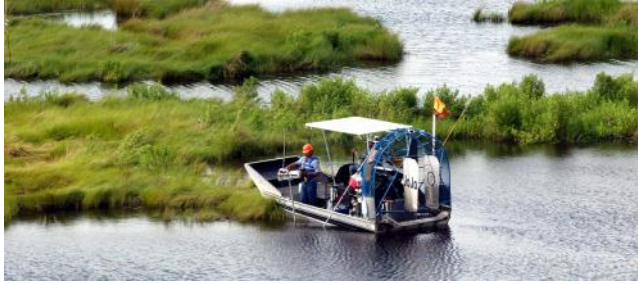

HiPo
High Pressure Incident 2011

Houston 25 April 2012

International Association of Geophysical Contractors

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Setting the Scene

- Two days prior to this incident air had been blown from the bottle bank to the arrays, without the compressors being run, for approximately 10-15 seconds. This is not normal practice and air is rarely if ever taken purely from the bottle bank, however on this occasion as only a small amount of air was required the compressors were not started. Between the bottle bank and the gun deck manifold is a significant oil/water trap due to the layout of the pipe work. It is thought that oil from this trap was blown into the pipe system and manifold at this time.
- Two days later when the mechanics asked for air for the array, a rapid combustion occurred creating extreme pressure in the high pressure (HP) air manifold on-board the seismic survey vessel. This explosion resulted in a fire inside the HP pipe work system leading back towards the bottle bank and compressors. It is highly likely that the initial explosion also created a pressure wave that travelled along the pipe work and caused a secondary explosion at the bottle bank.
- The secondary explosion at the bottle bank resulted in a serious injury to the 1st engineer who needed to be medivaced for treatment ashore.

