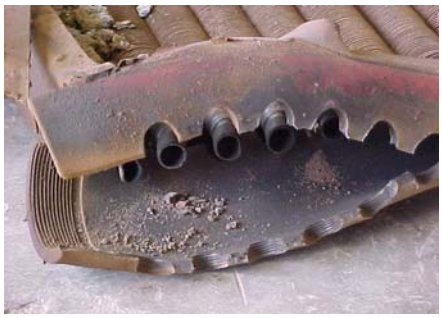
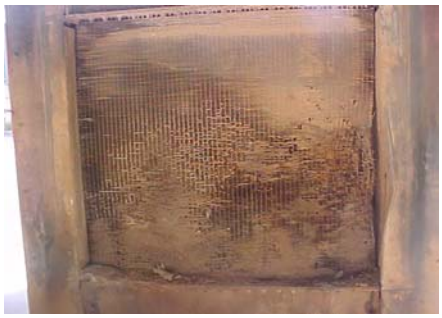
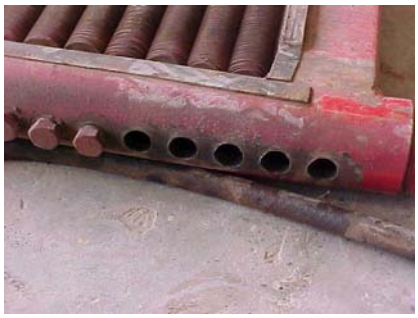
Department of Industry and Resources	DEPARTMENT OF INDUSTRY AND RESOURCES WESTERN AUSTRALIA **Safety Bulletin**
No:	SB71
Date:	01/10/2004
Subject:	**BOOSTER COMPRESSOR EXPLOSIONS-REVERSE CIRCULATION (RC) DRILLING**



Details:

Issues

Over the past few years a number of explosions involving booster compressors have occurred at RC drilling operations. The potential for serious injuries and fatalities is very high given the nature of these explosions.

Anecdotal evidence gathered from industry suggests that a considerable proportion of these incidents go unrecorded and unreported, thereby impeding awareness across industry and the inspectorate thus reducing opportunities to improve the management of hazards and risks associated with the use of this type of plant.

Occurrences involving the explosion and or bursting of pressures vessels i.e. booster compressor heat exchangers (inter-coolers and after-coolers), condensate tanks (scrubber tanks) and the pipe work and hosing/fittings directly connected to these pressure vessels must be recorded and reported to the Department of Industry and Resources pursuant to **Section 78 of the Mines Safety & Inspection Act 1994 (MSIA)**.

Causes & Contributing Factors

There is little accurate data on the nature of these types of occurrences, but what is known about the reported occurrences is alarming because in almost all of the reported cases there were common factors such as:

- Booster compressors were older models.
- Ingress of hydrocarbon (oil) into the booster compressor compression system and to down stream components resulting in oil mixing with air to form an air/oil (air/fuel) mixture, which under the right conditions ignites and combusts producing tremendous heat and pressure.
- Inadequate maintenance resulting in worn or defective mechanical components allowing oil to ingress the booster compressor system either from other compressors feeding the booster or from the booster itself.
- In at least one case hammer oil was intentionally introduced into booster compressor system thus increasing the level of hydrocarbon in the air/fuel mixture and increasing the potential for ignition and combustion.
- Deterioration of the scrubber element's condition thus reducing its effectiveness to capture oil, water and other contaminants e.g. in one case the steel gauze and steel wool was found to have melted indicated several combustion events prior to the explosion.
- Worn and defective mechanical components generating excessive heat thus increasing the air/fuel mixture temperature.
- Partially blocked/clogged inter/after-coolers bringing the temperature of the air/oil mixture within the booster system closer to the critical range for ignition and combustion to occur.
- Build up of carbon from previously burnt oil, which provides an excellent ignition source within a high temperature environment.
- Spikes in booster system pressure e.g. from sudden discharge valve closure.
- Sparks from various sources e.g. static electricity and or mechanical parts.

Symptoms

- Excessive oil loss caused by mechanical wear/failures allowing oil to ingress into the booster compressor system e.g. compression chambers.
- Oil leaking from parts of the booster eg breather hose, seals, gaskets etc.
- Excessive oil present when draining scrubber tank.
- Excessive operating temperatures of booster engine and compressor.
- Excessive oil loss from compressor feeding booster compressor.

Duties of Employers and precautions to be taken

Given the pressures and volumes of compressed air involved with RC drilling operations where booster compressors have become an integral part of the RC drilling industry it is imperative that the highest standards of design, maintenance and operation of all compressors is established and maintained.

Before continuing any use of high-pressure compressed air at RC drilling operations all employers should immediately undertake the following actions:

- Establish monitoring procedures to ensure that none of the above-mentioned conditions are present at operations under their control and establish measures to eliminate such conditions.
- Ensure compliance with the following Regulations (Reg.) of the Mines Safety & Inspection Regulations 1995 (MSIR) by completing a formal hazard/risk assessment and reducing identified risk to an acceptable level determined in consultation with employees:

- **Reg. 4.13 – Induction and training of employees**
- **Reg. 6.2 – Employer to ensure plant is maintained and operated in a safe manner**
- **Reg. 6.17 – Employer to identify hazards associated with plant and to assess risks**
- **Reg. 6.18 – Employer to reduce identified risks**

Duties of Designers, Manufacturers, Importers, Suppliers and Hirers etc.

Designers, manufacturers, importers, suppliers and hirers etc have duties under the MSIA. They must ensure that any hazards/risks associated with the plant are identified, assessed and reduced so far as is practicable and should ensure they are in compliance with the respective Regulations contained in Part 6 of the MSIR.

Opportunities for Improvements

The following should be investigated, considered and where appropriate actioned by employers, designers, manufacturers, importers, suppliers, hirers etc:

- Improving end user's awareness and management of hazards/risks associated with use of high-pressure compressed air plant.
- Providing adequate instruction, training, assessment of competency and supervision to equipment operators and maintainers.
- Ensuring operation, maintenance and safety information is readily available.
- Development of systems and methods for reducing the reliance on increasing compressed air pressures to achieve desired drilling outcomes.
- Reducing booster intake and discharge air temperatures.
- Provision of sensors that automatically shut down the booster when recommended temperatures are exceeded e.g. cylinder head and discharge air temperature sensor/s.
- Utilisation of oils with higher flash point ratings.
- Provision of additional pressure safety devices eg burst discs in addition to pressure relief valves (PRV) to safely vent in event of internal combustion occurrences. PRVs are not designed for such sudden occurrences.

Reference information for the management of hazards in drilling operations is provided in Safety Bulletins (SB) No: 21, 31; Significant Incident Reports (SIR) No: 003, 020,036, 047, 051, 061, 077, 079, 087, 092, 095, 109, 113, 119; MOSHAB Reports: Drilling Hazards Sub-committee Report and Drilling Hazards Report. These are available from the Department's website: www.doir.wa.gov.au

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