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ABSTRACT

This thesis has looked at how Apply Sørco handles risk, and what the legislations and international standards say about risk management. The purpose of this thesis is to evaluate the risk management system and procedures in Apply Sørco and identify if there are any gaps in Apply Sørco's risk management system related to Norwegian legislation and international standards. It has been a goal to make suggestions for improvements to help guide the company in the correct direction regarding the risk management process throughout the project execution.

During the thesis the basic theory of risk management is reviewed, together with Apply Sørco's management system and risk management procedures. The work method is evaluated and proposals for improvements have been made.

After reviewing the risk management system in Apply Sørco it is clear that it could use some improvement. All of the three procedures related to risk management could benefit from re-work and especially CR-1550 ALARP in projects. One or two new procedures should be created, to support the existing procedures. This could also help the organization carry out the work correctly and in a uniform matter across the different disciplines, making sure that every project, regardless of the size, work in compliance to internal and external requirements. Together with the new and improved procedures, Apply Sørco should invest in some basic training to raise the level of knowledge regarding risk management. This is to fully benefit from the improved procedures and work as effectively as possible.

PREFACE

This master thesis represents the end of my master degree in Risk Management, specialization in offshore safety, at the University of Stavanger. The five years I've spent at the University have been interesting, educational and fun! It is five years that I'll look back on, and remember for the rest of my life.

During my last year at the University I have been given the opportunity to work part time at Apply Sørco, picking up valuable experience that I have benefited from writing this thesis. For this I would like to thank Elin Østbø Lunde, for encouragement and support. At Apply Sørco I would also like to thank Victoria Øvrebø for informative discussions and especially Reidar Jordal for always having time for interesting and valuable discussions and guidance.

Finally I would like to thank my supervisor at UiS, Terje Aven, for guiding me in the right direction and giving me quick and constructive feedback.

University of Stavanger, June 15th 2012

Thor-Erik Sandven

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Abbreviation List

ALARP	As Low As Reasonably Practicable
CR	Company Requirement
DFO	Document For Operation
EPCIC	Engineering, Procurement, Construction, Installation and Commissioning
FEED	Front End Engineering and Design
FMEA	Failure Modes and Effect Analysis
HAZID	Hazard identification
HAZOP	Hazard and Operability studies
HSE	Health, Safety & Environment
ISO	International Standard Organization
M&M	Maintenance and Modifications
P&ID	Piping and Instrument Diagram
PEM	Project Execution Model
PIMS	Project Information Management System
PTW	Permit To Work system
QRA	Quantitative Risk Assessment
SAMS	Samsvar (Compliance)
SIW	Structured Information WEB
SJA	Safe Job Analysis
S-PRO	Sørco Prosedyreverk
TRA	Total Risk Assessment

1 Introduction

1.1 Background information

Apply Sørco represents the Centre of Excellence within the Apply group, delivering M&M and EPCIC activities to the oil and gas industry. Offshore oil and gas production involves risks of accidents with a major loss-potential [1]. Thus all the companies operating in this industry must have a high focus on health, safety and environment. In the recent years there have been more focus on risk management, but how risk is defined and how risk is managed, varies from company to company. Statoil ASA, as one of the big players on the Norwegian continental shelf, has their way of working with risk management and the use of risk analyses, whilst other operating companies have a different view on risk and the risk management process.

As a contractor company it is up to Apply Sørco to interpret legislations and define the risk management process and the making of risk management procedures.

1.2 Purpose of this thesis

The purpose of this master thesis is to evaluate the risk management system and procedures in Apply Sørco. The basic theory will be established and the current method will be examined and measured against recommended practice from regulations and standards to check that there is compliance. Improvements will be proposed to close any gaps that are identified.

The improvements will help guide the company and all projects in the correct direction regarding the risk management process throughout the project phase.

1.3 Content

The first part of this thesis, chapter two and three, will establish the theory around risk management and describe best practice in Apply Sørco respectively. In chapter four, the thesis will evaluate best practice in Apply Sørco, including the work methods, IT systems and the personnel. After the theory and current practice are established, the thesis will move on to recommendations on how to improve the work in chapter five. Chapter six is the conclusion.

2 Basic theory of risk analysis and risk management

This chapter defines the basic risk management theory that the current method of work will be measured against.

From the moment you wake up in the morning, until the moment you go to bed at night, and even as you are asleep you are exposed to risk. One way or the other, risk is included in our everyday life and people do risk analyses and subconsciously risk management throughout the day. We often refer to extreme sports such as parachuting, rock-climbing or rafting as risky hobbies, or the risk of the plane crashing the next time you're out flying. When it comes to extreme sport "risky" is used instead of dangerous or hazardous. In the case of risk of a plane crash, "risk" is used to describe the probability of a specific outcome (chance of plane crashing). In the same way, we have a comprehension of what is "high" and "low" risk. As a pedestrian wanting to cross a busy street would wait until the cars get a red light because there considerable is risk involved in crossing the busy street, another pedestrian at the same street would probably cross the road in the middle of the night, without waiting for a green light, because he sees the risk of getting hit by a car as very low.

Managing risk assumes recognition of its existence, and understanding of what the risk consists of.

2.1 Risk

Risk = probability x consequence is by many the definition of risk¹. This definition is too simple to give an adequate description, because there is no room for uncertainties. If uncertainties are taken into consideration then risk can be defined as "a combination of possible consequences and associated uncertainties" [2]. Risk is related to the future events *A* and their consequences *C*. Today, we do not know if these events will occur or not, and if they occur, what the consequences will be. In other words, there is uncertainty *U* associated with both *A* and *C*. How likely it is that an event *A* will occur and that specific consequences will result, can be expressed by means of probabilities *P*, based on our background knowledge *K* [2]. An example could be lifting operations offshore, with the time-frame of one year. Consequences of dropping an object could be differentiated between minor or major personnel injuries or structural damages. The uncertainty is very large, it is not possible to know if a crane will drop its load or what the exact consequences will be. With the help of background knowledge of e.g. dropped objects statistics, type of rig and weather information, it is possible to express the probability of an event occurring, given the consequences.

¹ PSA's guidelines regarding the Framework Regulations §11 states: "Risk means a combination of probability and consequence"

2.2 Risk management

Risk management is defined as all measures and activities carried out to manage risk. Risk management deals with balancing the conflicts inherent in exploring opportunities on the one hand and avoiding losses, accidents and disasters on the other [2].

Any activity managed by a company is related to some kind of risk, so risk management relates to all activities in an organization, and is often divided into three main categories:

- Strategic risk
- Financial risk
- Operational risk

In a company like Apply Sørco where the work is project based the strategic and financial risk are generally handled on top management level, while the operational risk is handled in the everyday life of the projects. But, as a maintenance or modification project is of similar size as many Norwegian companies (from 40-60 and upwards employees and a turnover which normally starts from 30 mill NOK to several hundred million NOK per annum), there has to be focus on strategic and financial risk on the project level as well.

It is impossible to manage risk if we do not know which elements the risk consists of, and which incident mechanisms that may take place [3].

The risk management process is illustrated by figure 2.1. By establishing the context, the framework conditions shall be identified and defined. Appropriate objectives, criteria and requirements are defined, including identification of relevant stakeholders (the organization, owners, personnel, customers, suppliers, government, society, etc.) and mapping a strategy for communication between these. The risk acceptance criteria are defined in this phase, and are followed by a risk analysis [4].

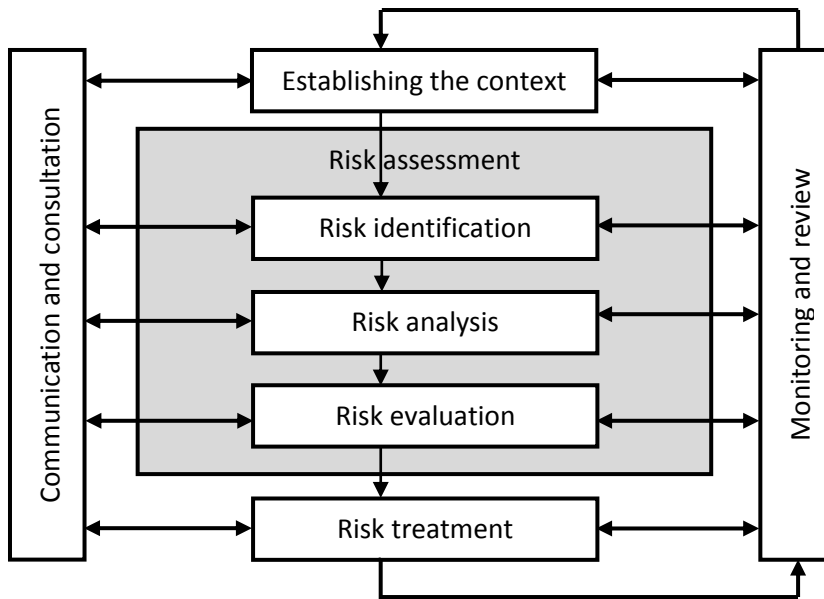


Figure 2.1 Risk management process [4]

2.2.1 Risk assessment

The foundation of a risk assessment is historical experience, analytical method, knowledge and judgement [5]. The goal is to get a good understanding of the risk picture. What can go wrong? What are the impacts? How likely is it? To answer these questions a risk assessment must be performed. Risk assessment is a key element in risk management and is the overall process of risk identification, risk analysis and risk evaluation.