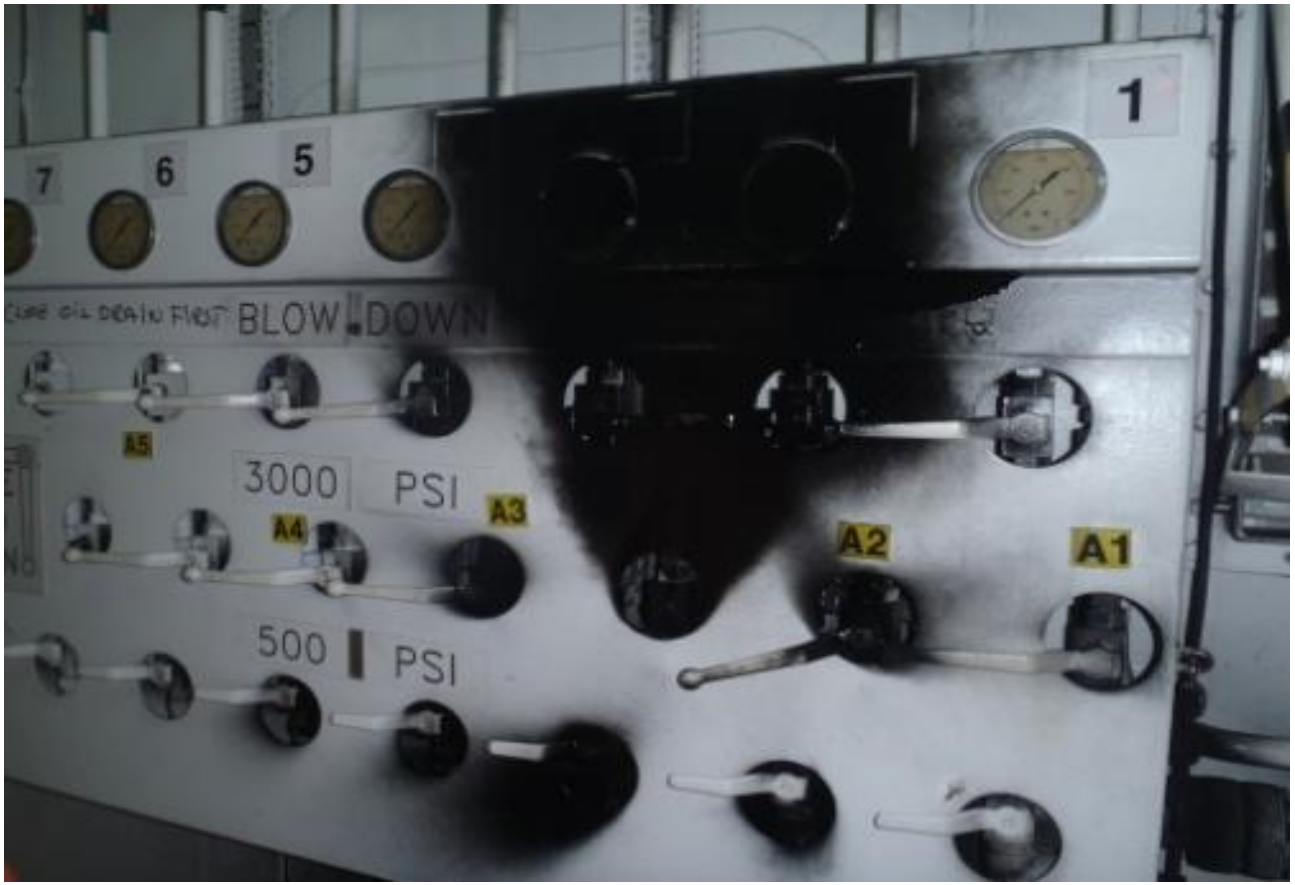
Sequence of events 1

- Compressors started for pressurizing the guns on deck, HP Warning lights on and deck cleared
- The main valve to the manifold opened by the Ch. Mechanic and no air was heard entering the manifold. (Valve normally open already)
- The main manometer on the manifold was checked and no pressure was observed.
- Valves to arrays were opened and again no pressure was observed on the manometers, no air heard.
- All valves were closed. Fisher valves were checked and working ok
- All HP piping traced and checked for damage

Sequence of events 2

- Engineer opened the manual drain valve from the bottle bank, he heard air escaping.
- Engineer left and suddenly heard explosion and saw smoke. Compressors were stopped
- The combination of oil and adiabatic compression when the main shutoff valve was opened (even very slowly) resulted in this explosion.
- Pipe on bottle bank exploded causing injury. The initial explosion in the manifold caused a shockwave that travelled down the pipe work and this energy exited at the burst pipe on the bottle bank.
- Injured person was standing next to the bottle bank
- Casualty taken to hospital onboard

