

# **"Will Stricter Regulations Improve Disaster Management?"**

## **A Discussion of The Norwegian Petroleum Directorate's Experience with the use of Functional Legal Requirements**

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### **Key words**

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Risk Reduction  
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Barriers

### **Abstract**

During the relatively short history of the offshore petroleum industry in Norway, the Norwegian Authorities have significantly changed their approach in regulating safety and emergency response. When it all started, back in the mid-sixties and the early seventies, the obvious choice for the newly born Norwegian Petroleum Authority was to prepare a number of detailed prescriptive regulations, similar to the approach that had been common in shipping for centuries. "Lifeboats to be equipped with four sets of wooden 16' rowing-oars....etc". The regulations had a heavy focus on detailed emergency response-systems and -equipment. Back then, that choice was probably correct, supposing the companies dedicated themselves to "management by compliance". Over the years, these early prescriptive requirements have gradually been replaced by functionally oriented requirements allowing for extensive use of analysis and risk-based approaches, and for increased flexibility with regard to solutions. The intention was to stimulate and draw advantages from improvement processes in a modern industry dedicated to "management by objectives" to achieve the right focus on accident prevention rather than protection.

The general experience with the new approach has been very good, even though there have been indications that a few might have pulled their risk-based approach somewhat too far. By putting too much of their effort into accident prevention only, they might have been blindfolded, and misled to neglect the adversity of the accidents if they should happen. History is after all still the best evidence that hazards cannot be completely prevented. This is why the drafted new regulations of the Norwegian Petroleum Directorate is now based on the principle of "defence in depth", which can shortly be explained as a combined risk- and vulnerability-based approach. The general and overruling functional requirement will be to reduce risk until the costs become unreasonably disproportional to the risk reducing effect. The risk-reduction shall preferably be obtained by applying inherently safe designs, complemented by barriers to effectively prevent escalation of failures, hazards and accidents and to limit possible harm.

This paper will discuss the background for this change of approach in some more detail, and will give a comprehensive presentation of the newly adopted principle of “defence in depth” as a drive towards improved risk-management in the Norwegian offshore petroleum industry.

## 1. Introduction

The question raised in the title of this paper cannot easily be answered. It all depends on the circumstances. If the responsible entities are not properly complying with your regulations, and you interpret “stricter” as being equivalent to “more detailed” prescriptions, I am personally convinced that the answer to the question will almost always be a definite no. If “stricter”, on the other hand means “more challenging”, and the responsible entity is taking that responsibility seriously, you will probably see improvements.

The Norwegian offshore petroleum regulations have gradually changed from being highly prescriptive, requiring a compliance-culture, to presently being highly functional, and requiring a responsibility-culture, or in other words, a safety culture.

By the end of this year, this development will receive a further “push”, as a completely new set of common health-, safety-, and environment regulations will be issued. The new regulations comprise the latest development in risk-based techniques, and introduce the principle of “defence in depth” as the backbone of hazard- and accident management.

### 1.1 The early prescriptions

Back at the early beginning of the petroleum activities on the Norwegian continental shelf, from the late sixties and into the seventies and early eighties, the majority of the regulations were prepared as fairly detailed prescriptions. I have randomly picked a few examples from the bookshelf of a college of mine, where he still keeps his old 1982-edition of the NPD-regulations.

