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Analysis of hazard scenarios for a research environment in an oil and gas exploration and production company

Marco de Bruin [a,*], Paul Swuste [b]

[a] *Shell International Exploration and Production, HSE&SD Site Services Team, Rijswijk, Netherlands*
[b] *Sectie Veiligheidskunde, Technische Universiteit Delft, Netherlands*

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Samenvatting

Het onderhavige artikel onderzoekt HSE-gevaarsscenario's in de onderzoeksfaciliteiten van een internationaal bedrijf dat gespecialiseerd is in de exploratie en productie van olie en gas. Doel is:

I. het analyseren van de grootste HSE-gevaarsscenario's voor de experimentele opstellingen in de nieuwe onderzoeksfaciliteiten;
II. in staat te zijn deze gevaren terug te dringen tot een te bepalen minimum door optimaal ontwerp.
III. in staat te zijn het aantal en ernst van toekomstige (mondiale) onderzoeksgerelateerde incidenten/bijna-ongevallen terug te dringen.

Om de tien grootste HSE-gevaarsscenario's te kunnen vaststellen die ontwikkeld zijn in een eerdere studie, wordt gebruikgemaakt van de Tripod ß-methode. Met deze methode worden ook barrières en "General Failure Types" bepaald voor de tien grootste gevaarsscenario's.

De meest frequente barrière is het checken van ontwerp, systemen en installaties. De tweede frequente barrière is (centraal georganiseerd) onderhoud. Andere frequente barrières zijn het gebruik van juist materiaal/apparatuuronderdelen, periodieke inspectie en veiligheidsapparatuur. Meest frequente "General Failure Type" is ontwerp, op afstand gevolgd door onderhoudsbeheer, organisatie, procedures en de overige types. Om bovengenoemde reductie van incidenten te bereiken, wordt verbetering van deze barrières en "General Failure Types" voorgesteld. Alhoewel dit artikel zich concentreert op het Nederlandse deel van het bedrijf, zijn de resultaten ook bruikbaar voor de gelijkwaardige faciliteiten in de USA.

Het gepresenteerde onderzoek is een afstudeerproject geweest van de post-academische opleiding 'Management of Safety, Health and Environment' (MoSHE) van de Technische Universiteit Delft.

* Corresponding author. Tel.: +31 70 447 3702.
E-mail address: Marco.DeBruin@shell.com (M. de Bruin).

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Abstract

The present study analyzes HSE hazard scenarios at the research areas of an international company that specializes in the exploration and production of oil and gas. Objective is:

I. to analyze the major HSE hazard scenarios for the experimental facilities in the new research location;
II. to be able to reduce those hazards to a pre-defined minimum through optimal design;
III. to be able to reduce the amount and severity of future research-related incidents/near-misses.

To analyze the ten major hazard scenarios, which were developed in a previous study, use is made of the Tripod ß technique. With this technique, also barriers and general failure types are determined for the major hazard scenarios.

The most frequent barrier is the checking of design, systems and installations. Second frequent barrier is (centrally guided) maintenance. Further frequent barriers are the use of adequate material/equipment parts, periodic inspection and safety device. Most frequent general failure type is design, followed at a distance by maintenance management, organization, procedures and other types. To reach the above mentioned reduction of incidents, it is proposed to improve these barriers and general failure types. Although focusing on the Dutch part of the company, results are also usable for the equivalent facilities in the USA.

The research presented in this article is based on a final report of the post graduate master course 'Management of Safety, Health and Environment' of the Delft University of Technology.

Keywords: Hazard; Scenario; Tripod; Research; Barrier

1. Introduction

This article analyzes health, safety and environmental (HSE) hazard scenarios at the research facilities of an international company that specializes in the exploration and production (E&P) of oil and gas. The location studied in this article houses a centre of technology, in which some 60 research locations are accommodated. In these locations, a wide range of equipment and chemicals are in use, all facilitating dedicated research and services in the field of E&P for the oil and gas industry. The focus is on general physical, chemical and mechanical research on rock, multiphase (oil/water/air) systems, drilling flush and drilling technology; mainly by destructive and non-destructive experiments on rock, oil and (natural) gas samples. Emphasis herewith is on mechanical properties of tubes, drilling bars, drill heads, etc. and on analysis of properties of oils and gases. Experiments are mainly physical; chemical reactions are not common and chemicals in use are mainly used as solvent or extraction agent. Experimental research is carried out by 50 staff members; experiments take place under pressures up to 1000 bar and temperatures up to ca. 150 °C. To deliver the necessary gases, a gas distribution system fed from a central facility is in use.

Currently, the company is in the middle of a total renovation project of the site. The renovated site will amongst others contain a new indoor and outdoor research area in which all current large and small scale equipment will be based. To pave the way for the construction of the new facilities, large scale research equipment was moved to a temporary outside location in 2002. In 2007 all large and small scale equipment will be transferred to new facilities.

The company owns a similar E&P centre in Houston, Texas (USA) in which 55 laboratories are housed, employing 40 research staff members. In the late 1990s globalization efforts started and 'global' practices were adopted by the two centres. This resulted in amongst others the same system of incident reporting beginning in 2000. The USA facilities will be integrated in the present study; in this way, the USA incident data can also be used which will make final results more accurate and globally applicable.

To assess the hazards for the situation in the current and hence also new (from 2007 on) research facilities, major hazard scenarios were developed (de Bruin and Swuste, 2006). For development of these scenarios the following input was used: Layout Reviews, reported incidents from 1993–2004 and hazard scenarios from the