The Manifold on gun deck

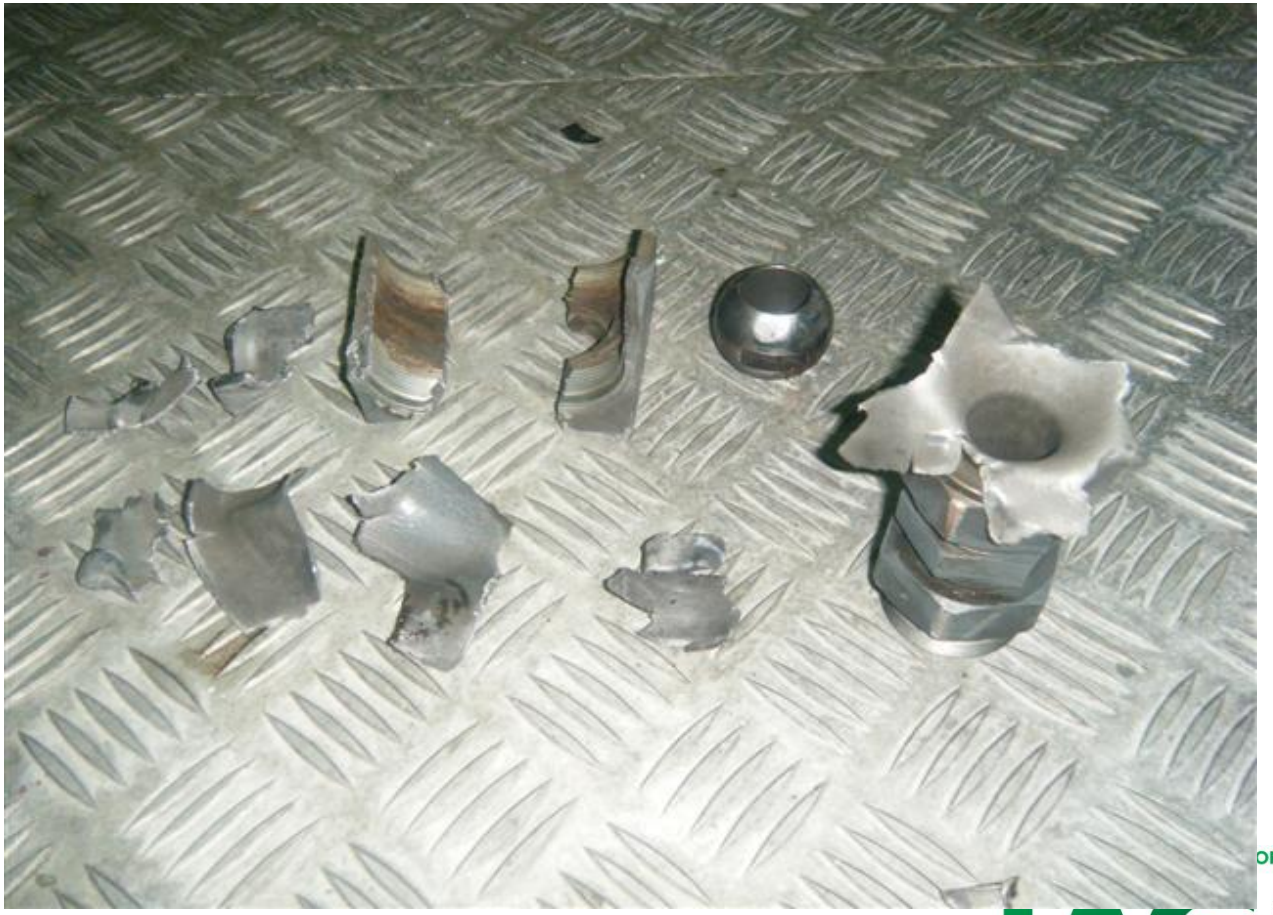


Bottle bank in compressor room

Consequences

- The explosion at the bottle bank caused a puncture wound to the left should and neck of the crewmember. This explosion also caused damage to the bottle bank, the manifold and three dowty sealing rings in the pipe work between the manifold and bottle bank.
- **The possible consequences**
- The injured person could have been killed by the shrapnel that caused the puncture wound.
- If anyone had been standing next to the manifold on the gun deck the person could have suffered serious injuries or possibly have been killed.

Damaged parts of pipe and ball valve that exploded



Lessons learned 1

Inadequate use of lock out/tag out

- Although the main shutoff valve to the manifold had been locked closed it had not been returned to its ‘normal’ open position after the work had been completed.

Inadequate blast protection

- The blast protection both at the manifold and the bottle bank was inadequate

Inadequate on site risk assessment

- Despite abnormal conditions existing no further tool box meeting was held to discuss the potential hazards and risks.

Lessons learned 2

The design of the HP air system was inadequate.

- Through failings in the system design and installation the conditions for the incident were created.
- There are no agreed standards/best practices within the seismic industry for the design or installation of HP air systems. Currently only the compressors and bottle bank (reservoir) are certified by DNV, the pipe work and manifold are not certified.

Lessons Learned 3

The SMS failed to identify the need for a risk assessment

- At no point during the design or installation of the HP air system on the vessel was there a requirement for a risk assessment to be carried out.

Failure to implement findings and recommendations from similar incidents.

- There have been at least 5 similar incidents in the seismic industry in the last 10 years and probably significantly more than this. The lessons learned from either contractor or external investigations were not addressed and or implemented.

Immediate actions taken

- Experience transfer was published.
- Design deficiencies in the current HP pipe system were identified and corrected.
- The valve to the manifold was removed - removing the potential combustion chamber
- A non return valve has been installed in the HP blow off line to the oil scrubber

Key recommendations 1

- Investigate the need to install suitable oil/water drainage to the replacement
- Review and risk assess the manifold designs fleet wide focusing on simplification.
- Review the current gun lubrication oil used fleet wide giving particular consideration to flashpoint, biodegradability, removing.
- Appropriate warning signage at all manual ball valves used to operate the HP air system.
- Consider installing an oil filter in the high pressure outlet line from the compressors
- Introduce safety devices that could help improve the safety of HP air systems.(rupture disks etc)

Key recommendations 2

- A risk assessment, fleet wide, of the design of the HP air system should be carried out.
- Be driving force in gaining agreement with IAGC and DNV on standards and codes of best practice for HP air systems and issuing an industry wide ET.
- Develop written procedures for the safe installation and operation of the HP air (best practice)
- An improved training program for HP air systems, on-site risk assessment and lock out tag out should be put in place for all offshore crew.
- Improve on following up actions identified in incident reports from both internally and externally (IAGC).



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