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Enhanced risk assessment and management

A work group established by Norwegian Oil and Gas has reviewed current practice for risk analyses in order to identify improvement areas. The purpose has been to produce proposals which can enhance risk management through more effective risk analyses, and to ensure that today's level of safety is maintained and developed further.

This memo summarises the work group's assessments and recommendations, including proposed plans for further work. The review is entrenched in strategy work at Norwegian Oil and Gas in areas 4.1 – major accident risk and 4.3 – safety and regulations. It has been based on the Petroleum Safety Authority Norway's definition of risk, with the shift in focus from calculating the "actual level of risk" and checking that against risk acceptance criteria, to risk-informed decisions. The framework for the work is decisions/aspects included in the scope of quantitative risk analyses (QRAs).

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This memo is in three parts. The first summarises identified improvement areas, part two presents proposed recommendations, and part three summarises proposals for further work.

1 Identified improvement areas

Risk analyses have had and retain an important role in safety work in the petroleum sector. Their systematic approach, with the focus on what can go wrong, causes, consequences and the risk picture, has contributed to enhancing system understanding and to improve the basis for many types of decisions in various phases of a project. The analyses have helped to provide detailed and extensive knowledge of risk conditions related to this industry, and have played a key role in developing the design principles and solutions which have been established. However, a potential for improvement exists in a number of areas.

Increased knowledge about potential incidents – such as fires and explosions – combined with ever-better tools for running a large number of complicated simulations have permitted the development of instruments which can currently model and take account of factors and conditions at a very detailed level. Given the desire to understand what could happen and what can be done to prevent/deal with incidents in the best possible way, this development has clearly been important. But it also presents challenges. The models and tools used today call for information and input at a very detailed level, and a mismatch arises in many cases between a) the need for input and the time it takes to set up and use the tools, and b) the information and time available at the point when key decisions are taken. In many cases, the decision support comes too late.

Another challenge is that experience and insight acquired over the years from doing analyses, has had little influence on the way these are conducted. To a great extent, "everything" is looked at anew each time – knowledge acquired both with regard to the incidents which could occur and the best design for the facility is not adequately utilised.

Taken together, these two considerations mean that extensive quantitative risk analyses are conducted but that their value is relatively limited in many cases. *The decisions which the risk analyses are intended to provide a basis for are often taken before the analyses are completed.* These then function primarily as a verification tool rather than as decision support. The position is one where the actual management processes and the use of risk analysis are more or less two separate activities, with the second of these failing to mesh sufficiently with the first.

The work group believes that a substantial potential for improvement exists in order to provide *better decision support at the right time, greater cost efficiency and enhanced safety*. Better use must be made of the experience and knowledge developed over the past 20-30 years in relation to safety and risk analyses. The driving force must be to continue developing, improving and simplifying current practice by adopting the knowledge available at any given time, so that better decision support can be provided at the right point.

The work group believes that the present proposals also meet the intention of the new risk definition, ref. the Guidelines of the Framework Regulations §11.

2 Recommendations

The work group has arrived at the following recommendations related to today's risk analysis practice.

1. Identification of hazard and major accident events is given substantially greater emphasis in risk management, and is conducted to an adequate level of detail for use in assessing the need for and role of various barriers and their performance requirements. Such identification must be tailored to different phases of a project and for operations.
2. Traditional quantitative risk analyses, which give substantial emphasis to detailed calculation of probabilities, expected values (frequencies) and checking against pre-defined risk acceptance criteria (such as FAR and 1.0×10^{-4}), are replaced by assessments and

processes tailored to the relevant circumstances, and particularly to the prevailing level of knowledge. These evaluations and processes emphasise barrier management, consequence analysis and overall risk assessments, and represent a significant simplification compared with current risk analysis practice, particularly when facing circumstances characterised by known technology, substantial experience and low uncertainty – described here as "standard solutions".

3. The following is given emphasis in the presentation of risk associated with a facility, a system or different decision options:
    - what could happen
    - which incidents can and cannot be handled with the solutions chosen (or with the various options)
    - how are incidents handled
    - what assumptions are made
    - what knowledge forms the basis for the assessments made
    - uncertainty
    - etc.
4. Verification that the facility has a prudent level of safety is done using simpler risk analysis methods compared with current practice. An overall review/description of the risk is established in every phase, but given particular weight at the detail design (as-built) stage. The as-built analysis is partly intended to document a risk picture for the facility, so that the operations organisation can be familiarised with the functions of the barriers and their ability of these to handle relevant incidents.
5. In the operations phase, the requirement to obtain an updated risk picture is met by assessing the validity of the existing risk analysis and by making overall barrier and risk assessments which draw in information and knowledge of relevance for the decisions to be taken. Provision must also be made for risk analyses which can provide suitable decision support with operations-related issues such as simultaneous activities, the amount of hot work, temporary disconnection of safety systems and combinations of these activities/factors.

In development projects, worst credible events (WCEs) are established as a design basis. This can be done without calculating the probability of a WCE occurring. The aim is to identify which accidental loads should form the basis for dealing with the incident if it occurs. The choice if WCEs will ensure that the current level of safety is maintained and further developed. This is achieved in part by implementing an overall qualitative assessment to evaluate and reduce risk associated with potential incidents which exceed the WCEs.

For standard solutions, WCEs could be relatively simple to establish if other solutions are available for use as references. The overall qualitative risk assessment will focus attention on surprises concerning whether the facility/area/system is actually "standard".

Figure 1 outlines the principal structure for the choice of solution (screening of concept/system/area) in line with the recommendations above. Three situation categories are distinguished in order to reflect the degree of known technology, extent of experience and

differing levels of uncertainty (standard, standard+ and novel). The terminology used in the figure and the underlying principles accord with ISO 17776.