The aim of **risk identification** is to generate a comprehensive list of risks based on those events that might create, enhance, prevent, degrade, accelerate or delay the achievement of objectives. And it is also important to identify the risks associated with not pursuing an opportunity. During the identification phase people with appropriate knowledge should be involved. The group responsible should apply risk identification tools and techniques that are suited to its objectives and capabilities, and to the risks faced. See table 2.1 for different risk identification, analysis and evaluation methods. Sources of risk, areas of impact, events and their causes and their potential consequences should be identified [4].

The NORSOK standard [7] defines **risk analysis** as a structured use of available information to identify hazards and to describe risk. According to ISO [4] a risk analysis involves developing and understanding of the risk, and that a risk analysis provides an input to risk evaluation and whether risks need to be treated, and on the most appropriate risk treatment strategies and methods. Risk analyses can be undertaken with varying degree of details, depending on the risk, the purpose of the analysis, and the information, data and resources available [4]. A risk analysis can be either

qualitative, quantitative or a combination of these, see table 2.2. After the risks are identified, a cause analysis is performed, followed by consequence analysis. In the cause analysis the causal factors are studied, the identify causes and conditions that may lead to occurrence of initiating events. Furthermore combinations that will result in such an occurrence are identified and if failure data is accessible, predictions of the number of times an event can occur can be done. For each initiating event, an analysis is carried out addressing the possible consequences the event can lead to [2]. After causes and consequences are established, the probability of these scenarios is calculated. Probabilities and expected values are used to express risk [2].

Based on the risk analysis a risk picture is established. And generally the risk picture will cover [2]:

- predictions (often expected values) of the quantities we are interested in (for example costs, number of fatalities)
- probability distributions (for example related to costs and number of fatalities)
- uncertainty factors
- manageability factors

The risk picture is not complete until sensitivity and robustness analyses are carried out. These analyses show to what extent the results are dependent on important conditions and assumptions, and what it takes for the conclusions to be changed [2]. **Risk evaluation** is used to assist in making decisions, based on the outcomes of the risk analysis and about the significance of risks to the organisation and whether each specific risk should be accepted or treated. When the risk analysis process has been completed, it is necessary to compare the estimated risks against risk criteria which have been established, identify actions and their risk reducing effects and document the work and define recommendations.

Table 2.1 Overview of risk assessment methods [5].

Risk assessment methods			
Risk identification methods	Risk analysis methods		Risk evaluation methods
	Frequency assessment methods	Consequence assessment methods	
Brainstorming	Fault tree analysis	Computational fluid dynamics	Risk matrix
Checklist	Event tree analysis	Source term models	F-N curve
HAZOP	Historical records	Atmospheric dispersion models	Risk profile
HAZID	Human reliability analysis	Blast and thermal radiation models	Risk density curve
FMEA	Common cause failure analysis	Aquatic transport models	Risk index
Safety audit		Effect models	
What-if review		Mitigation models	
Literature search			
Walk-through			

Table 2.2 Main categories of risk analysis methods [2].

Main category	Type of analysis	Description
Simplified risk analysis	Qualitative	Simplified risk analysis is an informal procedure that establishes the risk picture using brainstorming sessions and group discussions. The risk might be presented on a coarse scale, e.g. low, moderate or large, making no use of formalised risk analysis methods.
Standard risk analysis	Qualitative or quantitative	Standard risk analysis is a more formalised procedure in which recognised risk analysis methods are used, such as HAZOP and coarse risk analysis, to name a few. Risk matrices are often used to present the results.
Model-based risk analysis	Primarily quantitative	Model-based risk analysis makes use of techniques such as event tree analysis and fault tree analysis to calculate risk

2.2.2 Risk treatment

When a risk analysis have been completed, and a risk picture has been established it is time for the treatment of the identified risk. Risk treatment is the process of selecting one or more options for modifying risk, and implementing those options. Different approaches can be taken to treat risk is shown in table 2.3. Risk treatment involves a cyclical process of [4]:

- Assessing a risk treatment
- Deciding whether residual risk levels are tolerable
- If not tolerable, generating a new risk treatment, and
- Assessing the effectiveness of that treatment.

Table 2.3 Examples of possible risk treatment strategies

Approach	Action	The action aims to reduce
Eliminate Risk	Can be achieved by either re-planning or re-design	Probability
Mitigate Risk	Action taken to reduce or mitigate risk	Probability
Transfer Risk	Share the benefit of gain or burden of loss for a risk with another party.	Consequence
Accept Risk	This action is best when risk is low. Development of contingency plans	Consequence
Avoid risk	Decision not to become involved in, or action to withdraw from a risk situation	-

Particular attention should always be given first to risk-reducing measures which have the effect of eliminating or reducing the probability of hazardous events occurring. Protective measures should be considered after the assessment of possible preventive measures, and should be aimed at mitigating the effects of a hazardous event once it has occurred [6].

2.2.3 Risk monitoring and control

Both monitoring and review should be a planned part of the risk management process and involve regular checking or surveillance to ensure that risks are effectively identified and assessed, and that appropriate controls and responses are in place. It can be periodic or *ad hoc* [4].

2.3 Risk acceptance criteria

Risk acceptance criteria is defined as *criteria that are used to express a risk level that is considered as the upper limit for the activity in question to be tolerable* [7]. The risk above this limit is unacceptable, and actions must be taken to reduce the risk.

The first risk acceptance criteria were implicitly introduced into Norwegian offshore legislation around 1980, and were extensively used until 2000. The new regulatory regime which was introduced from 1 January 2002, referred to risk acceptance criteria as well as the ALARP (As Low As Reasonably Practicable) principle. Risk acceptance criteria still continued to be the main instrument for risk acceptance. However, since 2004 there has been an increasing focus on the ALARP principle as a supplement or substitution for risk acceptance criteria [8].

The use of risk acceptance criteria in the petroleum industry are set in the Management Regulations § 9 *Acceptance criteria for major accident risk and environment risk*.

2.3.1 ALARP

ALARP comes from the British Working Environment Act (Health and Safety at Work Act, 1974), and stands for "As Low As Reasonably Practicable" [9]. The term means that the risk will be reduced as far as practicable.

An important principle of ALARP is the "reverse burden of proof" which means that an identified measure should be reduced to a level that is As Low As Reasonably Practicable. This principle implies that all risk reduction proposals that are well founded should be implemented unless it may be shown that costs and/or other negative effects are in gross disproportion to the benefits [8].

The Framework Regulations § 11 together with the Management Regulations § 4 covers the ALARP principle. The Framework Regulations § 11 states that: "*Harm or danger of harm to people, the environment or material assets shall be prevented or limited in accordance with the health, safety and environment legislation, including internal requirements and acceptance criteria that are of significance for complying with requirements in this legislation. **In addition, the risk shall be further reduced to the extent possible.***" And the Management Regulations § 4 states that: "*In reducing risk as mentioned in Section 11 of the Framework Regulations, the responsible party shall select technical, operational and organisational solutions that reduce the probability that harm, errors and hazard and accident situations occur*" and further on "***the solutions and barriers that have the greatest risk-reducing effect shall be chosen based on an individual as well as an overall evaluation.***"

The requirement § 11 for reducing the risk requires that the established minimum level for health, safety and environment shall be met regardless of costs and that the responsible party cannot set aside specific requirements in the health, safety and environment legislation with reference to calculation of risk. In figure 2.2 and figure 2.3 the line separating the unacceptable and the ALARP region shows the minimum level of health, safety and environment.

