

Integrated and unified risk management in the petroleum industry



PETROLEUM SAFETY AUTHORITY
NORWAY

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CONTENTS

Foreword	5
Summary	6
1 INTRODUCTION	7
1.1 The purpose of the memorandum	8
1.2 Background	8
1.3 Why is risk management important?	8
1.4 Approach	9
1.5 Limitations	9
1.6 Target audience	10
1.7 Concepts	10
2 RISK-INFORMED ENTERPRISE MANAGEMENT	11
3 DECISIONS MUST TAKE ACCOUNT OF UNCERTAINTY	16
3.1 Uncertainty is a key component of the risk concept	19
3.2 Risk-reduction processes	21
4 RISK IS MANAGED BY PEOPLE	22
4.1 Introduction	23
4.2 HSE culture	24
4.3 Management and culture	25
5 RISK-INFORMED ENTERPRISE MANAGEMENT IN PRACTICE	27
6 REFERENCES TO RELEVANT LITERATURE	31



FOREWORD

Financial value creation and protection of people, the environment and material assets generally pull in the same direction, where good safety contributes to positive economics. Risk management is intended to equip companies to find such good solutions, and to strike a reasonable balance in the event of conflicting goals for financial value creation and safety. Risk management is a prerequisite for the performance-based regulatory regime in the Norwegian petroleum industry.

The need to continue developing risk management for major accident risk has been pointed out in a number of contexts. Questions usually raised in the wake of accidents include whether those responsible had the information they needed when decisions which contributed to the incident were taken? Did they understand the circumstances as well as the consequences of their operations and the decisions they took? Did the circumstances change? Were they able to see and handle these changes? Did they make assumptions which later turned out to be wrong? And did their decisions make it difficult to work at the sharp end?

The purpose of this memorandum is to make a contribution so that companies in the petroleum industry can continue developing their own risk management. We raise key issues seen from our perspective, based in part on input from the industry. The aim is to contribute to an improvement in practice within the framework of the current regulations. No new requirements are introduced, and our supervisory activities will be based on the requirements specified in the regulations. This memorandum does not form part of the petroleum regulations.

Achieving good risk management requires that the individual company recognises the potential for serious accidents.

The memorandum covers the following main points.

- Risk management can only function as intended when integrated in the other decision processes.
- Before decisions are taken, issues relating to health, safety and the environment (HSE) must be adequately identified. Uncertainty has to be taken into account.
- Robustness is a key requirement because changes and surprises can occur.
- Knowledge of, involvement in, commitment to and engagement with safety must be a core value. This must shape decisions in every part of the organisation.

Important elements in the scientific basis for risk management are presented in these pages.

I would urge everyone to make active use of this memorandum, both internally in the companies and between them.

Anne Myhrvold, director general,
Petroleum Safety Authority Norway

June 2018

SUMMARY

Players in the Norwegian petroleum industry are given great freedom to find good ways of working. This is reflected in the performance-based regulatory regime. The goal is that the industry itself considers the specific nature of each of the activities. The prerequisite is that the companies manage risk well. The requirement for risk management therefore occupies a key place in Norway's HSE legislation.

The need to continue developing risk management has been emphasised in a number of contexts. Particular stress has been placed on

- continuing to focus attention on major accident risk
- taking ownership of residual risk
- systematic transfer of experience
- being conscious of the risk associated with the operating parameters set by management.

This is why the PSA is publishing this memorandum, which addresses the following main points.

- How can risk management avoid becoming something pursued outside the company's management processes, without real influence on decision processes? Risk management can only function as intended when integrated in the other decision processes. A unified approach ensures that a balance is struck between priorities, including different areas and parts of the organisation. See chapter 2 in particular.
- Issues relating to HSE must be adequately identified before decisions are taken. The decision basis must possess the necessary quality, and different options and consequences must have been investigated. Relevant specialists, the safety delegate service and user groups must have been involved. Uncertainty has to be taken into account. A high degree of uncertainty or great potential consequences calls for a cautious approach. This is discussed in chapters 2 and 3.
- Robustness is the ability to deal with changed circumstances and with failures, hazards

and accidents. The requirement for robustness occupies a key place because surprises can occur. This must be given particular emphasis where incidents have a high potential. See chapter 3 for more.

- The points above are important aids on the road to good risk management, but knowledge, involvement and a commitment to safety must be a core value. This must shape decision processes in every part of the organisation at all times. That applies particularly on occasions when the industry is under pressure. See more about this in chapter 4.

Financial value creation and protection of people, the environment and material assets generally pull in the same direction, where good safety contributes to positive economics. In the event of conflicting objectives, the right balance must be struck between safety and value creation so that safe solutions can be found within prudent financial parameters. At times, such an assessment could indicate that the activity cannot be pursued because the risk is too great.

Good risk management will equip the industry to find solutions which are good for both safety and economics, and to strike a sensible balance between conflicting financial and safety objectives. Priority must be given to measures in those areas which yield the greatest benefit for both value creation and safety.

The PSA considers that agreement prevails in the industry on the main points in this memorandum. Nevertheless, it finds that the topics listed above are those where the industry faces the biggest risk-management challenges. A particular description of these is provided in chapter 5.

In its preparatory work on the memorandum, the PSA has pursued a broad dialogue with the players. A number of questions and topics have been debated, and the players themselves have been allowed to identify the issues they believe to be important in connection with risk management.

¹ See, for example, the Engen report (2013), the PSA's follow-up of *Deepwater Horizon* (2014), the PSA's memorandum on the risk concept (2016) and work by the Norwegian Oil and Gas Association in the projects on black swans (2017) and enhanced risk analyses (2015).

1

INTRODUCTION



1 INTRODUCTION

1.1 THE PURPOSE OF THE MEMORANDUM

The purpose of this memorandum is to contribute to the industry's continued development of its own risk management. The PSA raises key topics from its perspective, in part on the basis of input from the industry.

The memorandum is intended to contribute to an improvement in practice within the parameters of today's regulatory regime.

1.2 BACKGROUND

The need to continue developing risk management has been identified in a number of contexts, as outlined below. As a result, the PSA has decided to publish a memorandum on the subject.

