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Methodology for determining the risk acceptance criteria for the Seveso establishments

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ABSTRACT

Accidents involving dangerous substances still happen and establishing an effective proactive methodology to provide safe daily operation remains a challenge. Findings about the limitations of the existing approaches with scenario presentation for the purpose of demonstrating that appropriate precautionary actions are taken to ensure a high level of protection, are the basis for the development of the new methodology, presented in this paper. The emphasis of the methodology is on effective daily operation, based on the identification of latent weaknesses; it takes into account that with dynamic processes safety changes from one moment to another. With the new approach, operators are encouraged to think continuously about the issues that have an impact on safety.

Another challenge is the fact that understanding what effective daily operation means may differ from country to country and from legislation level to the operator. The guidance in this paper illustrates what effective daily operation means. The assessment of effective daily operation is also used as the risk acceptance criteria for Seveso establishments, and the presented approach is one of methodological guidance on how to implement the Article 19 of the Directive, 2012/18/EU of the European Parliament and of the Council (the Seveso III Directive).

1. Introduction

The Seveso Directive for upper tier establishments requires the issuing of a safety report for the purposes of demonstrating that major-accident hazards and possible major-accident scenarios have been identified and that the necessary measures have been taken to prevent accidents and to limit their consequences for human health and the environment. Article 19 of the Seveso Directive requires the prohibition of the use of any establishment in which the measures taken by the operator for the prevention and mitigation of major accidents are seriously deficient (Directive, 2012). New approaches with the aim of improving risk assessment have been developed: for instance, the ARAMIS methodology (Aramis, 2004) was developed and, after the disaster in Toulouse, France adopted new legislation including a risk matrix for assessing the acceptability of the risk (Taveau, 2010; Lenoble and Durand, 2011). Organizational factors, usually included in the accidents analysis, as summarized in the SINTEF report, are recently integrated in the risk assessment for predictive purposes (Øien et al., 2010). For the purpose of evaluating the organizational factors that may have an impact on safety at nuclear power plants, the WPAM method has been developed with the aim of connecting organizational factors and the probabilistic approach (Davoudian et al., 1994a,b). Many approaches emphasize certain elements that also appear in safety management systems

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(SMS); therefore, duplication is possible, but the important factors can remain uncontrolled. According to the OECD report, communication is an organizational factor (OECD, 1999) and is also addressed in the management system approach; procedures and training are considered in the management system framework, as well as in the human reliability analysis on nuclear power plant applications as performance-shaping factors (PSF) (Swain and Guttmann, 1983). Monitoring the percentage of maintenance actions that are completed in the specified timescale proposed by HSE (2006) is similar to monitoring the effectiveness of maintenance as a process in the context of the SMS framework in which the process of maintenance specifies responsibility for the maintenance plan and its implementation, which means that some indicators have already been in place. Pasman et al. (2009) pointed out the strengths and weaknesses of the SAFETI model prescribed by legislating in the Netherlands; subjective influence on the results is minimized, but it does not include other elements influencing on the safety at the plant. For the purpose of monitoring the performance, indicators are often recommended. Øien et al. (2011) summarize a thorough review of the development of indicators; the guidelines for the performance indicators are also provided (OGP, 2008; CCPS, 2011; Competent Authority, ND). DyPASI is a further development; it is a method for atypical accidents scenarios identification (Paltrinieri et al., 2013). Another new method is the blended hazard identification methodology (BLHAZID), which is applied to generate outcomes with high coverage of hazards and failure causality in process systems (Seligmann et al., 2012). Schönbeck et al. (2010) introduced new approach including the impact of human and organizational factors on the achieved safety integrity levels (SIL) of safety instrumented systems. Furthermore, the Risk in Early Design (RED) risk assessment tool intended for identification potential failures in the oil and gas industry has been verified (AlKazimi and Grantham, 2015) and process accident model with predictive capabilities has been established by Rathnayaka et al. (2011). Upgrading the existing approaches to build an effective SMS is also a result of findings that SMS is often perceived bureaucratic and ineffective (Bragatto et al., 2015).

The scenario probability (scenario probability – the term is used as specified in the Seveso Directive) is compared with the reference value as the criteria for determining the need for additional barriers. In relation to the probability of an accident, it is necessary to highlight:

1. An interesting question that arises for all operators who work with characteristics like BP Texas City refinery: would the operator itself determine the scenario probability, before the accident as unacceptable? Furthermore, next question arises: what does the acceptable probability mean if awareness of the safety importance is at such a low level. In the case of inappropriate results of the scenario probability, the operator can (with measures added during the night) present an "appropriate level of safety", but if the processes in the plant are negligently controlled, and weaknesses remain unrecognized, additional barriers do not guarantee that accidents will not occur. The described approach is not acceptable; the mindset of the workers in such an establishment requires a thorough and complete change, which cannot be implemented overnight.
2. The results of the analysis based on subjective views may be different; in the case of the evaluations of several experts, the selection of events varies and, consequently, so do the results that are intended to make the decisions of the risk acceptance.
3. It is not sensible to speculate after the accident, but establishing an effective proactive methodology is based on thinking about weaknesses before the accident. It is necessary to be aware that what is avoided is not visible and, therefore, it is not analyzed and discussed; furthermore, the view before the accident, is not as critical as the view when a disaster has already happened. After the accident, certain decisions are termed as catastrophic. The Diet report (National Diet of Japan, 2012) summarizes that Tokyo Electric Power Company (TEPCO) overlooked warnings of the high possibility of tsunami levels as well as the possibility of core damage and did not take countermeasures. Nuclear and Industrial Safety Agency (NISA), the regulatory body, was aware of TEPCO's decision but did not require taking measures. Tsunamis are not rare occurrences; the diesel generators should have been lifted to a higher level. We can conclude that the problem is the attitudes and approaches towards tsunami. It is necessary to consider how to avoid the approach that forces the operator to achieve the criteria value, while the situation related to safety is not considered in an appropriate manner.
4. According to the Reason's states (Reason, 1990) that the precise nature, time, place and perpetrator of any single act, in the context of the human contributions to the breakdown of complex systems are almost impossible to predict, the operators in the scenario development cannot predict all the events and interactions that lead to an accident, consequently, the list of errors can never be completed.
5. The weakness of the existing approach, also dangerous, is that the steady state is considered, even the scenarios involving as many events as possible. The fact is that conditions at the plant change daily due to various factors, for example, replacement of workers causes change in level of skills and knowledge, consequently the circumstances that affect an accident, are changing.

Different approaches of the Member States for the purpose of land-use planning (LUP) have been discussed by Cozzani et al. (2006) and Basta et al. (2007). Pasman and Reniers (2014) outlined the contrast between the QRA-focused approach, typical for the Dutch LUP regulations, and the loss prevention-focused approach. Regardless of the findings that for the purpose of LUP, the focus is on the consequences outside the plant, while the focus in the loss prevention approach is on the details regarding equipment fails, i.e. on the errors and circumstances that cause major accidents (Pasman and Reniers, 2014), it is necessary to pay attention that daily deviations do not remain unnoticed. How to ensure effective daily operations is a vital question. After an accident, all causes are known, and it is also known what should have been done to prevent, but establishing an effective proactive methodology to provide safe daily operation remains a challenge. In the light of information about nonconformities and malfunctions before the accident in the Texas City accident report (Baker, 2007), it is not appropriate that the responsibility for the safe operation demonstration is only on the operator.

The new approach is based on the Embrey's definition of latent errors (Embrey, 1992), and follows the logic of the black swan occurrence: what we do not know is much more