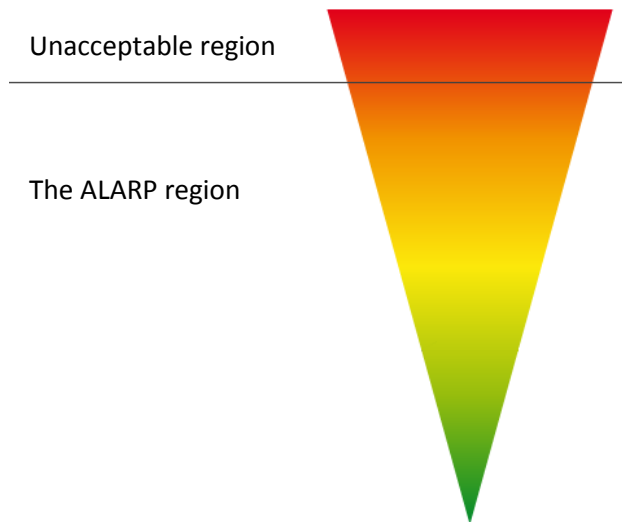


Figure 2.2 General illustration of the Norwegian ALARP principle

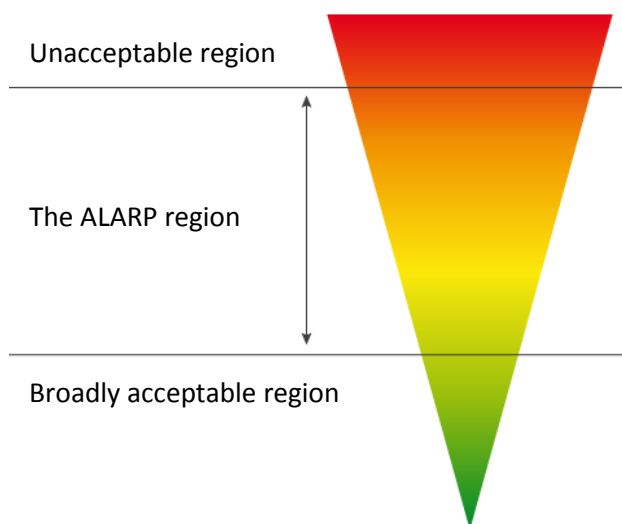


Figure 2.3 General illustration of the British ALARP principle

The region above the minimum level of health, safety and environment in figure 2.2 and figure 2.3 is called the intolerable level, and risk cannot be justified except in extraordinary circumstances. The region below the intolerable level is called the ALARP or tolerable region. In Norway, no lower level is defined which means that the risk shall be demonstrated to be ALARP regardless of the risk level [7]. In figure 2.3 there is a lower tolerable line, below that line is the broadly acceptable region, where there is no need to demonstrate ALARP.

3 Best practice in Apply Sørco

This chapter is about the everyday project-life in Apply Sørco. It explains what is done with regards to risk management, risk analysis information and the utilization of risk analyses in maintenance and modification projects.

The structure of Apply Sørco is divided into 4 main business units, shown in figure 3.1.

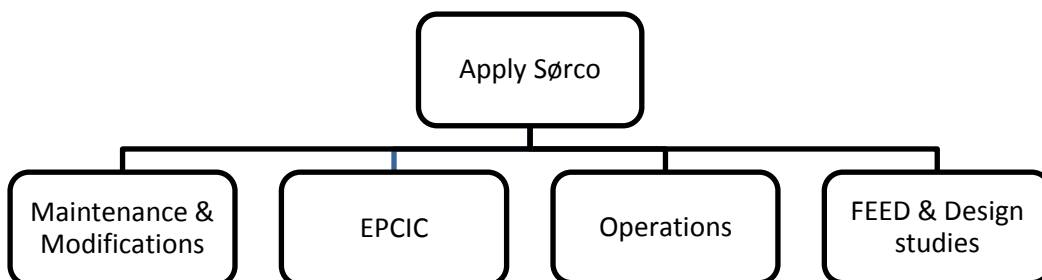


Figure 3.1 Apply Sørco four Business Units

All work that Apply Sørco undertakes is done in projects, and belongs to one of the four business units. Overall risk management principles are the same for studies, operations, maintenance and modifications and small and large EPCIC projects, There will however be a differing level of effort and detail depending on the size of the project and which stage of development to project is in, see table 3.1 which is based on table 2.2.

Table 3.1 Typical risk analysis method needed for different business units in Apply Sørco

Project type	Type of analysis
Maintenance and modifications	Simplified or standard risk analysis
EPCIC	Standard risk analysis
Operations	Simplified risk analysis
Feed and Design studies	Simplified risk analysis

Projects that falls within the area of responsibility of either “Operations” or “FEED and Design studies” are normally small projects that does not involve personnel directly in the field and hence does normally not require standard risk analyses, and can do with qualitative risk analyses executed through brainstorming and group discussions. However during bigger FEED studies a HAZOD and/or HAZID are normally carried out. A maintenance and modification contract is normally divided up into several smaller projects which can vary much in size and scope, so depending on the related task to be carried out the correct type of risk analysis is chosen. An EPCIC project is normally a big project which stretches out in time, and several different analyses are carried out during the project,

including brainstorming sessions, group discussions, HAZOP and HAZID’s, constructability review and design reviews. All of these analyses are done onshore by the onshore team, and in some cases with the participation of leading offshore personnel. When a project includes offshore work identified risks are put on job cards so the personnel offshore are aware of the risks, and own risk analyses are done offshore as well, including toolbox talks, safe job analyses (SJA) and the permit to work system (PTW).

3.1 Apply Sørco management system

In Apply Sørco’s management system the most important management tools needed for work can be found like; procedures, requirement and a regulation overview. Figure 3.2 below shows the principles and philosophy behind the management system. The idea behind the system is that there should be full traceability from regulatory requirements through the management system in the basis organization and all the way out to the activity conducted in a project. In addition to the requirements that Apply Sørco have to follow, there are often specific client requirements. In order to ensure the integrity of the management system the client requirements applies directly to the affected project. It is the project manager’s responsibility to take intact procedures from the basis organization and apply them to the project management system and supply with specific client requirements, if there is any.

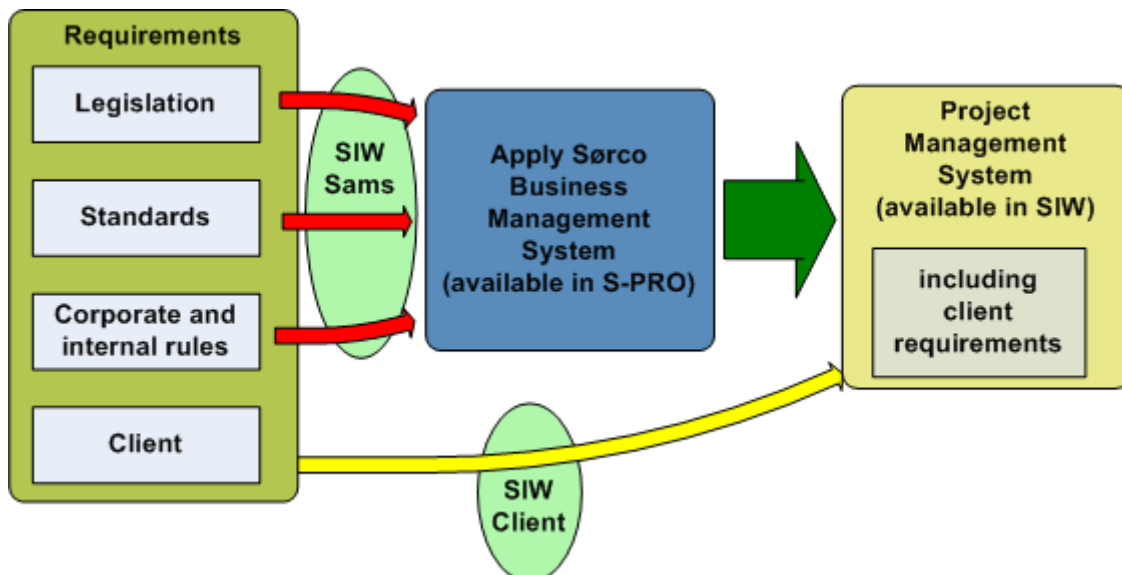


Figure 3.2 Business management principle

SAMS is the system used to identifying compliance between the requirements of laws, regulations and standards and management system to Apply Sørco. SIW is a project (or basis) intranet page, where the projects can post information about the project, organization, phone lists, project manual, project-specific procedures, links to tools used in the project and so on. S-PRO is the procedure

works for the company presenting all standard governing documents (procedures and instructions) valid for both the basis organization and project activities. In additions, you will find standard check lists and best practice when applicable. Project specific and customer adapted procedures and instructions are made available in the Project SIW site.

The management system is built up in this way, as mentioned, to ensure full traceability. This can be shown in two ways. Firstly, by including both the legislation, standards, corporate and internal rules into their management system Apply Sørco ensure compliance to the regulatory requirements. Secondly, it is possible to start in the opposite end by the execution of work, and take a look at the checklists and procedures and work your way backwards through the system and see that you are in compliance with the regulations.

Typical client requirements could be very general like establishment of a management system, or more precise where specific points are listed, see table 3.2.