- The Engen commission appointed by the Ministry of Labour and Social Affairs (2013) concluded that the present regime functions well and should be retained, but that further development of risk management – particularly in relation to major accident risk – is important.
- The report on trends in risk level in the petroleum activity seeks to give the parties a common understanding of conditions which influence the level of risk. Its findings indicate not only that significant improvements have been made in a number of areas over many years, but also that opportunities exist for further improvement.
- The *Deepwater Horizon* disaster demonstrated a need to reassess principles and methods associated with risk management and the way these are practised. In the wake of this accident, both the regulatory authorities and the industry itself have taken a number of initiatives in Norway relating to risk and barrier management and to management

follow-up (PSA 2014, Norwegian Oil and Gas 2012). The PSA (2014) concluded that such initiatives must be subject to continuous assessment and development in order to reap lasting effects.

- A Norwegian Oil and Gas work group on enhanced risk analysis (2015) has reviewed current practice in order to identify improvement areas for risk-informed decision processes. It has been pointed out that, in many cases, a risk-informed decision basis arrives too late. Norwegian Oil and Gas has also published a report on black swans (2017), which identifies the need for an expanded perspective on risk where knowledge-building, experience transfer and learning are given an even more central place.
- Furthermore, the risk concept in the regulations was clarified in 2015, with attention focused on uncertainty, and the PSA published a memorandum in 2016 which describes what it wants to see achieved with this clarification. The 2016 memorandum clarified the risk concept, while this document provides further clarification of the *management aspect* of risk.

1.3 WHY IS RISK MANAGEMENT IMPORTANT?

Financial value creation and protection of people, the environment and material assets generally pull in the same direction, where good safety contributes to positive economics. Good risk management is intended to equip companies to find such good solutions for both financial value creation and for protecting people, the environment and material assets, and to strike a sensible balance between conflicting objectives for these aspects.

Within the framework of the performance-based regulations, players in the Norwegian petroleum industry have considerable freedom to find good ways of conducting their operations. The regulations open the way for innovation and take account of the distinctive character of each enterprise, local conditions and operational requirements. A prerequisite for the proper functioning of the performance-based regulatory regime is that the players accept responsibility and implement good processes for managing risk. The regulations specify requirements for risk management and reduction processes, which also include an expectation for further development of and improvement in the level of HSE.

Good risk management will provide opportunities to use resources in a way which has the best effect on safety and economics. That calls for a firm understanding of how good risk management can be conducted in practice.

The risk concept relates to the consequences of the overall enterprise, and not simply those of a single activity or incident on the facility. Risk associated with a specific activity is not restricted to that activity alone. It is influenced by the way the activity is planned, where it takes place, under which parameters and in what context. All decisions taken at all levels in an organisation ahead of an activity therefore determine the risk which the enterprise is exposed to, as described in the PSA's 2016 memorandum on the risk concept.

1.4 APPROACH

In its preparatory work for the memorandum, the PSA has conducted a broad dialogue with the players through a number of technical meetings with operators, shipowners, contractors

and unions as well as academics. Work on the memorandum has also been discussed in the Regulatory and Safety Fora. The Norwegian Environment Agency and the Norwegian Directorate of Health (via the county governor of Rogaland) have also been informed about the project and have provided input to the memorandum before publication.

A number of issues and subjects have been debated, and the players themselves were asked to identify what they regard as important. Generally speaking, the debate and the contributions have revolved around the following questions:

- what is required to ensure good risk management?
- what tools are helpful for risk management?
- what key prerequisites and principles underpin unified and integrated risk management?
- what are perceived to be the biggest challenges?
- what are the necessary success criteria?

In its meetings with the companies, the PSA has given emphasis to broad participation and ensuring the involvement of relevant decision-makers, because these have a special responsibility for risk management. Risk management specialists at the players have also taken part. The technical meetings and dialogue with the industry during the project have been very useful in ensuring that the relevant issues are discussed in the memorandum. The meetings have also helped to ensure that the industry and the PSA have a shared picture of what good risk management comprises. This memorandum expresses the PSA's standpoint as a knowledge communicator and regulator.

1.5 LIMITATIONS

“Risk management” in this memorandum is confined to the PSA’s area of responsibility. The subjects covered are based on major accident risk, but are also relevant for the working and natural environments, health, safety, security and so forth.

The memorandum covers only selected topics. It is not a textbook, and is not intended to cover all important issues in the risk management field. The memorandum should be viewed in relation to other technical work at the PSA, such as the barrier memorandum, the documentation and learning projects, and the publication on HSE and culture. Note in particular that the memorandum builds further on the work of clarifying the risk concept described in the PSA’s risk concept memorandum (2016).

This memorandum is not part of the petroleum regulations, and introduces no new requirements.

1.6 TARGET AUDIENCE

The memorandum is addressed primarily to decision-makers and managers at all levels in the industry, from company directors down to supervisors. Important decision-makers could also be outside the management structure, not least in the safety delegate organisation. Other players with important roles may benefit from the contents of this memorandum as well.

1.7 CONCEPTS

Key concepts are applied and interpreted in a number of ways within risk management. This is because such management is used in many discipline areas and in different decision circumstances, including disciplines outside the PSA’s area of responsibility.

Two key concepts in the memorandum are clarified below. Otherwise, recognised terms are used as far as possible, primarily as applied in ISO 31000 (including ISO Guide 73). The PSA sees that certain groups and discipline areas will use other terms and interpret them differently. It emphasises the need for good clarification, communication and shared understanding of terminology.

Risk assessment: An overall process of risk identification, risk analysis and risk evaluation. (ISO 31000).

The PSA’s comment: This can be conducted in various ways as needed. Assessments could, for example, be conducted through brainstorming and group discussions without the use of formal analysis methods. The concept should not be understood to mean that each risk assessment demands major analyses.

Robustness: The ability of the system and organisation to maintain their function when circumstances change and in the event of failures, hazards and accidents. Robustness is the opposite of vulnerability (NS5814:2008), which deals with the inability to handle such circumstances.

This ability includes not only withstanding, but also adapting. Changes in circumstances include nonconformities, stress, errors and minor incidents. It is also necessary to be robust against more serious circumstances, and section 5 of the management regulations on barriers occupies a key place in this respect.

