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Mechanical Engineering Update

In-service failures of explosion-protected diesel engine systems during 2014

Background

NSW Mine Safety has again engaged a safety engineering consultant to review in-service failures of explosion-protected diesel engine systems (ExDES) reported under clause 56(1)(m) of the *Coal Mine Health and Safety Regulation 2006* during 2014.

A copy of the [report](http://www.resourcesandenergy.nsw.gov.au/miners-and-explorers/safety-and-health/publications/statistical-publications) is available at: www.resourcesandenergy.nsw.gov.au/miners-and-explorers/safety-and-health/publications/statistical-publications

Outcomes

There continues to be a reduction in the failure rate per 100 registered ExDES equipment for the calendar year 2014. The number of reported failures during 2014 was 130. This is 35 fewer reported failures than in 2013.

Key aspects of the report include:

- Overall, failures reported were down by 20%.
- Even though the number of mine-owned machines compared to hire company-owned machines is approximately 50:50, mine-owned machines accounted for about 75% of all failures reported.
- Pneumatic/hydraulic control system failures accounted for 40% of all failures - 52 in all.
- Nearly half of these failures were attributed to valve or sensor faults with circuit contamination also a significant factor.
- There were four reported electrical control system failures.
- Fixed connections accounted for 29% of failures. These mostly related to fasteners, gaskets and surface flatness of the joint surfaces.
- Exhaust flame trap issues accounted for 16% of all failures. Of that, carbon build up was the most significant factor but generally maintenance-related issues featured strongly.
- Design improvement recommendations approximately doubled that of maintenance improvement recommendations.
- Reclassification of some of the failure modes has led to a better understanding of the failure in terms of it being a 'random hardware' failure or a 'systematic' failure. The majority are considered to be systematic failures.

Recommendations

1. Pneumatic and hydraulic valves and float sensors and exhaust conditioners need to be regularly cleaned and maintained to ensure the reliable operation of this shutdown function.
2. Fasteners securing fixed connections should be engineered to good engineering practice and maintained in accordance with manufacturer's recommendations.
3. Pneumatic and hydraulic control systems need to be maintained to avoid contamination or blockages to ensure the reliable operation of safety critical and often single line elements such as shut down cylinders and solenoids.
4. Maintenance personnel need to be properly trained, supervised and provided with adequate instructions to avoid systematic failures arising from wrong settings, incorrect assembly, poor cleaning etc.
5. Maintenance personnel need to understand the importance of safety critical testing (i.e. proof and function testing) and prioritise their maintenance activities where required.
6. People in control of ExDES equipment should liaise with recognised service facilities (RSFs) to better understand the life cycle of safety critical components for their specific application and environment.
7. Designers, manufacturers of ExDES equipment should use non-conformance reports or similar feedback systems from RSFs and people in control of DES equipment to assess the need for design improvements. Changes to any ExDES equipment needs to be processed through the alterations to design registration process.
8. The recommendations of the reference list below are still valid. Designers, repairers and people in control of ExDES equipment should take the time to review them.
9. Mines are reminded of the importance to continue reporting all in-service failures.

Strategies

While a reduction of in-service failures is encouraging, the high potential risk of ExDES equipment operating in a non-explosion-protected condition cannot be understated. The need for continuous improvement in this area remains.

To assist industry on the path of continuous improvement:

- Follow up with organisations as to their obligations under clause 38 of the *Work Health and Safety Regulation 2011*, to review and as necessary revise control measures implemented to maintain a work environment without risks to health and safety, with a particular focus on engineering controls to reduce reoccurrence of systematic failures.
- Implement revised design and performance gazette criteria which focuses on ignition hazard assessments and functional safety principles for ExDES equipment being design registered post 1 July 2015.
- Industry training to raise awareness of functional safety has been provided to manufacturers and will soon be offered to mines.
- Auditing of recognised service facilities will continue
- Further releases of data from in-service failures to individual manufacturers will take place.

References

- SB08-05 In-service failures of explosion-protected diesel engine systems
- LU10-01 Guidelines for the renewal of item registration for diesel engine systems used in underground mines at a coal workplace
- SB10-06 Failure of explosion-protected diesel engine systems
- SB12-01 In-service failures of explosion-protected diesel engine systems during 2010 and 2011
- MU13-03 In-service failures of explosion-protected diesel engine systems during 2012

Signed



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NOTE: Please ensure all relevant mechanical people in your organisation receive a copy of this update and are informed of its content. This update should be processed in a systematic manner through the mine's (or other PCBU's) information and communication process.

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