The first sample is taken from the regulations relating to productions- and auxiliary systems on production installations, issued on April 3<sup>rd</sup> 1978, section 12.7:

*“The production installation shall be equipped with sufficient fireman equipment. The fireman equipment shall be stored in sets and each set shall as a minimum comprise the following:*

- *Breathing apparatus. The capacity shall be suitable for at least 2 hours use including any spare air containers and/or spare breathing apparatus permanently located within reasonable distance.*
- *A fireproof bodyline of sufficient length (appr. 30 m) and strength, fastened by a snap-hook to a belt.*
- *A self-contained safety lamp (hand lamp), which will operate for at least 3 hours. The lamp shall be certified for operation in Zone I.*
- *One set of protective clothing.*

- *One set of boots and gloves made of rubber or other material, which is electrically non- conductive.*
- *A rigid helmet giving effective protection against impact.”*

Another sample is taken from the regulations related to fixed means of access, stairs, ladders and railings on the production installations, etc, issued on April 2nd 1979, section 2,3,6:

- *“Latches on hatch covers and steel doors shall be marked with symbols/words which indicate direction of opening and/or closing.”*

Finally, a sample from the regulations related to life-saving appliances on fixed installations for production, etc, issued on Feb. 2nd 1978, section 5.3:

- *“Musters to the emergency stations shall take place at least once every 7 days. The drills shall be performed without any prior notice. As for those persons who are exempt from the mustering obligation, the Platform Manager shall ensure that they are informed of the mustering.*
- *When the signal for mustering is given, all persons on the installation shall, wearing life jackets, proceed to their respective emergency stations. The Platform Manager may grant exemption from the mustering obligation for personnel carrying out work in connection with drilling operations, etc if these operations are in such a critical phase that an interruption of the work might endanger the personnel or the installation. In that case, the next mustering must be so arranged and timed that this personnel may participate.”*

As you can all see, these sample-sections leave no doubt that NPD had their own conviction of what the best solutions were, no matter what the individual requirements of the actual installation would be. This might possibly have been the correct approach to set a high safety-standard from the early beginning. Over the years, however, it became more and more apparent that another approach was necessary if any further safety improvements were to be made. Rather than issuing more prescriptions, NPD decided the new overruling principle that the operating companies shall take the responsibility to design the most appropriate solutions to ensure the safety of each single activity. The basis for this selection of solutions should be based on risk-, and emergency preparedness analysis.

## **2. Functional requirements to risk- and emergency management**

During the years from 1990-93, all the previous NPD-regulations were replaced by a set of 14 new regulations. Two of these regulations were of special importance to the further development of hazard and accident management, namely the Risk analysis regulation issued on Dec. 4<sup>th</sup> 1990, and the Emergency Preparedness regulation issued on March 18<sup>th</sup> 1992.

According to the risk analysis regulation:

- *“Risk analysis shall be carried out in order to identify the accidental events that may occur in the activities and the consequences of such accidental events for people, for the environment and for assets and financial interests.*
- *The results of risk analysis shall be included as part of the basis for the decision making process in the course of ensuring that the safety aspect of the activities are in accordance with requirements laid down by virtue of law or regulation, with the operator’s safety objectives and acceptance criteria.*
- *The operator shall plan the implementation of risk analysis to follow the progress of the activities so that they are used actively in the planning and implementation of the activities.*
- *The effect of the risk reducing measures to be implemented shall be documented, assessed both individually and in a wider perspective.”*
- *Probability reducing measures shall, to the extent possible, be given priority over consequence reducing measures.”*

The emergency preparedness regulation requires a somewhat similar approach to the process of identifying and establishing the appropriate emergency preparedness measures. Firstly a selection of Defined Situations of Hazard and Accidents (DSHA) shall be selected. Most of them can be found in the risk analysis. To each of these DSHA’s, the operator shall define a set of specific emergency preparedness requirements. An emergency preparedness analysis shall then be carried out to design the emergency preparedness so as to meet the specific emergency preparedness requirements for the activity in question.

Ideally, these two regulations would have been sufficient. However, we still felt there was a need to give further guidance. The other 12 regulations are therefore stating requirements on a more specific level. Let us see what have happened to my samples from the first section. You will see that the level of detail is dramatically reduced, and the requirement have changed, now aiming at the function, rather than at the solution.

My first sample now reads:

- *“Sufficient fireman equipment to enable safe and effective fire fighting to be carried out shall be kept on the installation. The fireman equipment shall be stored in a cautious and suitable manner so that it remains ready for immediate use.”*

My second sample (remember the details on the latches) are now covered by these general requirements:

- *“Areas where people work and stay, access and transport routes and lifts shall be designed so that the actual stay on the installation, work operations, conveyance of people, equipment and goods can be carried out in a rational and fully satisfactory manner.”*

My third sample (the emergency muster) is now covered in these general requirements:

- *“Control shall be carried out to see that all requirements relating to emergency preparedness have been complied with. Control with the*

*emergency preparedness of the activity concerned shall be carried out systematically and shall be integrated in the total activity programme. Any deviation shall be identified and rectified immediately. The causes for such deviations shall be identified.”*

As you can see, nothing is mentioned about physical solutions. The general idea is that the companies are the ones best qualified to find the correct solution to control the individual situation of hazard and accident. All companies operating in Norway have set their individual, and in most cases very challenging safety objectives. The risk-based methods as outlined in the present NPD-regulations can easily be adapted to, and can be integrated as part of any of the companies' improvement-processes.

## **2.2 One or two negative side effects**

For this approach to be working, it is a basic pre-condition that the responsible entities are dedicated and sincere. They need to really wish to achieve their safety objectives. If a company don't seriously wish to improve safety, they can hardly be expected to be successful.

Unfortunately, there have even been certain examples of companies that have misused their increased freedom rather to cut what they claim are unnecessary and costly emergency response resources. Their general arguments have been somewhat like: *“We have acted according to the risk analysis regulation. We have concentrated our efforts at preventive measures. How can you expect us to still keep these expensive emergency response resources?”* Such arguments are obviously based on miss interpretations, but they are nevertheless a good argument for us to clarify even further how the general risk, - and emergency management principles are intended to be understood.

## **3. The 2001 health-, safety-, and environment regulations**

Four years back in time, the decision was taken to restructure and rewrite all the present NPD-regulations. At the same time, the decision was also taken to include all requirements from the pollution authorities as well as the health authorities into one common set of health-, safety-, and environment regulations for the petroleum activities.

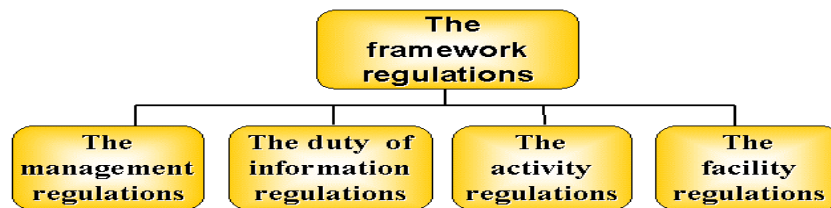
We decomposed every section in all the existing regulations, and soon learnt that many sections in the 14 different regulations often contained common organisational and management components, operational and maintenance requirements, and general safety principles such as barrier requirements, etc. We categorised four main groups, and edited these common requirements into what have become the four new regulations. This way, each individual requirement can be written only once, rather than 14 times.

- In the *“duty of information regulations”* you will find all requirements relating to information and materials to be submitted to the authorities.

- In the “*management regulations*” you will find all requirements relating to health-, safety-, and environment management systems.
- In the “*facility regulations*” you will find all requirements relating to design and outfitting of facilities.
- In the “*activity regulations*” you will find all requirements relating to conduct of activities.

This editing principle has reduced the physical volume considerably, and has also made it easier to understand the common philosophy of the petroleum regulations. To understand and use the regulations correctly, it is imperative that the general requirements and principles listed in the first sections of each of the four regulations are understood and used in combination with the more specific sections further out.

In addition to these four regulations, the “*framework regulations*” will be issued as a common Royal Decree by all involved Ministries. The framework regulations will act as the legal link between the four regulations and the different applicable laws and acts.



*Figure 1: The framework regulations and the four underlying regulations*

### 3.1 Safety Culture

The operating companies on the Norwegian Continental Shelf have been granted their licenses on a basis of mutual trust. The authorities trust their capacity to perform prudent operations. We have introduced a section relating to safety culture in the new regulations for several reasons. One good reason is to emphasize management commitment to safety.

### 3.2 Risk reduction

The term risk is based on the definition in the ISO/IEC guide 51, and applies for all types of hazard related to health, safety and environment. The principles for risk reduction and the selection of appropriate risk reducing measures as they are found in the present risk analysis regulations have been further clarified (ref also Norsok Z-013, Risk and emergency preparedness analysis).

In his book, “*Managing the Risks of Organizational Accidents*”, The author James Reason, who has been a source of great inspiration to us, has explained the model as “defence in depth”, or as “The “The Swiss Cheese Model”. The escalation of

situations of hazard and accident can only be fully controlled if each event in the chain of events can be effectively prevented. If some of the preventive barriers have common weaknesses, the chain of events can come out of control.

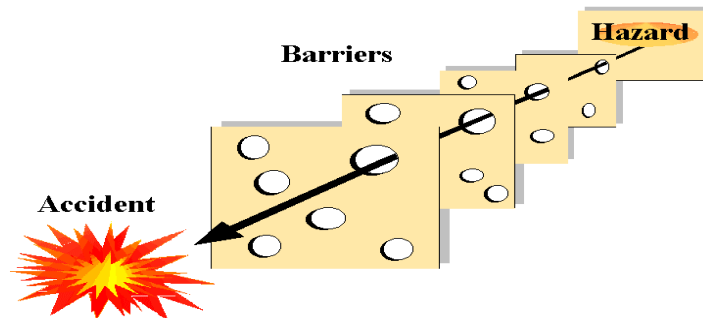


Figure 2: “The Swiss Cheese Model” according to James Reason

According to the new regulations, any risk shall be reduced so that it do not exceed the highest tolerable risk-level that is stated in

- a) statutory requirements,
- b) internal requirements that are necessary to comply with authority requirements,
- c) established acceptance criteria for risk.

In addition, the risk shall be reduced further, unless the costs are unreasonably disproportional to the risk reducing effects (ref Norsok Z-013 Annex E, Guidelines to cost benefit analysis).

The risk shall be reduced by selecting technical, operational, and organisational measures that prevent of failures, and situations of hazard and accident from occurring (inherently safe solutions).

In addition, barriers shall be established, to;

- a) prevent such failures and situations of hazard and accident from escalating,
- b) limit possible harm and inconvenience.

### 3.3 Barriers

In the present regulations, the expression “barrier” has been used only on certain technical safety systems, such as “well control barriers”. As you can see, the expression barrier” is now being used in a wide sense, to describe anything that is preventing escalation. Each barrier may have a certain complexity, and may comprise technical, operational and organisational elements.

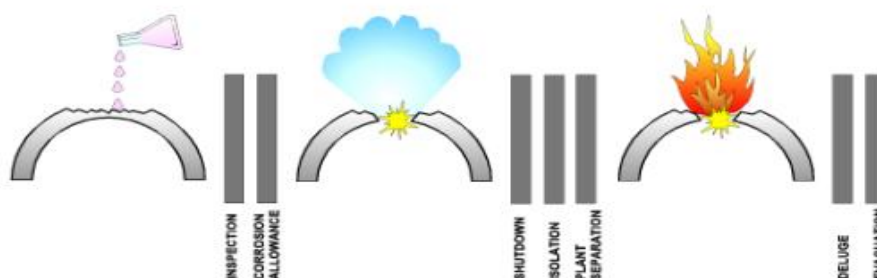


Figure 3: How different types of barriers prevent escalation.

Different types of barriers will be needed in different stages of the escalation of failures and situations of hazard and accidents. Similarly, completely different types of barriers may be needed to control hazards of different nature. However, the same logical “barrier-model” shall be used on all kinds of hazards, including occupational hazards as for instance chemical exposure to employees. These principles are the same that are generally applied by the risk-analysts to propose the appropriate risk reducing measures. Each output of every node and branch in a fault- and event tree depends on the failure or success of barriers. Our general idea is to transform the complexity of the risk analysis over to performance requirements that can be understood and controlled in an operational environment.

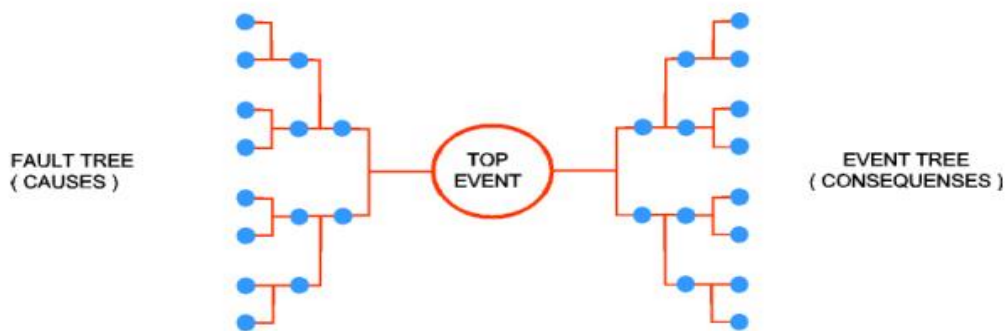


Figure 4: A fault- and event tree.

The general requirements to barriers are:

- The operator shall establish the strategies and principles to be applied for design, use and maintenance of barriers, so that their functions remain effective throughout the lifetime of the installation (ref. IEC 61508 and OLF guide 066 for safety-systems).
- Each barrier, its function, as well as the functional requirements that have been established for barrier-elements, shall be known.
- It shall also be known which barriers that are not working or are in a degraded state.
- Necessary measures shall be implemented to re-establish or compensate for any missing or degraded barriers.

In the activity regulations and in the installation regulations you will find further, and more specific requirements to barriers within a number of areas. As previously mentioned, you need to know the general requirements relating to risk reduction and barriers to fully understand these requirements on the detailed level. You need to fully understand the role of each barrier and what purpose that specific barrier has, in order to prevent the un-controlled chain of events that could eventually lead to a situation of hazard and accident.

In the present regulations we have requirements relating to process-control in one regulation, requirements relating to fire-detection in second, requirements relating to fire protection in at third, and requirements relating to rescue and evacuation in a fourth regulation, with no obvious link between them.



## 4. Conclusion

I think that we can all agree that more detailed prescriptions will hardly lead to improved hazard- and accident management. We are convinced that such improvements can only be obtained if you require the offshore-companies to take their responsibility seriously. They need to prepare their own specifications. They need to tailor-make their own solutions to effective hazard- and accident management. This can be obtained by strict, but still functional requirements. We believe that the new HSE-regulations, with their more transparent and logical structure is what the companies need in order to obtain a good understanding of the general principles of risk management, and to demonstrate that they have truly obtained a sound and prudent attitude.

## 5. References

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## 6. Author biography

Mr Svein Olav Drangeid (45) was since 1977 employed as a safety advisor with Phillips Petroleum Company Norway, an oil- and gas company operating the Ekofisk-field in the North Sea. With Phillips, he was engaged in a variety of safety, environment and working environment related issues, including safety and risk assessments, development of company controlling documents, audits and inspection, training, project planning and execution, etc. Since 1993 he has been employed as a Principle Engineer in the Norwegian Petroleum Directorate. In NPD some of his key areas of engagement are risk management and emergency preparedness, telecommunication, organisational restructuring processes, maintenance management and international institutional cooperation. Lately he has primarily been engaged in the comprehensive regulatory development project in NPD.