2

RISK-INFORMED ENTERPRISE MANAGEMENT



2 RISK-INFORMED ENTERPRISE MANAGEMENT

Enterprises must be managed in order to reach their goals

Enterprises must be managed in order to reach the goals they set for themselves, including *ambitious goals for major accident safety and HSE*. A management cycle² provides a model for such enterprise and activity management. This cycle is a management principle which crops up in relevant standards for enterprise and risk management, and in company management systems³.

ISO 31000 defines risk management as “coordinated activities to direct and control an organisation with regard to risk”.

Priorities must be set for using resources in those areas which yield the greatest benefit for both financial value added and safety.

Integrated risk management

Financial and safety considerations generally go hand in hand and usually pull in the same direction. Good safety will then contribute to positive economics. But financial and safety considerations can also give rise to conflicts over objectives.

A balance must then be struck between safety and financial value creation so that safe solutions can be found within prudent financial parameters. The opportunity to find such solutions is greatest in early phases, and becomes more difficult the more fixed activities, decisions and operating parameters become. ISO 31000 therefore makes it clear that effective risk management depends on being an integral part of the organisation’s enterprise management, and not an isolated activity.

Striking a good balance between several considerations requires that decisions are taken with good information on risk, among other aspects. A balance between financial value creation and safety is more difficult to achieve in sectors where incidents with a big potential exist. *Setting ambitious targets for managing risk is thereby important* as a driver in safety work. More resources are therefore generally applied to risk reduction in such sectors, and good risk-informed enterprise management is a key to success.

Risk management is a recognised tool for achieving the goals set for financial value creation and safety, and for striking a good balance between these objectives.

² Also known as the Deming cycle or the PDCA cycle from “plan, do, check, act”.

³ The petroleum industry is to a certain extent complex, with dynamic changes, uncertainty about oversight and control, and the need for flexibility. Such operations must be managed in accordance with the principles for prudent activity, and from a system perspective. See for example Power (2004). The important consideration is that management systems based on a system perspective must also be risk-informed.



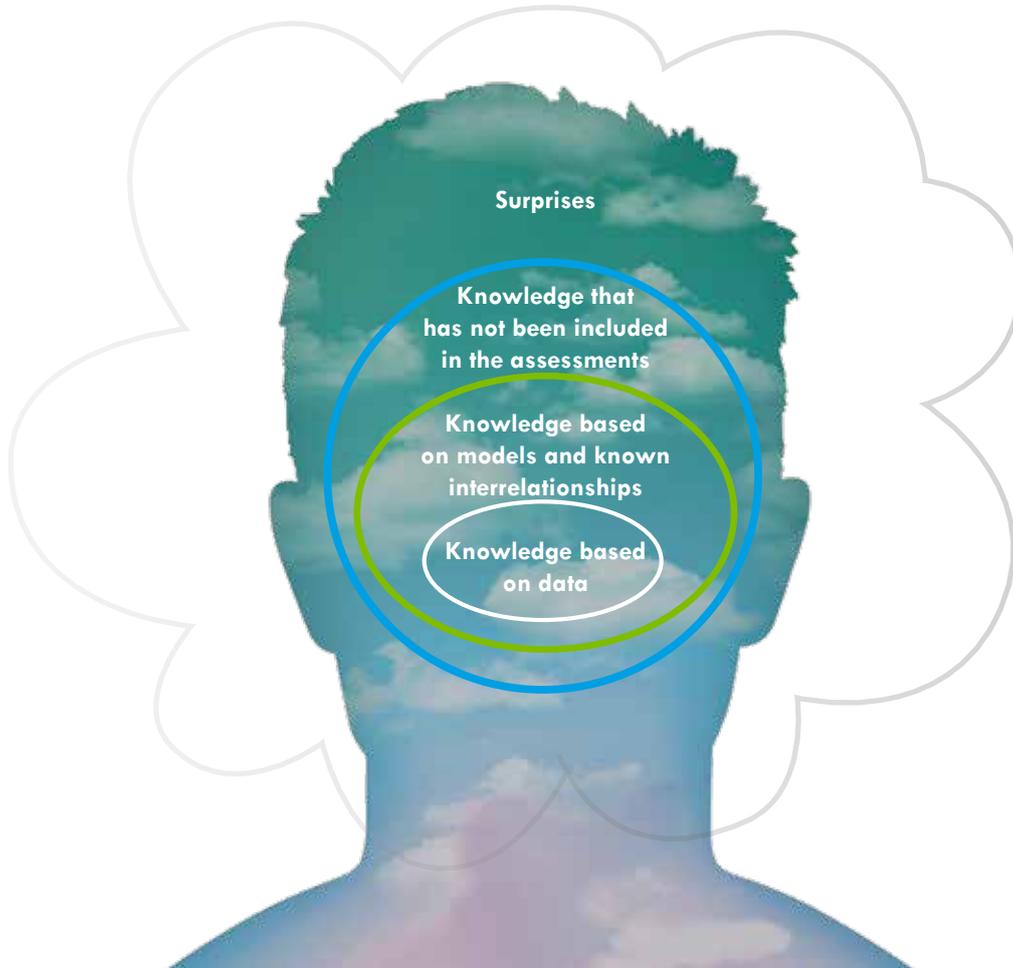


Figure 1: Uncertainty means a lack of knowledge. Decision-makers must therefore often “doubt their way” to greater understanding of uncertainty.

Risk-informed enterprise management means that the decision-maker is well-informed about risk at a sufficiently early time

When the industry describes good risk management, it outlines processes where decisions are taken on the basis of appropriate information acquired ahead of the decisions. In other words, they are conducting risk-informed enterprise management.

The following are good examples.

- Decision-makers make active efforts to obtain relevant information from their own company and elsewhere in the industry before making decisions.
- Decision-makers have good discussions on the information they possess and the strength of the knowledge involved, and use this in their decisions. This is discussed further in chapters 3 and 4.

“Doubt is the key to knowledge⁵»

People who take a critical approach can be said to “doubt their way” to greater understanding when making a decision. They ask questions and involve employees, contractors and suppliers with the aim of securing a decision basis which covers the whole knowledge area presented in figure 1.