Table 3.2 Example of typical client requirements

<p>4.6 Risk Management</p> <p>Contractor shall establish a management system to identify, register and follow up major threats and opportunities for the Work. These shall include any technical issues or interfaces, critical with respect to schedule, or any other areas that might cause an exposure to the project execution. Risks shall be handled in accordance with the requirements given in App D.</p> <p>Risks or mitigating actions identified as pending Company work or decision shall be presented to Company as soon as possible.</p>
<p>Contractor shall:</p> <ul style="list-style-type: none"> • Review the FEED HSE risk analysis, ref Appendix E, evaluate and identify mitigating measures accordingly • Identify HSE requirements and implement safe and operable solutions into the design • Carry out HSE reviews to continuously ensure that the work is being performed in full compliance with the HSE design criteria specified by authorities, recognized codes, standards and Design Basis • Perform HAZOP, HAZID and ALARP analysis • Establish and further develop a SAFU register/HSE follow up register.

3.1.1 Project Execution Model

As soon as the requirements are identified a project execution model is made. A PEM ensures that projects are implemented in the most optimal uniform manner, with regard to quality, health and safety, on schedule and within approved budgets. In addition, implementing the model increase the understanding of the milestones to be achieved, defines what has to be provided to achieve these milestones and the work processes that must be performed to complete the deliveries. The PEM can be used as a tool for continuous improvement. The client will, through the contract, take measures for an effective, safe and controllable implementation. This will be project-specific measures to be implemented separately in the execution model [10].

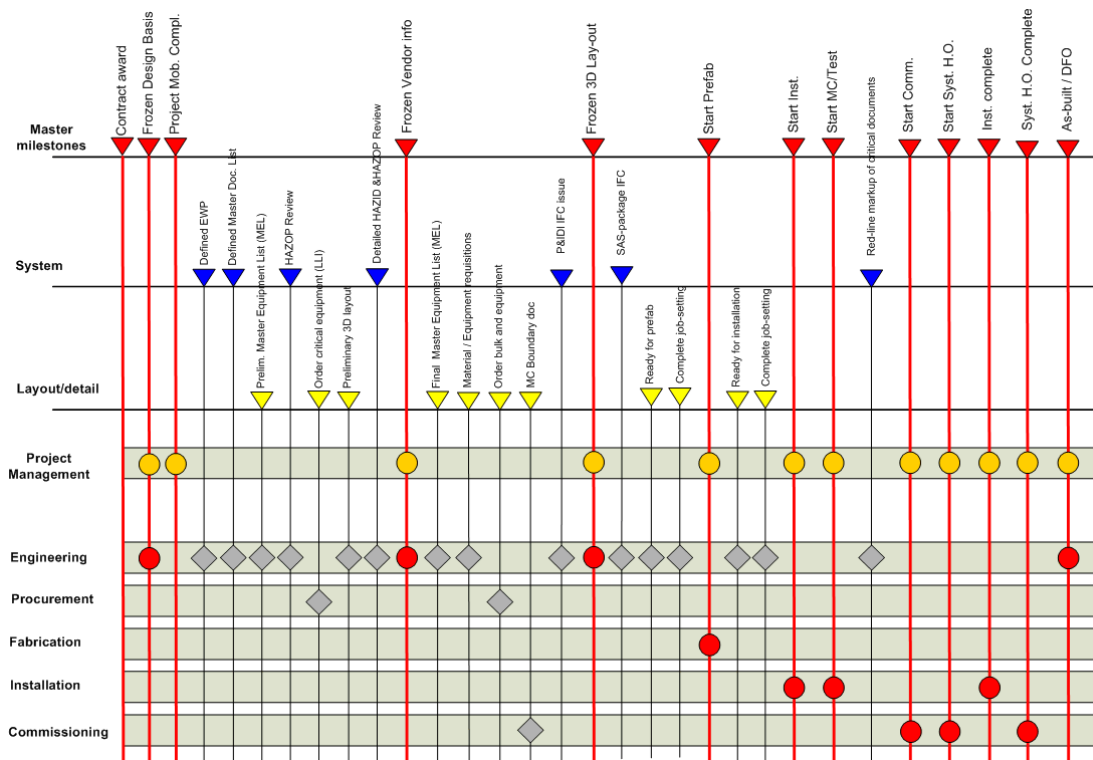


Figure 3.3 PEM for an EPCIC project.

As shown in figure 3.3 the PEM for an EPCIC project contains both minor and major milestones throughout the project from start (contract award) to finish (as-built/DFO). Some of the minor milestones are directly involved in risk management and can be linked to both internal and client requirements, like a HAZOP and HAZID study (see table 3.2 for client requirements).

3.2 Risk Management in Apply Sørco

The overall risk management in projects is the responsibility of a project manager, but is very often delegated to a key member of the project management team for the day-to-day follow-up. Figure 3.4 below shows a typical project organization during the execution phase of an EPCIC project. The project organization may vary from project to project depending on the size of the project and scope of work. For example can planning and procurement be placed under the responsibility of the project controller, or the HSE manager can hold the quality and risk responsibility too. The gray boxes in the project organization are so-called “safety boxes”, where work related to safety and risk is handled [1].

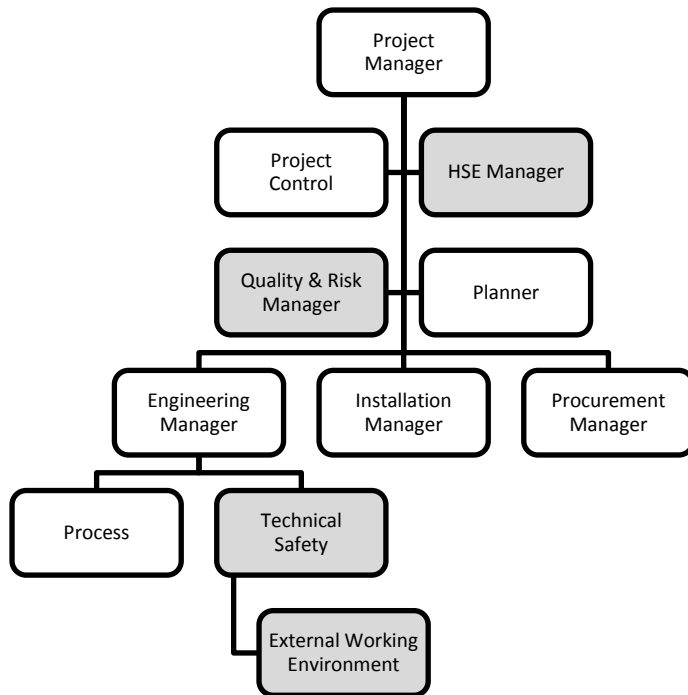


Figure 3.4 Typical project organization for an EPCIC project [1]

As seen in figure 3.4 the grey boxes are directly involved in the risk reducing work in one way or the other. It is not always clear where the different interfaces between the different disciplines is. The HSE manager is responsible for follow-up of the whole HSE area. In particular the HSE manager is responsible for continuously ensuring that the work is being performed in full compliance with HSE design criteria specified by authorities, recognized codes and standards such as NORSOK S-012 *Health, Safety and Environment (HSE) in construction-related activities*. The Quality and Risk Manager is responsible for follow-up of quality processes, continuous improvements, internal audits and the risk management area. However, it has proven that it has not always been the Quality Manager that has gotten the risk management responsibility. In some projects this has been placed under project control, and in other projects it has been neglected. The technical safety engineer, and also the environmental engineer if present, is integrated in the design organization. The design organization can be from only a few disciplines to many such as process, piping and layout, structure, mechanical, electro, fabrication and so on. Even if the design of man-machine interfaces and technical safety systems takes place in one of the other disciplines it is the safety discipline engineer or lead who has the necessary expertise for interpretation of the safety requirements to such systems and stays in continuous contacts with the other disciplines for clarification of detailed design issues. The safety discipline (and environmental engineer) comprises expertise on safety systems, working on environment and environmental care. The safety personnel's competence is a critical issue, because of the complexity of the work processes to implement safety requirements [1].

3.2.1 Risk management process through a project

Figure 3.5 below gives an overview of the risk management process, from the tendering phase, through the execution phase to the final steps. Briefly explained, during the tendering phase a brainstorming risk workshop is carried out and all the risks connected to the contract and project execution are listed in a risk register. This register establish the basis for further work once the contract is secured. Together with the contract award follows a lot of background information for the project, and sometimes information from the QRA/TRA for the platform is made available, and sometimes not. During the project execution the risk register is maintained and updated continuously by the help of risk workshops that are carried out with regular intervals throughout the project, where new risks are identified and handled. During design, at certain milestones, larger risk analyses are carried out. I.e. when all the P&IDs are finished, HAZOPs and HAZIDs are executed. When the installation phase offshore starts, then additional risk follow up is done offshore, with the help of SJA, toolbox talks and work permit systems. When the project is nearing the end, the handover documentation to the client is prepared. From the risk management point of view, this means preparation of safety documents and an evaluation report with input to the client, for the regular update of the QRA/TRA with for example information regarding new leakage points.