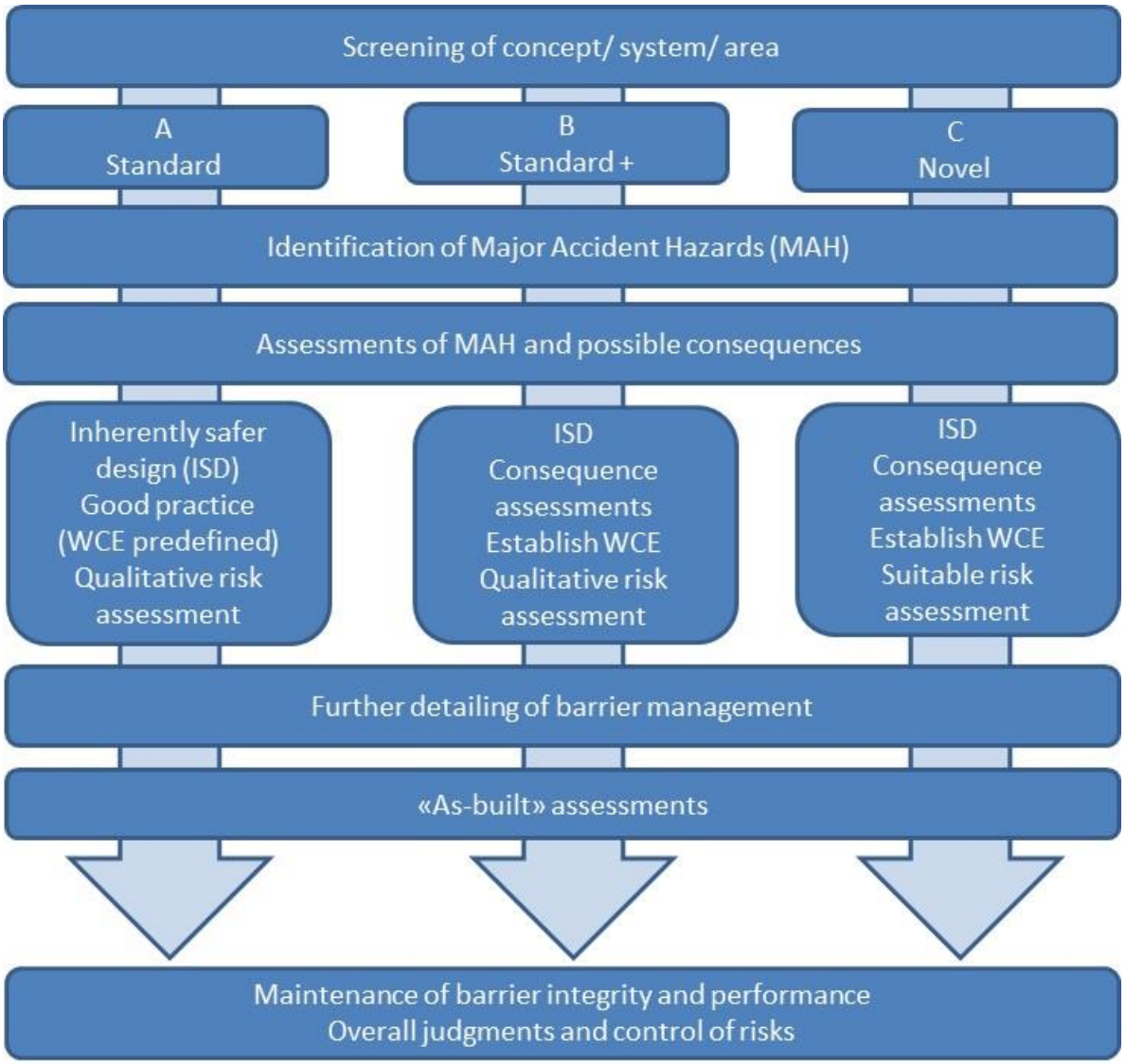

Figure 1: Overall structure for the choice of solution (screening of concept/system/area) in accordance with the recommendations in this memo.

3 Proposals for further work

Overall findings and recommendations made by the work group are presented in this memo. However, further work is required to firm up the recommendations. Specifically, the following is required.

- Describe an overall model for risk analysis, which includes showing how WCEs are to be used. Figure 1 is to be regarded as a first outline of this model. Further testing and development of the model is needed to ensure that it functions as intended. A particular

need exists to assess how the model can be entrenched in international standards, such as ISO 17776.

- Identify decisions that require information that can only be provided by performing risk analyses (or significantly improved be performing such analyses), and which decisions that can be taken without doing such analyses. This should take into account the available information at the time when the various decisions are typically made.
    - For some decisions, the outcome could be that current risk analysis practice is replaced by specific technical requirements for systems and components.
- Describe a methodology for establishing design accidental loads with a WCE approach for the standard, standard+ and novel situation categories and for different levels – concept, system and area (see figure 1). A particular need exists to develop WCEs for explosions.

It will also be necessary to discuss and clarify requirements for amendments to regulations, particularly with regard to risk acceptance criteria and main safety functions.

Activities for the short term

1. Detail and describe the overall model
2. Identify some typical decision situations for the three courses named in figure 1
3. Develop the WCE methodology for process fires and explosions
4. Contribute to regulatory amendments (including the natural environment)

Long-term goals

- Recommendations in chapter 2 implemented
- Methodological description established for all WCEs (implemented as an updating of NORSOK Z-013, for example), including description of “standard” solutions with associated design accidental loads
- Regulations amended