Unified risk management

A good risk management process is integrated and unified, and has a decision basis which is appropriate and available ahead of the decisions. Unified risk management can be understood as a coordinated management of aspects associated with risk, conflicting goals, needs and risk acceptance at different levels and in different units and discipline areas in the enterprise.

An example could be the conflict between good natural ventilation and providing good working

conditions in the process area. Good natural ventilation will reduce the threat of gas accumulations and explosion pressure. Good working conditions could reduce health burdens for employees, but could in some cases be in conflict with for instance the need for ventilation.

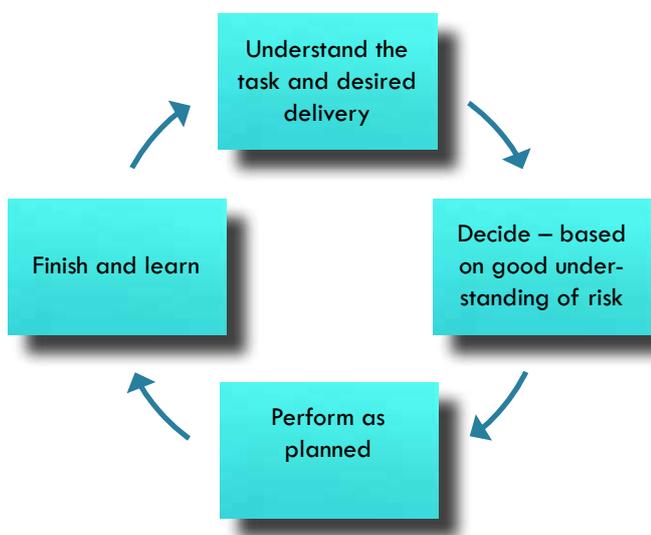
Another example is the goal of good progress for a development project, which could be at the expense of sufficient time to reach safety objectives. Excessive attention to progress could, as Norwegian Oil and Gas (2015) writes, create circumstances where decision support comes too late.

In a unified approach to risk management, security risk (intentional undesirable incidents) is one of several considerations an organisation must take into account. Knowledge of intentional undesirable incidents as a phenomenon, and methods for implementing security measures, must form part of unified risk management.

A challenge many face today is that a divide runs not only between security and other disciplines, but also within the security discipline. Such divides have been seen between discipline areas for physical security, personnel security, IT (office networks) and industrial process and security systems (operational technology – OT). This has prevented a unified understanding of security-related risk.

A normal description of enterprise management is presented in figure 2.

1. The first requirement is to understand the enterprise and activity, and what delivery (goal) is desired. Understanding the context and the requirements posed for the enterprise or activity is important here. Furthermore, risk and possible reasons why things might not go as wanted must be identified, along with their consequences.
2. The decision on how the enterprise is to be run or the activity conducted must take account of the understanding achieved in step 1. This requires consideration of whether the plans are robust against changed circumstances, and whether decision-makers are well-qualified to take such a decision.
3. The activity must be conducted as planned, and it is important that those who conduct it have understood the operating parameters for what they are to do as well as processes and procedures developed for the job. It is also important that they have understood the basis for the decisions, the consequences and the uncertainties, so that they can react correctly if changes occur.
4. Continuous assessment of execution, delivery and attainment of goals is important in order to learn while conducting the activity, and to perform better next time something similar is to be done. Attainment of goals can include a number of aspects, but should naturally include safety – in other words, accidents have been successfully avoided.



⁴ This memorandum uses “risk-informed” as a term in place of “risk-based” in order to point out that enterprise management and decisions must not rest exclusively on the findings of a risk analysis. Such analyses have their limitations, and aspects such as uncertainty and strength of knowledge, the goals of the enterprise, external requirements and rules, and the values of other stakeholders must be included. “Risk-based” is a term in ISO 31000 which the PSA considers actually to mean the same, and it accordingly warns against an interpretation where decisions are taken “mechanically” on the basis of the risk analyses.

⁵ Persian proverb.

Figure 2: Risk-informed enterprise and activity management.

3

DECISIONS MUST TAKE ACCOUNT OF UNCERTAINTY



3 DECISIONS MUST TAKE ACCOUNT OF UNCERTAINTY

3.1 UNCERTAINTY IS A KEY COMPONENT OF THE RISK CONCEPT

Uncertainty is a key component of the risk concept. Taking account of uncertainty when choosing solutions and measures is therefore a regulatory requirement. See section 17 of the management regulations on risk analyses and emergency preparedness assessments.

Uncertainty takes various forms. It is uncertain which incidents will occur, how often, how they will arise and what the consequences will be should they occur.

Taking account of uncertainty means clarifying the strength of knowledge

Uncertainty must be assessed. It could be argued, for example, that a specific type of incident is unlikely to occur in a given period. These assessments build on a certain level of knowledge, based to a varying degree on data, information, testing, analyses, arguments, theory, models, assumptions and so forth.

Determining wave heights for use in designing facilities, for example, requires a lot of data from the relevant location. Good models, theories and assumptions are also needed (such as the models provided in Norsok N-003 and ISO 19901-1).

This knowledge can be more or less strong. “Taking account of uncertainty” also means clarifying what this knowledge comprises and how good it is. If it is weak, assessments based on it will have little impact.

Where security risk analyses are concerned, for example, few people currently describe the strength of the knowledge or the uncertainty. This means that an unrealistic picture of the risk is provided, and decisions are taken on an erroneous basis.

The strength of knowledge says something about what impact the assessments should have

An important element in this work is to clarify which assumptions the assessments build on, and the effect if these assumptions are wrong. The knowledge basis could be more or less good or even completely wrong. “Taking account of uncertainty” means in particular that this knowledge – these perceptions – and these assumptions are investigated with an eye to weaknesses, possible errors and potential surprises.

Taking account of uncertainty means systematically seeking out potential surprises

The conclusion is often drawn that an incident can be ignored because of its low probability. Such probability assessments can build on inaccurate or weak assumptions. “Taking account of uncertainty” means concentrating systematically on this problem and seeking out potential surprises. It is particularly important in this work to be aware of what is known in the organisation or in the industry beyond, but unknown to those making the assessment (“unknown knows”).