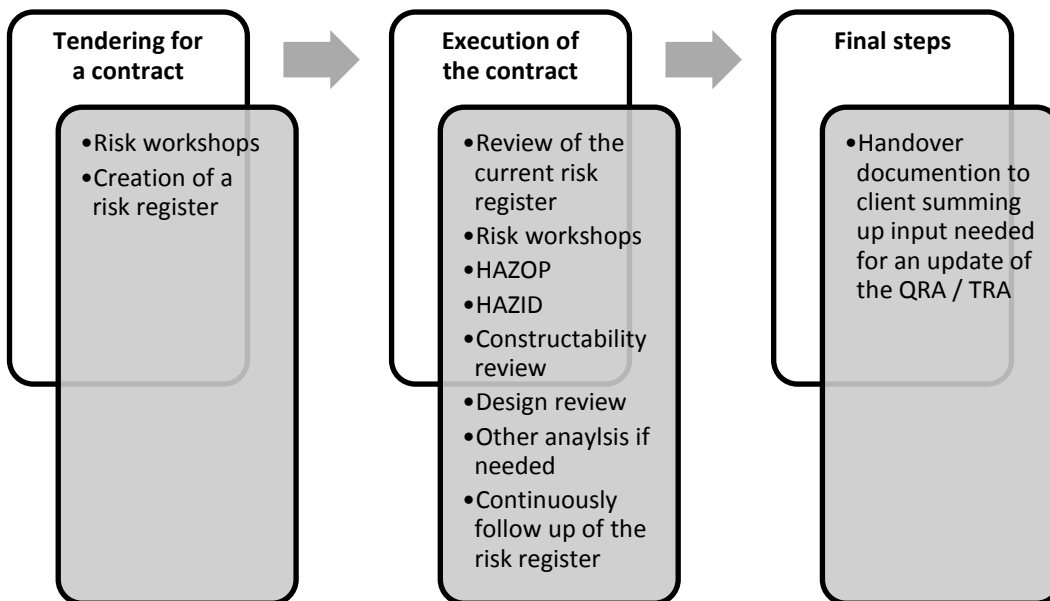


Figure 3.5 Illustrative overview of the risk management process through a project

3.3 Risk Management procedures in Apply Sørco

Below is a brief summary of the three procedures regarding risk management in Apply Sørco.

3.3.1 CR-1500 Uncertainty and Risk Management Manual

CR-1500 [11] establishes how risk, associated with the contracts Apply Sørco undertakes, shall be identified, registered and treated. The manual defines responsibility and the risk management software to be used. Risk management is an integral part of project management. Hence, Risk Management is the responsibility of the Project Manager.

Projects may appoint a Risk Manager assisting the project manager in the continual updating of the risk register, but the project manager still has the overall risk management responsibility.

It is then the risk manager's responsibility to ensure that the project review all risks, that the project treats them in accordance with the requirements, the risk register is continuously updated and that the company's top management are kept informed so that it can at all times keep track of the total risk the company is exposed to.

3.3.2 CR-1510 Risk Management in projects

This procedure establishes the Risk Management process to be used in all projects. CR-1510 [12] opens up for the project manager to decide how risk management shall be carried out in minor projects being carried out under a Maintenance and Modification contract. However, the risk register and the risk assessment for the whole contract shall be complete and adequate in alignment with the intentions in the Risk Management process in Apply Sørco.

Further it gives a description of the identification phase, the risk assessment and the risk register, with the use of PIMS R3. PIMS R3 is, by CR-1500, defined as the risk management application to be used in the organisation.

As part of the start-up activities for a project the risk management context shall be defined, this includes how often to update the risk register. For insignificant risks and risks concerning tasks or activities under the cover of procedures or other approved work descriptions omission from the risk register shall be considered. However, if there is any doubt whether the risk should be registered in the risk register, the risk shall be registered. The common approach is having a workshop facilitated by the risk manager.

Before the risk assessment is done, CR-1510 states that all relevant risk acceptance criteria must be established. The risk acceptance criteria laid down in legislations are embedded in the Apply Sørco Business Management System and hence is the standard in PIMS R3 configuration. For project

specific risk acceptance criteria, which deviate from the standard setup, the project must ensure to update the register accordingly. CR-1510 has many good points when it comes to performing the risk assessment and treatment. When evaluating the risks identified and the treatment a risk owner shall be assigned, who is responsible for mitigating action aiming at reducing the risk level to an acceptable level. The outcome of the risk assessment should be a prioritized list, according to the combination of probability and consequence.

3.3.3 CR-1550 ALARP in projects

CR-1550 [13] determines how the requirements of ALARP shall be fulfilled in the projects, and a short description of responsibility and the ALARP process, in addition to a reference to “*ALARP-prosesser. Utredning for Petroleumsylsynet*” from Preventor. The article referred to is not a framework nor a guideline, but a review of 9 operator company’s documentation and practice from Preventor. As stated in the study “PSA wanted to prepare a report that can give an overview of how the industry understands these guidelines (*“these guidelines” meaning the ALARP process in § 11*) and how they put this into practice. The report shows that the industry has an incomplete understanding of how the ALARP principle should be implemented to comply with § 11 of the Framework Regulations” [9]. In the article there is also a chapter explaining the ALARP concept in a risk management context and what an ALARP process is.

3.4 PIMS R3

In addition to the procedures regarding risk management, Apply Sørco has PIMS R3 to help with the handling of risks. PIMS R3 is a risk management IT software, where identified risks are recorded and managed. In PIMS R3 identified risks can be categorized, a preliminary risk assessment can be performed, mitigating actions can be planned, and risk and action owners can be assigned². A risk owner is an organizational unit or person with the authority and responsibility to manage the risk and an action owner is an organizational unit or person with the authority and responsibility to implement and carry out the action. In PIMS R3 every project has its own domain and every project have the opportunity to aggregate risks, which then will be visible on the upper management level in Apply Sørco.

During the risk assessment, the risk matrix together with a consequence matrix in PIMS R3 can be very useful. The risk matrix shown in figure 3.6 has a 5x5 dimension with the probability scale moving horizontally and the consequence scale moving vertically. In PIMS R3 there are two different matrices, one for risks defined as threats and one for “positive” risks or opportunities. The latter one

² See Appendix A for the layout in PIMS R3

is however, in different shades of blue. When a risk ends up in the red area, actions must be taken immediately to reduce either the consequence, likelihood or both to lower them down into the “ALARP-area”. According to UK-legislations it is only the yellow area that is defined as ALARP, and the green area is the broadly acceptable area, see figure 3.2. According to Norwegian legislations the ALARP principle is prevailing both in the yellow and the green area.

P1/C1	P2/C1	P3/C1	P4/C1	P5/C1
P1/C2	P2/C2	P3/C2	P4/C2	P5/C2
P1/C3	P2/C3	P3/C3	P4/C3	P5/C3
P1/C4	P2/C4	P3/C4	P4/C4	P5/C4
P1/C5	P2/C5	P3/C5	P4/C5	P5/C5
Threat		Opportunity		

Figure 3.6 Risk matrix used in PIMS R3

The probability moves on a scale from P1 to P5, from very unlikely to very likely, and the consequence moves on a scale from C1 to C5, from negligible to huge, see table 3.3. The probability is a set value, while the consequence can be both positive and negative depending on whether the risk is a threat or opportunity.

Table 3.3 Probability and consequence scale used in PIMS R3

Probability scale		[%]	Consequence scale	
P5	Very likely	50 to 100 %	+/- C5	Huge
P4	Likely	25 to 50 %	+/- C4	Major
P3	Less likely	5 to 25 %	+/- C3	Moderate
P2	Unlikely	1 to 5 %	+/- C2	Minor
P1	Very unlikely	0 to 1 %	+/- C1	Negligible

There is a consequence matrix [appendix B] designed to assist the risk assessment, with the following categories:

- Health, safety and security
- Reputation
- Environment
- Quality

- Financial impact
- Schedule impact

The first 4 categories are set consequences, whilst the two latter ones can be adjusted according to the size of the project. PIMS R3 allows for a multitude of different reports to be created, which will help the risk management process.

In PIMS R3 there is an ALARP function where it is possible to record a description of the hazard, source of identification and potential risk reduction measures, but this function is currently not being used in Apply Sørco.

4 Evaluation of best practice in Apply Sørco

In this chapter Apply Sørco's work methods is evaluated and discussed, together with the IT-system and personnel in the company.

4.1 Work methods

The management system in Apply Sørco is, as shown in chapter 3.1, a comprehensive and robust system that is carefully designed to meet prevailing regulations, standards, internal and client requirements.