Risk management and the regulations are based on three main categories of ways to meet risk:

- risk-informed enterprise management
- the cautionary and precautionary principles
- dialogue between decision-makers, specialists and executing personnel.

Risk analyses have a key place in good risk management, but require an understanding of their limitations

Conducting and applying risk analyses can form an important element in the decision basis when decisions of significance for HSE are to be taken. They therefore occupy a key place in good risk management. At the same time, good use of risk analyses depends on an understanding of their limitations, strengths and weaknesses.

If the consequences of an activity are serious and uncertain, the cautionary principle must be applied

The cautionary principle is applied precisely because risk assessments are not perfect. They do not reflect any objective reality, but provide assessments which can be more or less good and even wrong. Surprises can arise in relation to the conclusions in the risk assessments. Many requirements in the regulations, and the need to pay attention to knowledge and uncertainty in assumptions, therefore have their background in the cautionary principle.

This principle states that, if the consequences of an activity or enterprise are serious or uncertain, measure should be taken to reduce the risk and uncertainty, or the activity should not be pursued. An example of the cautionary basis of the regulations is that specific requirements – such as fire walls between main areas – cannot be ignored.

In other words, the regulations set a number of specific requirements for robustness because surprises are possible relative to the decision basis. Furthermore, section 5 of the facilities regulations requires robust solutions to be chosen.

The precautionary principle is a special case of the cautionary principle which applies when the uncertainties are “scientific”. This could include the phenomena involved not being scientifically understood – using new chemicals, for example, when the long-term effect on humans is not known.

An example is when a serious security incident is found to have a low probability and can thereby be ignored. A challenge here is that the knowledge could be more or less strong. A few companies have therefore chosen to assume the worst credible scenario when establishing risk-reducing measures.

Take account of uncertainty through: risk-informed enterprise management, the cautionary principle and dialogue

Taking account of uncertainty means giving weight to all forms of risk management, particularly the cautionary and precautionary principles. Trade-offs will always be needed – over costs, for example – but taking account of uncertainty means that uncertainty assessments must always be conducted. Dialogue is discussed in more detail in chapter 4.

Risk-acceptance criteria are discussed by Norwegian Oil and Gas (2017). To summarise, a risk acceptance criterion is fulfilled when the probabilities are

- within the criterion, and the knowledge is strong, or
- within the criterion by a big margin, and the knowledge is not weak.



3.2 RISK REDUCTION PROCESSES

The risk reduction process does not stop even if the risk acceptance criteria are met

Do risk reduction processes stop when the risk-acceptance criteria are considered to be met? No is the answer. The PSA highlights that risk is to be dealt with and reduced even further, and as far as possible. This is discussed in the following paragraphs, with the emphasis on uncertainty.

In NORSOK Z-013:2010 Annex A⁶, the industry describes processes which balance the need for an ambitious level of safety against value creation, cost-efficiency and what can realistically be achieved.

NORSOK Z-013 emphasises documenting accepted and rejected risk-reduction proposals. The standard also emphasises a “reverse burden of proof” – in other words, *being able to show why a proposal is not implemented*.

The proposals must be implemented unless an unreasonable imbalance between cost and benefit can be demonstrated.

The PSA emphasises that a pure cost/benefit assessment based on expected values is not enough to demonstrate an unreasonable imbalance. Expected values reflect uncertainty (knowledge strength), robustness and surprises to only a limited extent.

When the requirements above are taken into account, these simple assessment criteria can be established as an example of a balanced cost/benefit assessment for proposals which improve safety.

1. If the cost is low, the proposal will be implemented.
2. If the cost is not significantly out of balance with the risk reduction, the proposal will be implemented.
3. If other aspects justify it, implementation of the proposal is considered. Other aspects could include substantial uncertainty, the need for barriers and robustness, and so forth.
4. Furthermore, specific regulatory requirements and established minimum solutions in the industry cannot be ignored on the basis of arguments about risk-informed cost/benefit assessments.

Such assessment criteria are used in the industry already, but the PSA observes that the same emphasis is not always given to item 3 about “other aspects”.

Example: use of assessment criteria based on an imagined development project where the need for a subsea isolation valve (SSIV) is assessed.

An SSIV is an emergency shutdown (ESD) valve which is usually installed on the flowline close to a facility so that its contents can be isolated from the latter. An SSIV could improve robustness by limiting the quantity of hydrocarbons released

⁶ As low as reasonably practicable (ALARP) is an established process in the industry, based on British legislation. The PSA notes that ALARP is often understood as risk-reduction processes which also meet the requirements for risk reduction in the Norwegian regulations, but it has also seen examples where ALARP is used in a way which does not contribute to risk reduction (PSA 2007). Because of these varying interpretations, ALARP is not a concept used in the Norwegian regulations.

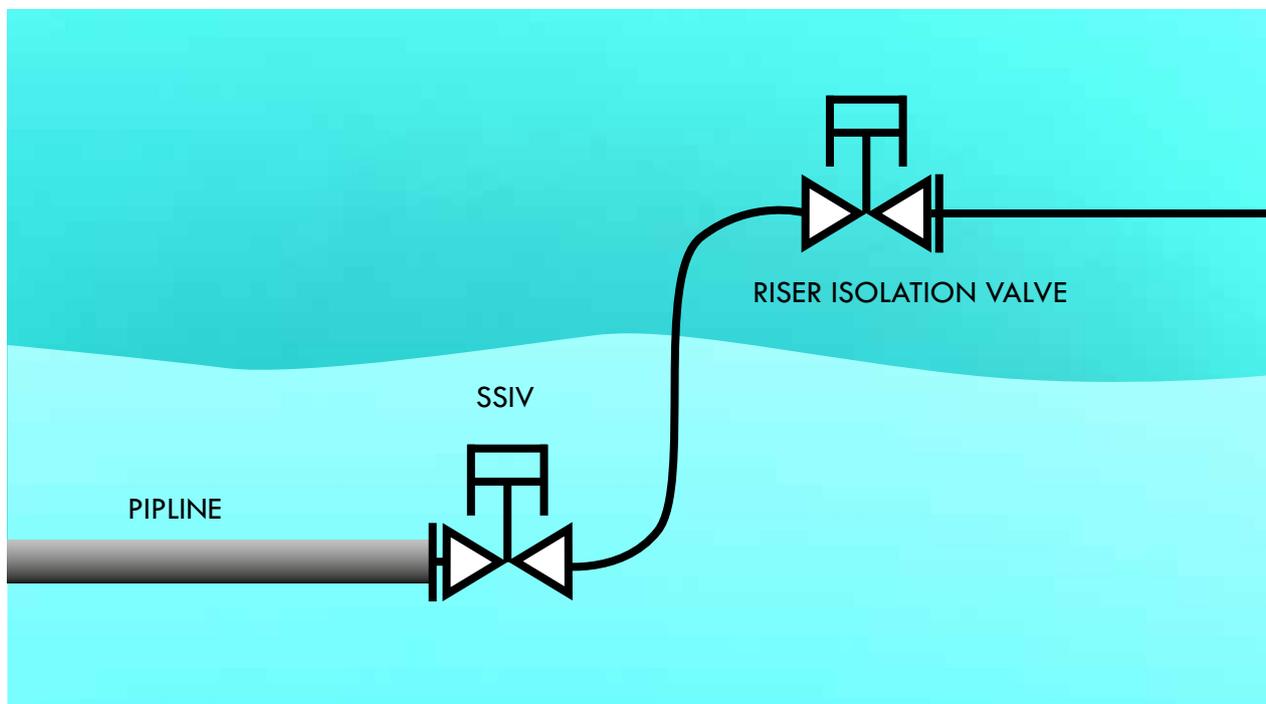


Figure 3 Illustration of a subsea isolation valve.

during an accident. The scope of the incident is then confined. One reason why the Piper Alpha accident on the UK continental shelf in 1988 became so serious was the lack of such valves. SSIVs are nevertheless excluded from a number of projects, generally on the following grounds.

- The existing regulations specify the installation of ESD valves which can halt hydrocarbon and chemical flows to/from the facility and to/from wells, and which isolate or section fire areas on the facility. Furthermore, barriers are required in the event of failures, hazards and accidents. On the other hand, no specific requirement exists for ESD valves of the SSIV type.

- Statistics can be used to argue that the probability of such incidents will be low, while installing SSIVs involves a substantial cost.

Based on the assessment criteria described above, it can be seen that the need for an SSIV is also influenced by the strength of knowledge in the risk assessments and the fact that the valve would provide substantial robustness – particularly in relation to rare but very serious incidents. Note that the decision logic does not mean that such a valve must always be installed, but that the need for it must be assessed in a balanced manner where the consequences of a worst-case scenario are also assessed in the light of the cautionary principle.

4

RISK IS MANAGED BY PEOPLE



4 RISK IS MANAGED BY PEOPLE

4.1 INTRODUCTION

The risk management principles described in chapters 2 and 3 are necessary, but not adequate without commitment, involvement, knowledge and engagement.

Management – at all levels in the petroleum industry – has a special responsibility to help reduce the risk of major accidents. This concerns the way management maintains an overview of activities and risk conditions in its own operations. Management must ensure that the responsibility to understand and manage risk is clearly defined, both internally and between stakeholders involved.

This special responsibility also means that management is conscious that the decisions it takes influence operating parameters at the sharp end. Contracts and their follow-up, for example, could lead to a difficult balance between requirements for progress and safety.

A commitment to safety must be not only a priority, but also a core value

A commitment to safety must be not only a priority, but also a core value which shapes decision processes in all parts of the organisation at all times. This commitment must also be a core value in difficult circumstances when not everything has gone according to plan and when cost overruns and delays threaten.

Management's commitment to, ownership of and engagement with safety is a precondition for risk-informed enterprise management. Its priorities are crucial for the way the company deals with major accident risk.

Recognising that petroleum operations are associated with risk is not the same as accepting that accidents happen. On the contrary, recognising

risk allows for the implementation of measures to reduce it.

A good HSE culture and management is a precondition for achieving commitment to and engagement with safety throughout the organisation. The sections below identify important elements related to HSE culture and management which are relevant to good risk management

4.2 HSE CULTURE

An important characteristic of a good HSE culture is that the organisation provides fair treatment, reporting, learning and flexibility. This enhances motivation and contributes to a positive commitment to safety work in the organisation.

A good HSE culture is characterised by continuous, critical and detailed work to improve HSE

Establishing a culture which is completely fair represents an ambitious but important goal. Everyone must be sure they will be fairly treated when they raise issues of significance for safety. That will support the ability and willingness to correct matters, and promote trust and creativity.

Everyone must be sure they will be treated fairly

Behaviour in an organisation usually attracts positive and negative reactions – both formal and informal. Being perceived as fair and constructive is important for this to function well in practice.

In organisations with a good HSE culture, incidents and near-misses are examined, reported and used for learning in the enterprise's risk management processes. A good HSE culture is one where people are trusted to be open about their own errors without having to fear sanctions. The benefit of reporting is visible through actions, follow-up and learning in the organisation.

A good HSE culture builds on openness and trust between employees and management

Rewards and sanctions related to goals can undermine an HSE culture where incidents are reported. This applies to both HSE goals and efficiency. If, for example, a manager, an organisational unit or a supplier receive a bonus because there are few incidents in their area of responsibility, the result could be under-reporting. It is important that goals are used in a way which contributes to promoting a long-term approach, commitment, engagement and improvement. (Sintef 2015, PSA 2016).

CHECK POINTS

- How does the organisation treat people who report hazardous conditions?
- Are people who speak out when they see a danger signal/hazard taken seriously, valued, ignored or regarded as troublemakers?
- How are goals used to manage risk?

Learning from one's own experience and that of others in order to improve risk management is important. Drawing lessons from earlier incidents is crucial for avoiding recurrences.

"Those who cannot remember the past are condemned to repeat it."

George Santayana, 1905

A learning culture is characterised by the ability to identify and react rationally to danger signals, including when these are ambiguous or diffuse. Where major accidents are concerned, somebody in the organisation has often been aware of the problems which led to the incident.

The Chemical Safety Board (2016) reports that several cases involving delayed detection of well kicks had been experienced on Deepwater Horizon before the explosion and fire in the Gulf of Mexico in 2010, without improvement measures being implemented. One of the incidents had occurred just over a month earlier. Information from

these incidents was not used to identify measures, and the lack of conformity between procedures and work practice identified after two previous well kicks was not communicated to relevant parts of the company.

Danger signals can be more or less clear before an accident happens. Management has a special responsibility to ensure that all important signals are included in the enterprise's risk assessments.

CHECK POINTS

- Are all relevant danger signals included in the risk assessments?
- Are all relevant specialists and employee representatives included in identifying risk?
- Is a subordinate encouraged to challenge a decision by their superior? A contractor employee to challenge an operator employee? Does this happen in practice?
- Are problems swept under the carpet because the information could create problems for the organisation or the individual?
- Are work processes and procedures updated and developed on the basis of experience?
- Does the organisation succeed in setting sensible priorities and adjusting these?
- Is the greatest attention devoted to the most serious problems, or does the organisation drown in minor issues?

The organisation's flexibility and robustness

An organisation must be flexible and robust to be capable of dealing with uncertainty and surprises. This means in part that it adapts more quickly to changing external demands and unexpected circumstances. Such a culture tackles new conditions and changed tasks without affecting safety.

Organisations in the petroleum sector can be complex, technology-intensive and vulnerable to human error. Their work is demanding in terms of both technical expertise and coordination. Although the work is often procedure-governed and

much investment is made in training personnel in procedures and routines, the latter also need to be trained to handle the unexpected.

4.3 MANAGEMENT AND CULTURE

Aspects given systematic attention and priority by management make a strong contribution to shaping a culture. Management responsibility and behaviour are therefore key elements in work on the HSE culture. Managers are role models when they take decisions and implement measures which improve the working environment and safety. It is important that they are conscious of their leadership role, so that they communicate the message in a considered manner during day-to-day work and in the decisions taken.

Management's visible engagement in and commitment to risk management are significant in shaping the organisation's HSE culture.

The guidelines to section 15 of the framework regulations on a sound health, safety and environmental culture emphasise in part the need for a clear understanding in the organisation that culture is not an individual quality but something developed in the interaction between people and given framework conditions. Management responsibility and behaviour at all levels are highly significant in achieving this.

An example is organisations where management has clearly put security on the agenda and works systematically on this. It then contributes to a good safety culture where attention is given to security, and continuous efforts are made to identify and deal with risk in relation to intentional undesirable actions.

Trust and credibility

A manager's expertise is important for creating trust, but credibility is also created when employees perceive a correspondence between what

the manager says and actually does. Trust does not just occur. It is built up gradually through dialogue and interaction, helps to enhance efficiency in organisations and reduces risk.

Trust plays a key role in organisation with major accident potential. At the same time, avoiding a consensus culture, naivety and "blindness" is important. Trust in high-risk organisations should therefore be combined with scepticism and vigilance.⁷ Management plays a key role here by promoting a culture where danger signals are taken seriously, and openness and fairness prevail.

Management qualities which influence the perception of credibility include consistency, integrity, empowering employees, facilitating open communication and the ability to learn from their own errors and those of others.

Managers must have appropriate and adequate expertise in risk management. Good training on managing risk must be an integral part of management education in the enterprise. Managers must understand their own role and responsibility, and have adequate knowledge of tools and methods for risk management, their application and their limitations.

CHECK POINTS

Does conformity exist between theory and practice at all levels in the organisation?

- Are employees and contractors treated with respect?
- Are one's own errors and those of others used for learning?
- Are commitments and responsibilities followed up at all levels?
- Do managers engage with and accept responsibility for the health and safety of employees and contractors?
- Is taking short cuts accepted in the organisation?

⁷ See the discussion of "doubting one's way" to greater understanding of risk in chapter 2.

CHECK POINTS

- Are HSE given priority in day-to-day work?
- Is systematic attention paid to dealing with conflicts between safety and financial goals?
- Do managers intervene in day-to-day activities when safety requirements are not met in the same way as when targets for progress and financial performance fail to be met?
- Do managers take responsibility for HSE and show clearly that they give it priority on an everyday basis?
- Do managers create and use opportunities for dialogue about HSE with employees and contractors?
- Do managers take short cuts over decisions which could be significant for HSE?
- Do managers investigate whether procedures and equipment are appropriate for safe working? Are changes made if required?
- Do managers contribute to securing adequate capacity and expertise?
- Are managers familiar with the most importance risk conditions and how to deal with them?
- How is expertise on risk management integrated in the enterprise's management education?

Dialogue and collaboration

The way managers communicate helps to maintain and develop a good HSE culture. Managers must communicate the company's expectations for risk management and ensure that they are met in day-to-day work. The ability of managers to approach and communicate values related to risk management to their employees is crucial for the acceptance of these values.

Effective communication is a two-way process where the message is communicated clearly, and where understanding and acceptance of the message's content are demonstrated. A manager who actively seeks suggestions from an employee

will also motivate their subordinates and secure valuable help in managing risk.

A prerequisite for obtaining all relevant input is that employee knowledge and experience are used to ensure that risk is adequately identified before decisions are taken. Acceptance and understanding of goals and measures can only be achieved through collaboration. Mutual influence on goals and measures can only be exerted in a culture which promotes learning. Involving managers and employees in all participating companies is important. Tripartite collaboration contributes at an overarching level to dialogue between management, employees and government.

Involvement of and collaboration between management and employees is crucial for developing and reaching the organisation's HSE goals

The significance of the way managers express themselves is often underestimated. Those who are engaged, who draw on available expertise, and who devote time and effort will often win the respect of their subordinates.

Giving feedback and recognition to employees represents a strong instrument for promoting a safe workplace and building a good HSE culture. Good dialogue builds on constructive feedback, active listening and mutual respect.

CHECK POINTS

- Is collaboration and involvement present in issues relating to HSE?
- Is the safety delegate service involved in issues relating to HSE?
- Is feedback and recognition given to those who raise HSE issues?

Is appreciation shown if employees or contractors halt work they feel is risky?

5

RISK-INFORMED ENTERPRISE MANAGEMENT IN PRACTICE



5 RISK-INFORMED ENTERPRISE MANAGEMENT IN PRACTICE

What is required to secure adequate understanding of risk? Does good practice have any basic characteristics, and are there any pitfalls the organisation should be aware of?

Management's responsibility for and ownership of risk

Managers have a big responsibility for ensuring that decisions include balancing positive and negative aspects. Good decisions minimise drawbacks and maximise opportunities. Before decisions are made, a good manager will secure a sufficient decision basis and take account of uncertainties.

Good examples show that managers not only say that safety will be a priority, but also follow this up by *leading* the organisation towards safety as a priority. The opposite case is the typical “gala speech”, where the manager expresses an expectation of a high level of safety, but leaves it up to the organisation to implement this without parameters, direction and follow-up.

Another pitfall is static processes, where managers are presented with and informed about risk but make little effort to become involved and ask about knowledge, uncertainty and which assessments are included in the decision basis.

Managers have a responsibility for and must take ownership of risk. This includes taking ownership of residual risk⁸ in the operation of the enterprise.

Avoid a one-sided concentration on financial aspects

The commonest error is a one-sided concentration on financial aspects without taking account of possible conflicts between financial and safety goals. This is typical of organisations where risk management is dealt with more as separate processes than as an integral part of managing the enterprise.

Involving all affected disciplines and executing personnel

The PSA has seen examples of good risk management where the players themselves say that they “doubt their way” to greater understanding of the decision situation by asking questions and involving others. All affected disciplines, including the safety delegate service, technical experts and executing personnel, must be involved to ensure that risk contributions are mutually understood and included. Dialogue, communication, involvement and employee participation therefore play an important part in preparing the decision basis.

Good decision-makers balance varying needs. Technical experts take responsibility and deliver a sound decision basis which permits good unified decisions.

A common pitfall is that decisions are taken without necessary information on location-specific conditions and knowledge about the practical execution of the job. Some decisions are also taken on too narrow a basis, and without ensuring sufficiently broad knowledge and information across individual units. If such broad knowledge and unified understanding are lacking, the decision basis will be inadequate, and fail to take sufficient account of uncertainty and important knowledge.

⁸ ISO 31000 defines residual risk as the risk remaining after risk treatment. Roughly speaking, risks (hazards) can be divided between known and unknown (surprises). The hazards known to the decision-maker will in some cases be consciously accepted – because they have low probability and acceptance criteria are met, for example. Surprises (unknown unknowns and unknown knowns) and the consciously accepted hazards are the main sources of residual risk. It will also result from the failure of measures taken to eliminate risk fully.

Numerical values from a risk analysis must not be given more weight than they deserve

The PSA now and again finds risk analyses being used to document that risk falls within a given acceptance criterion and can therefore be ignored. Such use of risk analyses could be too one-sided and mechanical unless uncertainty is taken into account. Another key condition is sometimes breached when risk analyses are conducted after decisions have been taken in order to legitimise them.

The PSA has also found that risk analyses are used to legitimise solutions which lack robustness and to argue away the need for measures. In other words, a low probability must not be relied on blindly without assessing uncertainty and the consequences if an incident should nevertheless occur.

Risk management tools are no more than good aids

The PSA sees a wide variation in the way risk analysis and various risk management tools are used. In the good examples, they serve as aids. Decision-makers play an active role and check whether the underlying knowledge is strong or whether more information must be obtained. Risk analyses are a necessary part of the decision basis in addition to other sources of information.

In poor examples, various tools for identifying and aggregating risk are used more for reporting than for management. These cases reveal little understanding that these tools can help to conceal as much as visualise risk.

Risk assessments must be specific

Examples of good risk management show that players place great emphasis on identifying all relevant risk conditions. Quality is ensured by taking account of the specific nature of the activities, location-specific conditions and operational preconditions. Involvement, local expertise and broad-based knowledge are important key words here. In examples of poor risk management, the PSA observes the use of generic risk analyses and hazard identification. Generic lists of hazards can be used as a starting point for brainstorming, but are not enough to secure a sufficiently unified and comprehensive decision basis.

Risk understanding also in the execution phase

Good examples involve execution in accordance with the decisions taken and with good understanding of risk and what this means for the activity. Furthermore, a vigilant eye is kept on possible changes and nonconformities. The executor is assured adequate knowledge of and expertise about the job and the risk, and understands how the activity is planned and which factors must be taken into account. Furthermore, major accident risk forms a natural part of the decision basis for executing the job – through various forms of risk visualisation, safe job analyses and work permits, for example.

Jobs are not always executed in accordance with the decisions taken. This is often because plans need to be changed, they have been drawn up without the involvement of the executor, or the reason for the chosen method of execution has not been communicated. Changed preconditions and adjustments must be assessed and dealt with in a good way.

Another possible hazard is that execution sticks rigidly to procedures and decisions taken, without an understanding of the risk picture and the possibility that this can change. Rigid processes and procedures can lead to “silent nonconformities”.

Change management

Examples of good risk management incorporate processes for handling change. Change management involves assessing and managing changes on the facility, in the organisation and in operations, so that HSE accord with legislation and statutory regulations. It often means starting afresh in understanding the activity and the associated risk.

Examples of pitfalls could be that change management is pursued after the event in order to document and defend changes, and that the actual change management process is so complex that people seek arguments for claiming changes are not extensive enough to warrant the process.

Learning lessons

Learning lessons is perhaps the most difficult component in the management cycle, particularly with regard to promoting systematic learning in order to make knowledge available to those who need it. The PSA's publica-

tion on learning (PSA 2013) emphasises that organisational learning is a prerequisite for safe operation. In its report on black swans (2017), Norwegian Oil and Gas gives great emphasis to exploring good methods for learning.

Good examples include both safety and financial value creation in assessing whether targets are met. Safety is clearly identified as a target. Furthermore, experience is transferred to relevant parts of the organisation, other companies and industry organisations in order to ensure implementation of the lessons learnt.

The regulations specify requirements for improving safety where necessary (section 23 of the management regulations, see also section 15 of the framework regulations). That means it is important to have good processes for identifying the need for improvement. This manifests itself in organisations which have a conscious relationship to *whether* and *when* improvements are needed, and which are not satisfied with a “good enough” mindset. See the PSA publication on learning (PSA 2013).

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