This management system is designed as a procedure-based system with emphasis on procedures being the main guidelines to any task that shall be done. A procedure is a governing document providing detailed descriptions on how to carry out a specific task or how to fulfill a requirement. Apply Sørco is per definition in ISO 9001 a development company, and not a production company. A client comes with a request or an inquiry, and it is then up to Apply Sørco to solve it in the best possible manner. One of the main challenges with the procedure-based management system is that once the project is completed and the request and needs are fulfilled, Apply Sørco will most likely never carry out a copy of that project again. Another challenge with a procedure-based management system is the interfaces between the procedures and to make sure that nothing is forgotten in any procedures and that none of the procedures overlaps. In addition it generates a good amount of extra work having many procedures when all of them shall be updated with regular intervals. As the company takes on more and more complex projects and expands its knowledge level the number of procedures will also increase and the administration of the different procedures becomes a major job.

A process description on the other hand, is for many companies better than a procedure for more complex and non-repetitive tasks. When a task is getting complex it can be useful to start in the opposite direction of the step-by-step driven procedure that explains exactly how to do what, and instead have a look at the end product. What should be delivered? How should it be delivered? How can this be achieved? This compels the user to think about the process and the look at the bigger picture from beginning to end. A process description is a description, as the name implies, of a work process designed to undertake a specific task and produce a defined result with a defined quality. Included in the process description should be planned output and required input, the requirements from legislations, customer and internal requirements, and the required resources and competence.

The risk management structure in Apply Sørco is somewhat confusing. The risk management responsibility is placed under the Quality Manager on management level. The organization chart has however not been updated, so in reality it is difficult to recognize where the responsibility lays. In the management system there are three procedures that covers the field of risk management, namely CR-1500 *Uncertainty and Risk Management Manual* which came early in 2010 [11], followed by an ALARP procedure, CR-1550 *ALARP in projects* issued in 2010 [13], and the third procedure, CR-1510 *Risk Management in projects* was issued early in 2012 [12].

According to ISO [4] a company should have a risk management plan, which is defined as a scheme within the risk management framework specifying the approach, the management components and resources to be applied to the management of risk. This seems to be insufficient defined in Apply Sørco. As mentioned in chapter 3.2 several different disciplines are involved in risk and safety related work. As long as this is not clearly defined confusions may occur, regarding who should be doing what.

4.2 IT systems

The IT tool that Apply Sørco uses, PIMS R3, is explained in chapter 3.4. According to ISO [4] risk management activities should be traceable. Records provide the foundation for improvement in methods and tools in the risk management process, as well as in the overall process. In the early days of risk management in Apply Sørco a Microsoft Excel template was used as the risk register and for recording purposes. For smaller projects with few risks an Excel sheet can prove to be sufficient. For a larger project that extends over a long period of time with many risks and uncertainties (often over a 100 during the project period) an Excel sheet can become rather confusing and difficult to follow. With the use of spreadsheets it can be difficult to generate various reports if needed. In PIMS however neither various reports nor difficult setup is a problem, as the whole system has been designed to be an easy to understand and gives an easy overview of the three primary attributes of risk that should be identified and tracked: areas of potential risk, probability of risk occurring and the impact risk could have on the project if it occurs [14].

One of the challenges with the use of risk management software like PIMS R3 instead of a spreadsheet type is getting the personnel on a project to see benefits of using it. Not only see the benefit of using it, but actually getting the user to utilize the software on a regular basis. Normally with the use of a spreadsheet, you have only one user, however with PIMS R3 several people can log on to and use the tool at the same time. This leads to the fact that several people now has to take an ownership to the risk management process, and many believe this will mean an increased workload. On the other hand, this means that more people will be more involved and get an ownership in the

process. A key aspect of having successful risk management software is that the register is being kept live throughout the project, and not something that is only being used at certain milestone because a procedure says so.

One of the main benefits of specialized risk management software is that, once you learn how to use it, it is very user-friendly and gives new opportunities in the risk management process. There are a numerous amount of different reports which can be generated and visually it is easy to see which risks are the most important to focus on, and it gives a good risk picture.

Specialized risk management software is not a guaranteed factor for a company to achieve success in the risk management process. To accomplish that one must have qualified and dedicated personnel both in managerial positions and among the staff who sees the intention and purpose of having a good risk management process. Complex risk management software can be compared to a photographer and his camera. The quality of the pictures taken does not necessarily get better if the old camera is upgraded to the newest and most high-tech camera as long as the photographer does not possess basic knowledge of photographing, but the picture quality will get better if the photographer keep his old camera and seek the help to develop himself and expand his knowledge as a photographer. There must be a balance between the quality of the tools and the knowledge of the user.

4.3 Personnel

In many companies the most vital asset is its personnel, and that is also the case for Apply Sørco. This is supported by Bolman, Deal and Thorbjørnsen, “It is said that people's skills, attitudes, energy and commitment are important resources that can be used to either create or destroy a business” [15]. The company can have an excellent management system and very good procedures; these will however be worthless if there is no compliance from the personnel. A company's expertise is dependent on the personnel's education, training and experience. To exploit the maximum potential it is important that the majority pull in the same direction and work towards the same goal. The same principle can be demonstrated with an example of moving, or pulling, a heavy object from A to B. If it takes 10 strong men to move the heavy object it would go a lot faster if everyone was pulling in the same direction and working towards a mutually agreed goal. It is the same with risk management, and to get everyone working with a common understanding and towards the same goals, it is important that everyone has the same apprehension of what risk management actually is, and that everyone shares a common definition of risk. It can be clever to start with a top-to-bottom approach with risk management, and get a get a commitment from the management team. Once you

have the upper management's attention in place, leading by examples is always a good thing, and then you can start to focus on the necessary areas.

To get everyone working in a uniform matter it may be clever to get a standardized method of working in projects, with the risk management responsibility placed on the same discipline in every project. In the different projects today the risk management responsibility is divided between HSE, quality and project control. These three disciplines have a different working-day, so it is challenging to get a standard way of working with risk management when the responsibility is split between different disciplines. A project control manager with the responsibility of risk management might have a different view of how to manage the risk than a HSE or quality manager. When a common discipline across the projects have been established it will be possible to launch a forum to further develop the risk management process. Even though a project risk manager is in place, it is still a collective responsibility to work as safely as possible, and do the necessary actions to reduce the risk level.

With the use of software like PIMS R3, training is necessary, and this has started in Apply Sørco. At present around 50 people have received training in PIMS R3 and how to use to software³. However there is currently no training or courses scheduled in neither PIMS R3 nor the field of risk management, and as long as that is lacking it can be difficult to get a uniform understanding of risk management.

³ Somewhere along the way from the course instructor to the HR-department and the person responsible for the competence tracking, an error has been made and the courses has not been registered into Apply Sørco's course management system. The author has however seen the list of participants on the intro course to PIMS R3 and can confirm that the number of people taken the course is 48.

5 Proposal for improvements in the work process

In this chapter two main proposals for improvements will be presented, regarding risk management in Apply Sørco. The two proposals for improvements are getting a common understanding of risk management in the company, and creating new governing documents.

Increasing focus in the industry and growing attention from PSA forced Apply Sørco to start generating a formalized process of risk management. A new regulatory regime was introduced from 1 January 2002, and referred to risk acceptance criteria as well as the ALARP principle. Risk acceptance criteria still continued to be the main instrument for risk acceptance, but since 2004 there has been an increasing focus on the ALARP principle as a supplement or substitution for risk acceptance criteria [8].

As stated in chapter 4, Apply Sørco is doing much the right way. Even though many things are in place and a lot of good work is carried out, there are always room for improvements, such as making sure that everyone working in Apply Sørco has a common understanding of the concept of risk, and that all of the managers, who have a decision responsibility in Apply Sørco has an understanding of risk management. In order to improve the level of knowledge regarding risk, several measures can be taken, for instance; hired instructors to give introduction courses, include risk as a topic in the internal HSEQ campaigns and update the governing documents.

5.1 Get a common understanding of risk and risk management

Based on the observation of several projects in Apply Sørco, it is clear that there is no common method of working with risk management. In one project the risk management responsibility is placed under the project controller and in another it is the HSE manager's responsibility and in a third project there is a Quality and Risk manager. One reason for this can be lack of procedures stating how it is supposed to be. This combined with the fact that different people and project managers have diverse experience, working to the best of their ability, gives different approaches in different projects. The same can be said for the personnel in the project; people in different disciplines have different education and experience, and does not necessarily have the same definition of risk and risk management. Whilst a project controller can be most concerned about the financial side of risk management and have less focus on the "soft side", a HSE manager can be more concerned about people's health, well-being and safety and the external environment, and less concerned about the financial aspect. Placing the responsibility on different disciplines in different projects will affect the projects and be conducive to different focus. Assigning the responsibility to the same role in every

project can help getting a consistent work method and hopefully increase the understanding of risk management as the personnel are getting more experienced.

In every project there is a technical safety engineer who also works with safety and risk management, but on a different level. They are working on a more “hands-on” level with risk analyses and barrier management, as opposed to the management team who are working on an overall level. The types of risk analyses normally executed by Apply Sørco in projects are simplified risk analyses (ref table 2.2). A subcontractor is normally hired to execute standard risk analyses to the extent that Apply Sørco as a contractor has any responsibility for that. Regarding HAZOP’s and HAZID’s it is Apply Sørco’s responsibility to execute and follow up the analysis, however a subcontractor is hired to facilitate the meeting. This is done by a professional facilitator, who is unbiased, to ensure that every aspect in the analysis is covered and that nothing is forgotten.

The personnel from Apply Sørco working offshore (for Statoil) must follow action pattern, called A-standard. This means that before the job is started there is a set of 11 items on a checklist that shall be accomplished as a dialogue in the team responsible for doing the job, like identifying risks and finding the correct procedures. Once the job is started a planned time-out shall be taken, where the whole team is gathered and have a dialogue regarding the job and if anything has changed from planning to execution. When the job is finished the team shall be gathered again to sum up the job to see if everything went according to plan and if there are any improvements to be done [16]⁴. One of the most important of the 11 items to be done before the job is started is a safe job analysis. A SJA is a simple qualitative risk analysis used to identify hazards that are associated with a work assignment that is to be executed [2]. Offshore this method is very effective and highlights the focus on preventing anything from going wrong, i.e. reducing the likelihood.

Onshore however, even though the same principle applies, a job or delivery may have an execution plan of several weeks, months or years and the same action pattern tends to be taken more lightly. Still, it is important to plan the job, have on or several time-outs as the project are moving towards completion. This starts already before a contract is handed out. In the tender phase the first risk workshop is carried out to identify every uncertainty and risk associated with the contract. If the risk involved with the job is not at an unacceptable level, the company will tender for the job. If the contract is awarded another risk workshop is conducted in order to create a risk register and start with the risk treatment.

⁴ See also appendix C for an extraction from the little A-standard book from Statoil

All the disciplines involved in the project will be represented at the risk workshop, together with the management team. This could be everywhere from a few people up to around 15-20 in bigger projects. When you have so many different disciplines and people working with the same matter, a common work method and understanding of risk will ease the workload of the involved personnel and ensure a comprehensive review.

Several methods can be used to enlighten the company on the subject of risk and enhance the knowledge level. As a first the company should define their goals, and what level of knowledge the company should be at. Then, to increase awareness run campaigns with risk on the agenda. Campaigns are popular tools to get focus on special areas. Simultaneously, an expert on the area should be engaged to give a lecture in an auditorium to the personnel. Another option is to give the lecture in smaller classrooms where the participants can practice what they're learning on computers.

5.2 Improve and add new procedures regarding risk management

Improving and adding new procedures are in connection with the previous point in 5.1. In order to achieve a common understanding it is important to have support from the governing documents.

With reference to chapter 4.1, Apply Sørco only has 3 procedures concerning risk management. There is no minimum requirement of procedures given in the Norwegian statutory framework. On the other hand the management regulations section 5 states that barriers shall be established to reduce the probability of failures and hazard accident situations developing [17]. Having procedures in place and consistent work methods can help getting a common work method in Apply Sørco.

The 3 procedures that Apply Sørco has, is a good starting point, but CR-1500 and CR-1510 is only up to a tolerable standard and the last one, CR-1550, can barely be called a procedure, it only describes briefly what the ALARP principle is and that the ALARP process should follow the guidelines given in the document "ALARP-prosesser. Utredning for Petroleumstilsynet 2006" [13]. The fact that the two procedures, CR-1500 and especially CR-1510, are only based on ISO 31000 and nothing else indicates that they could be somewhat thin. This does not necessarily mean that the procedures are poor, but it gives an indication that they could be lacking some substance. A look could be taken on ISO 17776 *Guidelines on tools and techniques for hazard identification and risk assessment* and NORSOK Z-013 *Risk and emergency preparedness analysis* to see if that is something to build one of the procedures on. Another alternative which could be an option is to make some checklists to go with CR-1510, to ensure that everything is accounted for. In addition to the three existing procedures, some guidelines could be helpful for the different projects.

CR-1550 *ALARP in projects* is the procedure made to cover the ALARP principle. This procedure is lacking several important aspects. It states that the ALARP process shall follow the guidelines and principles in *“ALARP-prosesser - Utredning for Petroleumstilsynet”*. This document is, as stated, not a framework nor a guideline, but a review for PSA of 9 operator company’s documentation and practice from Preventor. The document concludes that there is an incomplete understanding of the ALARP principle. In the document only review operator companies, and not any contractor like Apply Sørco. It is likely to believe that if there is a lack of compliance from the operators then this will also follow the contractors. However, the report from Preventor is now 6 years old (published in 2006) and presumably the industry has gotten a better overview and improved understanding of the ALARP principle. This improved understanding (if any) seems to be lacking in Apply Sørco though. The ALARP procedure states that “the project manager is responsible for the ALARP principle is considered for all identified uncertainties and risks, and that appropriate measures are planned and monitored” [13]. In the study from Preventor there is a chapter explaining the ALARP concept in a risk management context, and this is missing in CR-1550. So instead of just referring to a large document in CR-1550, the procedure should be rewritten to include an explanation of what the ALARP process is, and how an ALARP process should be carried out. In the ALARP procedure there should also be a description of the risk identification methods, or a reference to another procedure containing risk identification methods to help give a uniform work method.

Together with to CR-1550, there should be an additional procedure, for instance: “CR-1560 ALARP Register” with information and instructions regarding an ALARP register. This does not necessarily have to be a procedure, a company guideline might be sufficient. An ALARP register is also an important aspect to the ALARP procedure according to NORSOK Z-013: *“All identified risk reducing measures, where the conclusion to implement or reject is not obvious, should be registered and treated in a systematic way in order to ensure that the risk is ALARP. An ALARP register can be established to keep track of identification, evaluation and decisions regarding risk reducing measures that are subject to an ALARP process”* [7]. Further on it states “Documentation of risk reduction should be documented as part of the planning of major re-buildings or modifications of the facility or changes to the operation or organization of the facility”. The latter one is not applicable to Apply Sørco as it is the Client (Operator Company) who has the responsibility. The first line however, “re-buildings or modifications” are one of Apply Sørco’s main areas of business (see figure 3.1). In the process of making a risk register template it could be a good idea, because of Preventor’s report stating that there is a lack of understanding of the ALARP principle, to include one of the big clients that Apply Sørco have on their client list, to ensure that there is commonality and learn from each other.

As mentioned in chapter 3.4, there is an ALARP function in PIMS R3 which is currently not being used. The reason for this is firstly that there are no instructions or guidelines on how this should be used, and secondly, after having reviewed it, it is not very intuitive nor user friendly, see appendix D. As shown, there are several references to internal Statoil documents, like TR1055 and TR2237. If however, Apply Sørco is going to utilize the full potential of PIMS R3, it is worthwhile having PIMS R3 customized to fit Apply Sørco internal procedures. Before this can be done, the procedures and guidelines have to be created.

In addition to improving the ALARP procedure, and preferably improving the two other procedures too, and the proposed CR-1560, a procedure describing how the identified risk should be managed, and clearly defining the interfaces between different disciplines should be defined, because that is lacking today. This could either mean a re-writing of CR-1510 *Risk management in projects* or an entirely new procedure.

In the projects there are several instances involved in the risk identification process and there are confusing interfaces between the ownership to the different risks, see figure 5.1. As it is today, the risks emerging during a HAZOP or HAZID is under the ownership of the technical safety discipline, treated there and after the risks are treated the outcome is a HAZOP- or HAZID close-out report [18],[19]. Risks discovered during a brainstorming however, is assigned to the risk manager and although he or she is not assigned as a risk or action owner. The environmental engineer has their own procedure and risk identification to identify and follow-up the environmental risks like pollution, environmental spill or chemical handling. And there are procedures to identify and follow up HSE-related risks like risk exposed groups, noise, vibrations etc. In order to keep track of all the risk assessment and management in the different discipline, a procedure stating how all the different elements should be managed in the overall risk management process is needed. As mentioned in chapter 5.1, there is also a lot of risk identification ongoing offshore. The personnel offshore is the installation manager's responsibility, see figure 3.4, and as mentioned they have their own procedures regarding the management of risks offshore. But as long as Apply Sørco are in charge of the personnel offshore, it is also Apply Sørco's responsibility to carry out risk management and safe operations, and should therefore be covered by the overall risk management philosophy in the company.

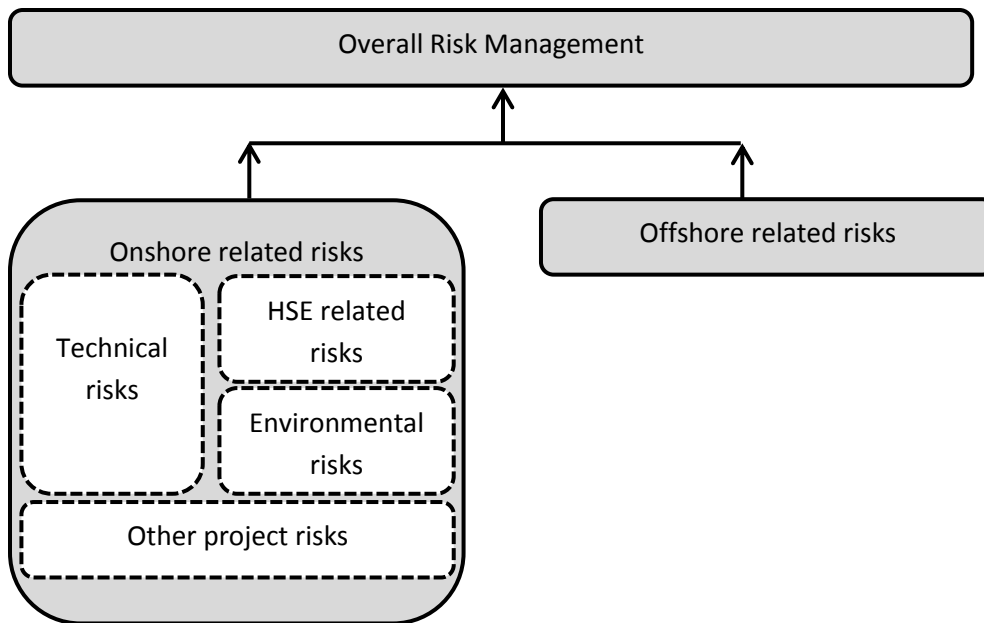


Figure 5.1 Typical risk areas in a project

Finally, consideration should also be given to a procedure or a guideline regarding the risk management software PIMS R3. There is a need for clear guidelines on how to utilize the software the best possible way. Roles and responsibilities of the risk- and action owners should be defined, as well as the interfaces between the different disciplines, and all procedures should contain definitions and abbreviations.

6 Conclusion

After reviewing the risk management system in Apply Sørco it is clear that it could use some improvements. There is not a shortage of good work and correct actions, nevertheless an overall system and structure that is satisfactory is still not in place. Several of the procedures need re-work, especially CR-1550 ALARP in projects. One or two new procedures should be created, to support the existing procedures. As mentioned in 5.2 one of the new procedures should be “CR-1560 ALARP Register” to help guide the company with the use of an ALARP register and the documentation of the results from the ALARP assessments. Another procedure regarding PIMS R3 should be created, to help the various project utilize the software to its full potential, yet at the same time have be in accordance to the other projects.

This could also help the organization carry out the work correctly and in a uniform matter across the different disciplines, making sure that every project, regardless of the size, work in compliance to internal and external requirements. Together with the new and improved procedures, Apply Sørco should invest in some basic training to raise the level of knowledge regarding risk management. This is to fully benefit from the improved procedures and work as effectively as possible.

Therefore, getting a common understanding across the company regarding risk management and a uniform work method is believed to help Apply Sørco becoming a respected company regarding the risk management process.

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8 Appendices

Appendix A

RM - Risk Lite ×

Risk ID:

Description:

Risk Owner:

Installation:

Contract:

Project Phase:

Title:

Status:

Project:

Assessment part

H & WE
 Security
 Quality
 Safety
 Environment
 Reputation

Manageability:
 Schedule: days
 Cost: mill.

Consequence Comments:

Assessment Date:

Threat

Opportunity

TopTen:

Nominated:

Aggregate:

Confidential:

External:

ALARP:

Potential major accident:

Time of exposure:

[Quick](#)

Action ID	Action Title	Responsible	Deadline	Status
* Record 0 of 0 (Total: 0)				

RiskID

Title

Filter By:

- Risk Activities
- Installation
- Status
- Impact Category
- Assessment
- Project Phase
- Contract
- Risk Owner
- Risk Visibility

Appendix B

Consequence Matrix
Tordis / Gullfaks C Topside Upgrade



	HEALTH, SAFETY AND SECURITY	REPUTATION	ENVIRONMENT	FINANCIAL IMPACT	SCHEDULE IMPACT	QUALITY
C1 Negligible	First aid injury or occupational illness/effect with minor impact on health and ability to function	Negative exposure with limited importance	No or very limited impact on natural habitats. No impact on population level, only on individual organism level	0-1 millions	0-14 days	None
C2 Minor	Medical treatment injury or occupational illness or short term psychological stress	Local/regional negative exposure in mass media or from authorities and	Adverse short term impact on natural habitats	1-10 millions	14-30 days	Minor effects on capacity/regularity
C3 Moderate	Serious injury, psychological stress or illness with possible permanent effects	National negative exposure in mass media. Negative exposure from national	Adverse medium or long term impacts on a significant part of habitats (e.g. restitution)	10-50 millions	30-90 days	Moderate effects on capacity/regularity
C4 Major	1-2 fatalities on workforce, serious illness, psych. stress or chronic exposure resulting in significant life shortening effects/death to workforce	Negative worldwide news coverage in media. Negative attention from important organisations	Adverse long term impact on ecologically valuable natural habitats (e.g. restitution time 3-10 years)	50-100 millions	90-180 days	Major effects on capacity/regularity
C5 Huge	Several fatalities on workforce or fatalities to public, serious illness, psychological stress or chronic exposure resulting in significant life shortening effects/death to public	Legal proceedings with possible major legal impact. Extensive negative worldwide news coverage. Possible loss of license to operate	Adverse permanent impacts on key ecosystem functions and services in larger natural habitats (e.g. restitution time > 10 years)	100-> millions	180-> days	Huge effects on capacity/regularity

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Probability Scales:
P5 Very likely 50% to 100%
P4 Likely 25% to 50%
P3 Less likely 5% to 25%
P2 Unlikely 1 to 5%
P1 Very unlikely 0 to 1%

Consequence Scales:
- / + C5 Huge
- / + C4 Major
- / + C3 Moderate
- / + C2 Minor
- / + C1 Negligible

Manageability Scales:
Low
Medium
High

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Appendix C

1. A-standard action pattern – Procedure

Before the job starts

– when you prepare yourself (inside or out in the field):

The items below must be carried out as a **dialogue** in the team where **everyone** is involved.

- Agree in the team on what you will actually do and what the end-result should be.
- Divide the operation/work task into several smaller sub-operations.
- Identify risks, i.e. what can go wrong, in the individual sub-operation. The risks may be hazards, obstacles, pitfalls, bottlenecks which arise during the performance of the operation.
- Summarise the risks so that everyone in the team shares the same understanding.
- If you have a WP, feel free to write the risks down on the reverse side of the WP.
-

- Find the requirements and procedures that apply for the task (where they exist).
- Discuss how complying with the requirements and the procedures will help you handle the risks you have identified. Ensure that you clarify which team member will handle which risks.
- Agree on how you will handle risks that are not covered by requirements and procedures. Ensure that you clarify which team member will handle which of these risks as well.
- Summarise how you intend to handle the individual risk.
- If relevant (if you have a WP), contact the area authority and summarise the risks and how you intended to handle them. Also ask if there is anything that should be taken into account in relation to other ongoing operations in the area.
- Just prior to starting the job, agree on when to take a time-out.

28 A-standard action pattern

When the job is underway

– when you are out there in the nuts and bolts phase:

Take a time-out as planned (this need only take a few minutes). The time-out takes the form of a **dialogue** in the team where **everyone** is involved.

- Gather the team.
- Discuss whether you are sticking to the plan you prepared and if you are handling risks as agreed.
- Take a helicopter perspective and check if there are any changes that could influence the work (these may be minor, but it is important to address these as well).
- Discuss which risks the change may result in.
- Agree on how you will handle the new risk.
- Continue the work.

When the job is done

– summarise with the team:

The summary can take the form of a **dialogue** where **everyone** is involved.

- Gather the team after the job.
- Discuss how you planned the job. Was everyone involved in the discussion? Did we identify potential risks/hazards? Did we have a good plan to handle the risks?
- Discuss how you planned the job. Did we do as planned? How did we take the time-out? Were there any changes?
- Discuss if you have suggested improvements as regards procedures (requirements, methods, SAP).
- Discuss if you learned anything you want to copy the next time you plan and perform a job. What do you want to communicate to colleagues/other shifts?

A-standard action pattern 29

Appendix D

My Pims | RM - Risk Lite | **ALARP** ×

Risk ID: 0117 Test risk Created: Created:
Updated: Updated:

Description of Hazard (cause or situation):

Source of identification, e.g. HAZOP, HAZID, QRA etc.:

Relevant defined situation of hazard and accident (DSHA):

Relevant safety barriers according to MTO principles:

Relevant performance std. (PS in TR.1055 or TR.2237):

Potential risk reduction (quantitative / qualitative evaluations):

Reference document for implementation of mitigation measures and actions:

Description of proposed risk reducing measure (RRM)

RRM 1:

RRM 2:

RRM 3: