RISK MANAGEMENT IN MARINE - AND SUBSEA OPERATIONS

JANUARY 2003
FOREWORD

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- **Offshore Standards.** Provide technical provisions and acceptance criteria for general use by the offshore industry as well as the technical basis for DNV offshore services.
- **Recommended Practices.** Provide proven technology and sound engineering practice as well as guidance for the higher level Offshore Service Specifications and Offshore Standards.

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B) Materials Technology
C) Structures
D) Systems
E) Special Facilities
F) Pipelines and Risers
G) Asset Operation
H) Marine Operations

ACKNOWLEDGEMENTS

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- Aker Marine Contractors
- Gard Services AS
- Norsk Hydro AS
- Statoil ASA

DNV is grateful for the co-operation these companies offered and acknowledge the individuals for their valuable contributions.

As part of publishing this RP, a draft copy was sent for hearing to several additional companies. Constructive feedback and comments were obtained through this process. DNV appreciate time and effort given to the hearing by these companies.

Comments may be sent by e-mail to rules@dnv.com

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1. Introduction

1.1 General

1.1.1 Objectives

The overall objective with this Recommended Practice is to establish guidelines and recommendations for the process required to reach an acceptable and controlled exposure to risk during marine operations, for personnel, environment, assets and reputation.

The Recommended Practice aim at zero accidents, incidents or losses through promoting safe, robust and efficient marine operations, and through application of the principles of ALARP.

It is further the ambition that this document shall influence the overall awareness and consciousness of the exposure to risks during marine operations, as well as provide a basis for consistent and uniform understandings and applications of processes, tools and methods commonly used for managing and controlling these risks.

A Risk Management Plan is recommended to describe, communicate and document the objectives, responsibilities and activities specified for assessing and reducing risk to an acceptable level.

1.1.2 Application

This Recommended Practice should be used as a support document for the Risk Management Process required for Marine Operations. Marine Operations in this context are defined as:

"Non-routine operations of a limited defined duration carried out for overall handling of an object at sea (offshore, inshore and at shore). Marine Operations are normally related to handling of objects during temporary phases from or to the quay side or construction sites to its final destination or installation site. Marine operations include activities such as load transfer operations, transport, installation, sub sea operations, decommissioning and deconstruction, rig moves and pipe laying".

The Recommended Practice is considered applicable worldwide, for simple single operations as well as larger complex development projects, from the need for a marine operation is realised, through the project period, until the operation is completed.

1.1.3 Basis

Basis for this Recommended Practice are principles and recommendations given in references /1/, /2/ and /3/.

1.1.4 Use and users of this Recommended Practices

Principles, methods and tools described in this Recommended Practice are foreseen used as:

- Guidance for assessing risks during marine operations.
- Basis for tendering (through specification and/or definition of required processes and/or indicated risk levels).
- As a contract reference, providing descriptions/specifications for the risk management process.

Foreseen users of this document are:

- Oil companies, object owners, other responsible parties
- Insurance companies
- Marine operation contractors/sub-contractors
- Other involved parties.

1.1.5 Alternative Methods

This document describes a practice recommended by DNV. This should not inhibit use of other alternative approaches meeting the overall ambitions and objectives.

1.2 Principles of Risk Management

1.2.1 Risk Assessment Principles

DNV recommends that risk within marine operations are assessed against criteria for:

- Personnel safety
- Environment
- Assets and/or lost production
- Reputation

Defined criteria should comply with company and projects policies, and be specific for each of the area above.

Assessment of risk is recommended performed according to the principles of qualitative risk assessments, and through assessment of minimum the parameters listed in Table 1.1.
Table 1.1 – Assessment Parameters

<table>
<thead>
<tr>
<th>Assessment Parameter</th>
<th>Keywords for assessment</th>
</tr>
</thead>
</table>
| Personnel exposure   | – Qualification and experience of personnel  
                                 – Organisation  
                                 – Required presence  
                                 – Shift arrangements  
                                 – Deputy and backup arrangements |
| Overall project particulars | – Delay  
                                 – Replacement time/cost  
                                 – Repair possibilities  
                                 – No. of interfaces and contractors or subcontractors  
                                 – Project development period |
| Existing field infrastructure | – Infrastructure – surface  
                                 – Infrastructure – subsea |
| Handled object | – Value  
                                 – Structural Strength/Robustness |
| Marine operation method | – Novelty and feasibility  
                                 – Robustness  
                                 – Type of operations  
                                 – Previous experience  
                                 – Installability |
| Equipment used | – Margins/robustness  
                                 – Condition/Maintenance  
                                 – Previous experience  
                                 – Suitability  
                                 – Experience with operators or contractors (track record) |
| Operational aspects | – Cost of mobilised equipment and spread  
                                 – Language barriers/hindrance  
                                 – Season/Environmental conditions  
                                 – Local marine traffic  
                                 – Proximity to shore |

1.2.2 Overall Methodology

DNV recommends a basic three-step process for management of risks within marine operations:

- An overall risk assessment of the operations to define them within low (L), medium (M) or high (H) potential risk categories - ref. Step 3, figure 1.
- Based on concluded potential risk category a detailed risk identification program should be established - ref. Step 4, figure 1.
- Based on risk category and findings from the risk identification program, the potential risk is reduced to an acceptable level through specific actions and risk reducing activities - ref. Step 5, figure 1.

Pre-activities for planning and establishing accept-, and screening criteria are included as step 1 and 2 in figure 1.

The process is also illustrated through a flowchart in Appendix D2.
1.3 Terminology and Definitions

1.3.1 Definitions

The terminology used in this document are defined below as found relevant.

**Accident**
Event that which cause injury, illness and/or damage/loss to assets, environment or third parties.

**Company**
The organisation having the overall responsibility for the development project and/or marine operations.

**Contractor**
The organisation being contracted by Company to perform a specific work-scope.

**Guidewords**
Used to facilitate a systematic and structured examination and search for possible deviations from the design intent. The list of guidewords is used in conjunction with a list of physical parameters associated with the applicable activity or medium, system conditions and dynamics.

**Hazard**
Potential source of harm.

**Hazards Register**
Register listing potential Hazards

**Incident**
Event or chain of events which could have caused, injury, illness and/or damage/loss to assets, the environment or third parties.

**Marine Readiness**
Activity normally performed close to the mobilisation for an operation.

**Verification**
in order to verify adequate preparations and that all relevant actions have been closed

**Risk**
Product of probability of an event and the consequences of the event.

**Risk analysis**
Use of available information to identify hazards and to estimate risk.

**Risk assessment**
Overall process of risk analysis and risk evaluation.

**Risk Management Plan**
Document describing objectives, responsibilities and activities for identifying, controlling and reducing project risk.

**Risk Register**
Register listing potential risks. See also Hazard Register

**Zero mindset**
A culture for always seeking solutions, design, methods etc. satisfying a zero accidents, incidents or loss philosophy, and additionally increase margins and robustness through application of the principles of ALARP.

HAZOP  Hazard and Operability study. The HAZOP is not only focused of possible hazards, but also on issues related to the operability of an activity or operation, the plant or system, including possible improvements, see also Appendix B3, B5 and B7.

HAZID  Hazard Identification Analysis, see Appendix B2.

HSE  Health Safety and Environment

IFC  Issued for Construction

ITT  Invitation to Tender

MRI  Marine Readiness Inspection

MRV  Marine Readiness Verification

MDR  Master Document Register

NC  Non Conformance

SJA  Safe Job Analysis, see Appendix B9.

SQRA  Semi-Quantitative Risk Analysis, see Appendix B8.

RMP  Risk Management Plan

RP  DNV Recommended Practice

1.3.2 Terms and Abbreviations

Terms and abbreviations used in this document are listed below.

**ALARP**  As Low As Reasonably Practicable, see 2.1.2.

**CAR**  Corrective Action Request

**DR**  Design Review, see Appendix B4

**EPH**  Early Procedure HAZOP, see Appendix B3.

**FEED**  Front End Engineering Design

**FMEA**  Failure Modes and Effect Analysis, see Appendix B6.

**FMECA**  Failure Modes, Effect and Criticality Analysis, see Appendix B6.
2. Risk Management Planning

2.1 General

2.1.1 Planning of Marine Operations

It is considered essential that marine operations, including all support activities are thoroughly assessed already at conceptual design stages. Risk management and quality assurance processes will then be a positive influence rather than a restrictive constraint on progress. Marine operations and the handled objects should be designed with due consideration to resisting characteristic loads and conditions as well as be practicable and safe. The planning process should address redundancy and backup philosophies as stated in /1/, as well as all other activities required to reach an acceptable risk level.

The planning process should include assessment of personnel exposure and possibilities for reducing this through use of remotely operated tools and handling systems.

2.1.2 HSE Zero Mindset

Basis for this RP is a zero accident, incident and loss philosophy. To satisfy this philosophy a "zero mindset" should be promoted and supported. One important element in the "zero mindset" is the understanding and implementation of the principles of ALARP.

The principles of ALARP are in this document understood as minimising all risks as far as practicable (also below the formally defined accept levels) after having assessed foreseen failure modes, consequences and possible risk-reducing actions. ALARP shall be used both to minimise the probability for an undesired event and the consequences, should such an undesired event happen.

In practise this principle means that all personnel participating in preparations and execution of marine operations should actively seek to minimise risk as far as practicable through preventive operational planning, selecting safe solutions, robust designs etc. Principles of ALARP are considered a mindset. Risk reducing means and actions should be based on subjective cost-benefit assessments.

Illustrative, and as examples are dimensions or particulars of critical low cost components such as padeyes and lifting gear, familiarisation and hazard awareness for personnel involved during operations, limiting number of personnel in potentially hazardous areas such as areas with wires under tension (or use of safety barriers), etc.

2.1.3 HSE Policy and Strategy

As a basis for the risk management process a project specific HSE Policy and Strategy, anchored in the company HSE goals and relevant statutory regulations, should be formulated.

The HSE policy should state specific targets for:

- Personnel safety
- Environment
- Assets
- Reputation

2.1.4 Risk Accept Criteria

Risk is defined as the product of probability of occurrence and consequence, ref. Appendix D3.

Consequence Categories

Consequence should be divided into categories. Each category should have specific criteria in compliance with the HSE policy and goals.

Probability Categories

The probability categories should be qualitatively described, with supplementary guidance if needed. Guidance is recommended related (subjectively) to experiences from similar type of operations, ref. Appendix D3.

Risk Categories

The consequence and probability categories will define risk. This RP recommends the following terms for categorisation of marine operation risk:

- High
- Medium
- Low

Acceptable Risk

Low Risk category is considered acceptable subject to application of the principle of ALARP and activities as specified in this RP.

For the risk categories "Medium" and "High", specified risk identification activities, the principles of ALARP, and risk-reducing activities are required to ensure performance of the operations with an acceptable risk level.

2.1.5 Personnel Qualifications

Key personnel involved in defining criteria, assessing risk, categorising of operations and establishing and maintaining the Risk Management Plan should be familiar with the practical and theoretical aspects of intended marine operations. Marine operation personnel should be represented.

For kick off sessions, reviews, verifications, etc. a larger group may be applicable. Size of team and fields of experience should reflect complexity and criticality of the intended operations. Representatives from company (responsible party), contractors, independent third parties, HSE management, critical disciplines and insurance may be considered. Personnel participating should be familiar with the planned marine operations.
2.2 Risk Management Plan

2.2.1 Objectives
The overall objectives for the Risk Management Plan (RMP) are to describe, communicate and document activities and processes necessary for managing, through all project phases, the risks involved in the planned marine operations. All processes and activities found required in order to manage risks during marine operations should be reflected in this document.

The RMP should define and allocate responsibilities and be a tool for monitoring status of the risk management process.

The document should be established early, and be continuously maintained to reflect the project status through its various stages.

Volume and complexity is foreseen to vary depending on project complexity and nature of intended operations, from 3 to 4 A4 pages for single low risk operations to more comprehensive documents for larger complex development projects.

2.2.2 Process
The activities required for establishing the RMP should be defined early with clearly assigned responsibilities. The activities defined are recommended controlled through a checklist tool (a sample checklist is included in Appendix D4).

The checklist is recommended to include the following main sections:

- Establish HSE policy and strategy, ref. 2.1.2 and 2.1.3.
- Establish acceptance criteria, ref. 2.1.4.
- Define objects, and operations for each object, ref. 2.2.4.
- Categorise the potential risk for each operation, ref. 2.2.5.
- Define required risk identification and risk reducing activities, ref. 2.2.6.
- Establish follow up and close out routines, ref. 2.2.7.

2.2.3 Structure and Revisions
It is recommended that the RMP is project specific, with company (or other responsible party) having the overall responsibility.

If several contractors or subcontractors are involved the document could be structured hierarchically, with involved contractors having a sub-document for his area of responsibility. Contractors/Sub-contractor's RMP should as far as possible be based on plans and systems already established and in-place.

A first revision of the RMP is recommended established as soon as the need for a marine operation is realised. Further revisions of the document should reflect the different project phases and stages. Example of possible revisions is given below.

- Rev. 01 – At Project Definition
  Purpose of Issue
  Define responsibilities for the Risk Management Process and its initial activities.

- Rev. 02 – At completion of overall assessment
  Purpose of Issue
  Communicate potential risk categories for planned operations.

- Rev. 03 – When Risk Identification and Risk Reducing activities are defined and/or when a marine operation contractor is nominated.
  Purpose of Issue
  Define details of all required risk identification and risk reducing activities, allocate responsibilities for these, position them in time and maintain an updated status.

- Rev. 04 – At project completion
  Purpose of Issue
  Document completion and records from planned activities.

Number of revisions and versions should reflect complexity and criticality of the planned operations, as well as number of involved contractors. A proposed index for a Risk Management Plan is given in Table 2.1. A sample RMP is enclosed in Appendix D6.
Table 2.1 – Risk Management Plan – Main Sections

<table>
<thead>
<tr>
<th>Index</th>
<th>Rev. 01</th>
<th>Rev. 02</th>
<th>Rev. 03</th>
<th>Rev. 04</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Introduction</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1.1 Objectives</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1.2 Application</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>1.3 Overall Responsibility</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2. HSE Philosophy and Strategy</td>
<td>X</td>
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<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2.1 HSE Goals</td>
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<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2.2 HSE Philosophy</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2.3 QA and QS Philosophy</td>
<td>X (draft)</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2.4 Risk Accept Criteria</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>3. Organisation and Resp.</td>
<td>X (draft)</td>
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<td>X</td>
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<tr>
<td>3.1 Organisation</td>
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<td>3.x Key Personnel</td>
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<td>X</td>
<td>X</td>
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<td>4. Object and Operation</td>
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<td>X</td>
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<td>X</td>
</tr>
<tr>
<td>4.1 Defined Objects and Operations</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4.2 Overall Risk Assessment and Risk Category</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>5. Process, Risk Identification and Risk Reducing Activities</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>5.1 Process Activities</td>
<td>X</td>
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<td>X</td>
<td>X</td>
</tr>
<tr>
<td>5.2 General QA Activities</td>
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<td>X</td>
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<td>X</td>
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<tr>
<td>5.3 Risk Identification Activities</td>
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<tr>
<td>5.4 Risk Reducing Activities</td>
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<td>X</td>
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<tr>
<td>5.5 Close Out</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

2.2.4 Defined Objects and Operations

The planned project should be reviewed and assessed in order to identify objects and operations to be considered in the risk management process.

An overview should be updated regularly, reflecting new objects and/or revised methods/operations. In the RMP each operation should have define start and end points, main responsibilities, and (when overall assessment is completed) the potential risk category.

2.2.5 Categorisations of Operations

According to the defined HSE policy, and as basis for specifying required QA activities, risk identification activities and risk reducing activities for the planned operations should be categorised into the following potential risk categories:

- Low
- Medium
- High

The categorisation should be made according to the principles as described in 1.2.1. Records of concerns, highlights and/or comments identified during the assessment with respect to risk, feasibility, installability or performance of the operations should be made.

Qualifications for personnel participating in the assessment should comply with 2.1.5. A group sized to reflect the complexity of the operations should perform the assessment. Too large groups should be avoided.

A proposed Assessment Form is included in Appendix D5.

2.2.6 Hazard Identification and Risk Reducing Activities

The overall assessment and following categorisation is performed to create a basis for definition of further risk identification and risk reducing activities. Tables below list recommended activities as a function of potential risk categories. Listed activities are further described in appendix A, B and C.

Generally QA activities are assumed based on the already established QA system. The activities listed in Table 2.2 are meant as emphasis of activities considered of particular importance.

Activities found required for the specific operation should be included in checklists specifying responsibilities, deadlines, status, etc. for each activity. These lists will be part of the RMP, and tools for monitoring and maintaining status for specified activities. A proposed format for the checklists is given in Appendix D4. The checklists are recommended to include the following main sections;

- General QA activities, ref. Table 2.2
- Risk identification activities (for object & operation), ref. Table 2.3
- Risk reducing activities (for object & operations), ref. Table 2.4.
Table 2.2 - General QA Activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Potential Risk Category/Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Medium*</td>
</tr>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>HSE and Q activities &lt;br&gt;Ref. Appendix A2</td>
<td>ISO requirements apply, see ref./2/.&lt;br&gt;Project specific targets, objectives, responsibilities, safety systems and activities (e.g. audits) shall be described/planned</td>
</tr>
<tr>
<td>Pre-qualification of Marine Contractors &lt;br&gt;Ref. Appendix A3</td>
<td>To be assessed and documented. Part of ITT</td>
</tr>
<tr>
<td>Planning and Scheduling &lt;br&gt;Ref. Appendix A4</td>
<td>Schedule shall be developed. Document register shall be prepared Milestones shall be stated.</td>
</tr>
<tr>
<td>Personnel qualifications and Job descriptions &lt;br&gt;Ref. Appendix A5</td>
<td>Statutory requirements apply. Personnel Qualifications defined and described. Management shall prepare work descriptions for all key personnel.</td>
</tr>
<tr>
<td>On site/field Deviation Handling &lt;br&gt;Ref. Appendix A6</td>
<td>Deviation to be logged in e.g. vessel log.</td>
</tr>
<tr>
<td>Non-conformance reporting &lt;br&gt;Near-miss reporting and registration &lt;br&gt;Incident reporting and registration &lt;br&gt;Experience transfer &lt;br&gt;Ref. Appendix A7,A8, A9, A10</td>
<td>Procedure shall be established and formal routines be followed. Non-conformances, near-misses and incidents to be logged in e.g. vessel log. ISO and NORSOK requirements apply, see ref./2/, /4/ and /5/.</td>
</tr>
</tbody>
</table>

(*) For a series of similar, repetitive “medium risk” type operations the requirements to “low risk” operations apply after the first typical operation is performed.
### Table 2.3 - Hazard Identification Activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Potential Risk Category/Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>HAZID Ref. Appendix B2</td>
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<tr>
<td>Early Procedure HAZOP Ref. Appendix B3</td>
<td>NA</td>
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<tr>
<td>Design Review Ref. Appendix B4</td>
<td>NA</td>
</tr>
<tr>
<td>System HAZOP Ref. Appendix B5</td>
<td>NA</td>
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<tr>
<td>FMEA/FMECA Ref. Appendix B6</td>
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<td>Procedure HAZOP Ref. Appendix B7</td>
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<tr>
<td>Semi-Quantitative Risk Analysis Ref. Appendix B8</td>
<td></td>
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<tr>
<td>Safe Job Analysis (SJA) Ref. Appendix B9</td>
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</tr>
</tbody>
</table>

(*) For a series of similar, repetitive “medium risk” type operations the requirements to “low risk” operations apply after the first typical operation is performed.
### Table 2.4 – Risk Reducing Activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>Low</th>
<th>Medium*</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operational feasibility</strong></td>
<td>To be documented. Performance at concept stage</td>
<td>To be documented. Assessment to involve experienced Marine Operation Personnel. Performance at concept stage.</td>
<td>To be documented. Assessment to involve experienced Marine Operation Personnel. Third parties should be represented. Performance at concept stage.</td>
</tr>
<tr>
<td><strong>Document Verifications</strong></td>
<td>Internal verification.</td>
<td>Internal verification. Verification by independent third party company. All documents subject to review shall be identified and listed as soon as the document register is established.</td>
<td><strong>Familiarisation</strong></td>
</tr>
<tr>
<td><strong>Familiarisation</strong></td>
<td>Familiarisation meeting before start of operation with all key personnel involved.</td>
<td>Familiarisation meeting minimum one week before start of the operation with all key personnel involved. Handouts covering key issues shall be distributed. Toolbox talks to be performed.</td>
<td>Familiarisation meeting minimum one week before start of the operation with all key personnel involved. Handouts covering key issues shall be distributed. Meetings and activities shall be planned and listed. Toolbox talks to be performed.</td>
</tr>
<tr>
<td><strong>Personnel Safety Plans</strong></td>
<td>Statutory requirements and general routines apply.</td>
<td>Statutory requirements and general routines apply. Project specific planes/routines to be established.</td>
<td><strong>Emergency preparedness</strong></td>
</tr>
<tr>
<td><strong>Emergency preparedness</strong></td>
<td>Statutory requirements apply and general routines apply.</td>
<td>Statutory requirements apply. Safety bridging document to be prepared. Communication checks before start of operation shall be performed. Table-top analysis and/or emergency preparedness drill to be performed.</td>
<td>Statutory requirements apply. Safety bridging document to be prepared. Communication checks before start of operation shall be performed. Table-top analysis and/or emergency preparedness drill to be performed. Documents, exercises and drills shall be planned and listed.</td>
</tr>
<tr>
<td><strong>Marine Readiness Verification</strong></td>
<td>Pre-mobilisation activities to be defined.</td>
<td>Pre-mobilisation activities to be defined. Detailed Marine Readiness Verification 1 - 2 months prior to operation.</td>
<td><strong>Inspection and testing</strong></td>
</tr>
<tr>
<td><strong>Inspection and testing</strong></td>
<td>Temporary structure to be inspected. Temporary systems and equipment to be inspected and tested for functionality and capacity. Permanent systems to be function tested.</td>
<td>Temporary structure to be inspected. Temporary systems and equipment to be fully inspected and tested for functionality and capacity. Permanent systems to be function tested. Systems and equipment subject to inspection shall be listed and records and results from inspection/testing documented (e.g. in checklists). Timing should allow possible corrective actions, recommended 1 - 3 weeks prior to operation.</td>
<td><strong>Surveys of vessels</strong></td>
</tr>
<tr>
<td><strong>Surveys of vessels</strong></td>
<td>Surveys by Contractor (if applicable). Immediately prior to operation.</td>
<td>Survey by Contractor. Survey by independent third party/company should be considered. Vessels, type of survey, survey scope, records and results to be based on/documented in checklists. Perform 1 - 10 days prior to operation.</td>
<td>Survey by Contractor. Survey by independent third party/company. Vessels, type of survey, survey scope, records and results to be based on/documented in checklists. Perform 1 - 3 weeks prior to operation.</td>
</tr>
<tr>
<td><strong>Toolbox Talk</strong></td>
<td>Performed prior to each work task</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 2.2.7 Follow-up and closeout

All planned activities relevant for specific operation should be checked out with an acceptable status by a formal signature of responsible for operations before start.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Low</th>
<th>Medium*</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surveys of operations</td>
<td>Surveys by Contractor.</td>
<td>Survey by independent third party company.</td>
<td>Survey scope, records and results to be based on/document in checklists. Certificate of Approval to be issued for the operation.</td>
</tr>
<tr>
<td>Ref. Appendix C11</td>
<td></td>
<td>(*)</td>
<td></td>
</tr>
</tbody>
</table>

(*) For a series of similar, repetitive “medium risk” type operations the requirements to “low risk” operations apply after the first typical operation is performed.
3. References

/1/ "DNV Rules for Planning and Execution of Marine Operations"

/2/ ISO 9001-2000, "Quality Management Systems Requirements"


Other References

/4/ S-012N, NORSOK "Helse, miljø og Sikkerhet /HMS) ved Byggerelatert Virksomhet"


Appendix A. - General Quality Assurance Activities
Appendix B. - Hazard Identification Activities
Appendix C. - Risk Reducing Activities
Appendix D. - Miscellaneous.
Appendix A. - General Quality Assurance Activities

A.1 Objectives
This appendix generally assume that parties involved in marine operations have a quality assurance (QA) system in compliance with /2/. This appendix is hence meant as emphasising and supplementary to activities considered of particular importance.

A.2 HSE&Q Activities
HSE&Q goals shall be developed and defined early in the project. The RMP is considered an important tool in order to achieve these goals.

All HSE&Q activities relevant for the marine operations shall be included on the RMP, such as applicable risk identification activities described in Appendix B, audits, survey of vessels, verification of preparations and operations etc.

A.3 Pre-Qualification of Marine Operations Contractors
A.3.1 Purpose
Purpose of this pre-qualification activity is to assess qualifications for a Contractor with respect to a Foreseen scope or responsibility. Major oil companies have internal procedures for pre-qualification of contractors in accordance with applicable rules and regulations. Less formalised approaches may be used for smaller projects/individual operations or contractors with limited responsibility.

A pre-qualification activity is recommended for all marine operations contracts in order to assess interested contractors before being invited to bid.

A.3.2 Expected Input
Potential contractors are frequently listed in databases, which can be screened based on selection criteria applicable for the contract. Additionally potential contractors are usually well known in the industry based on jobs performed in the past. Important input to pre-qualification of contractors are typically:
- Compliance with industry standards on quality and HSE
- Personnel qualifications and resources
- Vessels and equipment
- Computer programs
- Previous experience, including safety culture in organisation or onboard vessel, organisation of work, experience transfer, and finally number and nature of incidents and accidents.

A.3.3 Performance
The list of pre-qualified contractors will be established based on an evaluation made by contracts personnel and technical personnel. Essential in the evaluation is previous experience with the contractor, including number and nature of incidents and accidents and the ability to deliver their services on time, as well as availability of critical resources, equipment, etc.

The pre-qualification activity should result in a list of contractors defined as technically qualified and capable for the foreseen scope or responsibility. The list is normally basis for being invited to bid.

A.4 Planning and Scheduling
A.4.1 Purpose
Plans and schedules are required in order to meet the project milestones and will the basis for timing of contract awards and marine operations. Schedules and plans should identify critical decisions and document issues, and ensure that dependent activities can be performed within a realistic timeframe.

A.4.2 Application
Central in document planning is the Master Document Register (MDR). Schedules will be developed on various levels. An overall project schedule will be the basis for all project activities. Detailed schedules for the marine operations should be included as part of the Risk Management Plan.

A.4.3 Expected Input
Input to plans and schedules are the project milestones. Input to detailed schedules, including the RMP, will be the overall project schedule.

A.4.4 Performance
Important documents could be linked up to contract cost plans and/or penalty milestones, in order to ensure timely delivery.

Schedules shall be developed and reviewed by the project management to comply with the project goals and milestones. Incentives for meeting goals and milestones may be considered. If used these are recommended triggered when meeting individual tasks, typically having document approved IFC at planned date, etc.

Marine Operations Manuals should be developed to describe the planned operation. These should be issued in minimum three revisions:

Revision 1
Describing methods and main principles. Revision to be issued 1 - 4 months after contract award (IDC status). Basis for EPH.
Revision 2
Fully completed (IFC status). To be basis for Procedure HAZOP.

Revision 3
Final version and basis for performing operations. Actions from HAZOP to be reflected.

A.4.5 Deliverables
Plans and schedules on various levels, the Risk Management Plan and the Master Document Register.

A.5 Personnel Qualifications and Job Descriptions

A.5.1 Purpose
The quality and success of a project is highly dependent on the project personnel. In addition to technical qualifications the ability to work as part of a team is essential and shall be focused on. In addition, experience transfer from previous similar projects shall be considered when organising a project.

A.5.2 Application
Projects and operations shall be manned as per requirements given in the job descriptions. This is valid for operators, contractors and all other personnel involved.

A.5.3 Expected Input
The job descriptions shall comply with the applicable standards, regulations and rules, such as ISO 9001.

A.5.4 Performance
When establishing a project organisation, management is responsible for establishing job descriptions where work tasks and requirements to personnel are given.

A.5.5 Deliverables
Job descriptions and organisation charts.

A.6 Deviation handling

A.6.1 Purpose
The purpose of formal deviation handling is to ensure compliance with project requirements for proposed deviation. This shall include familiarisation of personnel and adequate engineering and verification of the proposed deviation.

A.6.2 Application
Formal deviation handling applies to all significant changes to approved procedures. Deviation handling shall be complete before the corresponding deviation is implemented/performe, unless immediate action has to be taken for obvious safety reasons.

The following considerations shall be included in the evaluation in order to ensure that a request for a deviation is the appropriate course of action.

− Does the proposed deviation impact on the HSE aspects of the marine operation?
− Is the proposed alternative equipment suitable for purpose and properly certified?
− Shall a Safe Job Analysis, tool-box talk or other assessment be performed before a deviation permit is granted?
− Can the work involved in the proposed deviation be performed with existing manpower/resources?
− Is there any impact on schedule, cost, rework etc?
− Consequences with respect to functional capabilities/requirements, capacities etc.
− Consequences for other part of work or equipment.

A.6.3 Expected Input
Input to deviation handling is the reasons for the deviation and proposed change and documentation supporting the proposal.

A.6.4 Performance.
Deviations to approved documentation within marine and subsea operations shall be handled by raising a deviation request before the execution of the operation or activity to which the deviation applies. A deviation handling procedure shall be developed and be implemented by the project. Major deviations to an operation should always be reviewed by a HSE specialist to assess whether the deviation significantly or unacceptably alters the risk.

A deviation request may be initiated by the vessel Captain, the Operations Manager/Superintendent, Client/Company or the Project Manager (deviation request originator) for handling due to the rapid response time required. A deviation permit shall be obtained before proceeding with the deviation.

The deviation request originator shall keep a copy of the permit and be responsible for the immediate implementation of the approved deviation according to the agreed plan.

All completed deviation requests/permits shall be filed and retained as formal quality records.

A.6.5 Deliverables
A brief, concise description of the proposed deviation shall be entered as part of the deviation request together with expected impacts. Relevant documentation shall be referenced. The deviation request/permit shall be logged in the operations log and/or the appropriate vessel log onboard.
A.7 Non-Conformance Reporting

A.7.1 Purpose
Non-conformance reporting is performed and corresponding corrective actions implemented to prevent reoccurrence of a failure or an unintentional action or activity.

A.7.2 Application
Non-conformances that have occurred shall be reported. Corrective actions shall be implemented as deemed relevant to avoid repetitive non-conformances (NC). A non-conformance reporting procedure and corrective action handling procedure shall be developed and implemented by the project.

A.7.3 Expected Input
Input is a description of the non-conformance and the proposed corrective action.

A.7.4 Performance
All personnel have a responsibility to immediately notify a detected NC to the vessel Captain, the Operations Manager/Superintendent, Company or the Project Manager, as applicable. A corrective action request (CAR) shall be initiated either by the vessel Captain, the Operations Manager/Superintendent or the Project Manager (CAR originator) once a non-conforming operation or equipment/service has been identified and issued to the responsible manager/vessel master (CAR Recipient) for action. A proposal for actions to be taken may be submitted with the CAR.

The CAR Recipient shall evaluate the cause(s) of the NC, if necessary in co-operation with other relevant personnel, and shall also evaluate any corrective action which may be proposed by the CAR Originator. In this context it is very important to find the real/basic cause(s) of the NC in order to determine the most effective corrective actions to prevent recurrence. Planned actions shall be entered in the CAR form.

If it is proposed that a Concession be obtained for the NC, the item shall be put on hold until the Concession is received. For all NCs not requiring a Concession, the CAR Recipient shall immediately commence implementation of the agreed corrective actions in accordance with the agreed plan.

When the planned corrective action has been completed, reviews shall be undertaken at regular intervals to ensure that the action has had the desired effect of ensuring against a recurrence of the NC.

A.7.5 Deliverables
Details of the corrective action carried out and the results of the action shall be fully recorded and contained in a report, which will form the basis of the closeout of the CAR.

When the corrective action has been implemented to the satisfaction of all parties, the CAR recipient shall fill in and sign the close-out section of the CAR form.

All completed Corrective Action Requests shall be filed and retained as formal quality records.

A.8 Near-Miss Reporting

A.8.1 Purpose
Adequate near-miss reporting, handling and registration is important in order to reduce the number of incidents and accidents to an absolute minimum and as means for experience feedback, i.e. it is in no way in conflict with the zero-incident target philosophy. It is a management responsibility to ensure that all personnel are briefed on the importance of reporting near misses and encouraged to report these.

A.8.2 Application
All near misses during marine operations shall be reported according to defined procedures. The procedures shall define recipients of the report.

A.8.3 Expected Input
Near misses shall be reported by personnel having witnessed the incident, preferably on dedicated reporting forms.

A.8.4 Deliverables
All personnel have a responsibility to immediately notify a detected near miss to the vessel Captain or the Operations Manager/Superintendent, as applicable. Simple near-miss reporting forms shall be easily available. Dedicated mailboxes may be placed at central locations during the marine operation. All near misses shall be logged in the vessel’s log/operations log and be reviewed in the daily meetings during marine operations. Near misses shall be properly registered.

A.8.5 Performance
Near-misses that have occurred shall be reported. Corrective actions shall be implemented as deemed relevant to avoid repetitive near-misses. A near-miss reporting procedure and corrective action handling procedure shall be present in the project.

The necessary actions shall be taken to prevent recurrence of the near-miss by the Project Manager, vessel Captain and/or by the Operations Manager/Superintendent.

A.9 Incident and Accident Reporting

A.9.1 Purpose
The purpose of incident and accident reporting is primarily to avoid recurrence but also to inform the involved companies and relevant authorities, as required by law and regulations.

A.9.2 Application
All incidents and accidents during a marine operation shall be reported.
A.9.3 Expected Input
Personnel having witnessed the incident or accident shall report incidents and accidents. In case of serious incidents or accidents all relevant witnesses should describe their version of the incident or accident in writing. The necessary reporting forms shall be available during marine operations.

A.9.4 Performance
A system for incident reporting, handling and registration shall be present during marine operations. All personnel have a responsibility to immediately notify an incident to the vessel Captain or the Operations Manager/Superintendent. The necessary immediate actions shall be taken to stabilise the situation. Rescue centres other vessels and/or installations shall be contacted for assistance as required.

A.9.5 Deliverables
Incidents shall be reported as soon as practically possible and be properly registered. Incident reports shall comprise the following minimum information:

- Where the incident occurred
- Time of incident
- Detailed description of the incident
- Description of injuries, if any, including name of personnel affected in case of an accident
- Description of damages
- Immediate actions taken
- Name of reporting personnel

Incidents shall be logged in the daily report and Project register and be discussed in daily meetings. Long term corrective actions shall be identified and implemented as appropriate in order to avoid recurrence.

A.9.6 Accident Investigations
The need for accident investigation must be assessed on a case by case basis, in accordance with relevant procedures. In case of a serious accident the project management shall instigate an investigation. A dedicated accident investigation task force shall be nominated and a mandate for the investigation shall be issued. A task force leader shall be appointed. All task force personnel shall be independent of the project. The task force will normally investigate the accident through interviews with personnel involved in the project and the relevant project documentation.

The task force shall conclude their work by issuing an accident investigation report. This report shall be presented to the project in a draft form. All relevant comments from the project, i.e. misunderstandings, errors and misprints shall be considered and corrected by the task force before the report is issued in its final form.

A.10 Experience Transfer

A.10.1 Purpose
Purpose of this activity is to seek previous and/or convey new experiences in order to optimise marine operations processes and solutions, and to avoid mistakes being repeated.

A.10.2 Application
All companies shall have a system for experience transfer.

A.10.3 Expected Input
Experience reports from previous projects. Experience transfer seminars.

A.10.4 Performance
Experiences may be sought through review accident/incident databases, holding experience transfer seminars, review of experience reports (might also be requested from other companies). Particularly parties recently been through similar operations should be invited to experience transfer seminars or asked for experience reports.

Practise has shown that the most efficient experience transfer system is to man the projects with personnel with experience from similar projects. In spite of this a short experience report shall be prepared for every non-routine project (typically for medium and high risk operations) and distributed within the company to relevant personnel.

A.10.5 Deliverables
After a project is finalised an experience report shall be prepared and filed for future reference. It is advisable that experience reports are easily available for future use.
Appendix B. - Hazard Identification Activities

B.1 General

B.1.1 Objectives
The objective with this section is to list and describe risk identification activities recommended for risk assessment and management of marine operations. Their application as well as suggested methods and tools are described.

B.1.2 Risk Identification Methods
The following techniques and methods are recommended for marine operations and shall be used as applicable for the intended operation.

- **Hazard Identification Analysis (HAZID)**
  HAZID is used to identify and evaluate hazards when the operations procedures have been developed and may be a useful technique to reveal weaknesses in the design and the marine operations detailed procedures. The technique is used to identify and evaluate hazards early in a project, being conducted at the conceptual and front-end engineering stages. HAZID may be conducted in conjunction with a pre-screening study and may be a useful technique to reveal weaknesses in the design and to determine the marine operations concept and methods. The method is also used as a tool for assessing the potential risks the operation initially represents.

- **Early Procedure HAZOP (EPH)**
  EPH is an interdisciplinary, systematic approach to identify hazards and operability problems for the planned marine operations procedure. EPH is commonly used as a tool in the development of marine operations procedures and is typically performed when a draft procedure is available. The same technique as for a detailed Procedure HAZOP is used. EPH can be combined with Design Review.

- **Design Review (DR)**
  DR is a systematic approach to review a particular design solution and is used in order to reveal weaknesses in design of a system, structure or component.

- **System HAZOP**
  For critical and/or complex systems used during marine operations (ballast systems etc.).

- **FMEA/FMECA**
  For critical and/or complex systems used during marine operations (ballast systems etc.).

- **Procedure HAZOP**
  Procedure HAZOP is an interdisciplinary, systematic approach to identify hazards and operability problems for the planned marine operations procedure.

- **Semi-Quantitative Risk Analysis (SQRA)**
  SQRA is a semi-quantitative risk assessment, which may be used in combination/part of other hazard review techniques (EPH, HAZID and/or HAZOP). The results of a SQRA are tabulated in pre-defined forms, which may be used as input to or part of the Hazards Register (Risk Register) for the project.

- **Safe Job Analysis (SJA)**
  SJA is used to identify hazards and risk reducing measures for a particular work task or activity. SJA is particularly relevant for work tasks and activities not adequately covered by the operations procedure, as part of a deviation request to an approved procedure and for work involving several work groups or work tasks or activities in the same area. SJA is particularly relevant for worktasks and activities with details not adequately covered by the operations procedure - SJA shall be performed by the actual personnel involved in the tasks or activity.

B.2 HAZID

B.2.1 Purpose
The purpose of the HAZID is to evaluate hazards early in a project at the conceptual and front-end engineering stages or at later project stages as found suitable. The identification of hazards at an early stage assists in selection of the most advantageous procedures or design.

HAZID is a structured review technique with the purpose to identify all significant hazards associated with the particular activity or operation under consideration.

B.2.2 Application
HAZID is an analytical technique used to identify hazards, which will without adequate precautions, give rise to a hazardous event. HAZID may be conducted in conjunction with a pre-screening study. This RP recommend the techniques of the HAZID also to be used for assessing and categorisation the potential risk of a planned operation.

HAZID work sheets may be directly used as part of the project Hazard Register (Risk Register).

B.2.3 Expected Input
The input to a HAZID is a principle description of the marine operations methods and concepts or the operations procedure.

B.2.4 Performance
The results from the HAZID shall be used as input to the RMP and the project Hazard Register (Risk Register).

Personnel with significant experience from similar marine operations shall participate in a HAZID.

The process normally adopted is first to identify all possible undesirable consequences that could occur and then to identify hazards which, when realised, would cause that consequence. All reasonably foreseeable hazards shall be included. A HAZID can also be denoted FMEA for an operation or system. The ALARP (As Low As Reasonably Practicable) principle shall be implemented to the extent possible.
B.2.5 Deliverables

HAZID is normally reported in tables typically formatted as in Table B1. In case the HAZID is combined with a SQRA, see Appendix B8 the parameter "Risk Value" should be included.

Table B1 - Typical Work Sheet for HAZID with SQRA

<table>
<thead>
<tr>
<th>Operation: _________________________________</th>
<th>Undesired event</th>
<th>Description of consequences</th>
<th>Existing risk reducing measures (probability and/or consequence)</th>
<th>Risk value $P \times C = R$ (SQRA only)</th>
<th>Actions/measures to reduce/eliminate risk</th>
<th>Responsible for implementation of actions</th>
<th>Comments</th>
</tr>
</thead>
</table>

B.3 Early Procedure HAZOP

B.3.1 Purpose

EPH is an interdisciplinary, systematic approach with the purpose to identify hazards and operability problems for the preliminary marine operations procedure.

B.3.2 Application

EPH is commonly used as a tool in the development of marine operations procedures. Early Procedure HAZOP (EPH) is a simplified version of a procedure HAZOP performed at a preliminary stage before design and procedures are finalised.

B.3.3 Expected Input

The input to an EPH is typically the draft operations procedure.

B.3.4 Performance

For each activity a short presentation of the main steps shall always be given by the person responsible for the procedure or a person equally familiar with the procedure, in order to update and inform the HAZOP team on the latest status and details, before the EPH is performed.

EPH can be combined with Design Review. For further guidance on EPH see Appendix B7.

B.3.5 Deliverables

The results from EPH shall be reported as outlined in Appendix B7.

B.4 Design Review

B.4.1 Purpose

Design Review (DR) is a systematic approach with the purpose to review a particular design solution.

B.4.2 Application

DR is used in order to reveal weaknesses in design of a system, structure or component and is hence used as a tool in the development of design solutions.

B.4.3 Expected Input

The input to a DR is the draft design solution.

B.4.4 Performance

The following items shall be presented and reviewed as part of a design review:

- Design intent
- Design basis
- Rules, regulations and specifications
- Functional requirements and environmental criteria
- Loads
- Load effects
- Structural strength (static, fatigue, serviceability, accidental and progressive collapse)
- Design solution
- Calculation methods and computer programmes
- Uncertainties
- Safety (difference/ratio between load effect and structural strength)

The design of a system, structure or component shall be systematically reviewed considering the above listed items.

B.4.5 Deliverables

A design review report shall be prepared, which reflects potential problem areas and lists actions and observations with corresponding responsible personnel and action due dates.
B.5 System HAZOP

B.5.1 Purpose
The purpose of a system HAZOP is to ensure adequate functionality and back up of a system in accordance with the design intent.

B.5.2 Application
System HAZOP analysis is applicable to marine systems critical for successful execution of the marine operation. Such systems are all other systems important for the operation, eg. hydraulics, ballast systems, essential electrical systems, etc. In system HAZOP analysis an interdisciplinary team uses a systematic approach to identify hazards and operability problems as a result of missing information or errors in the design which may result in an undesired event. During the system HAZOP analysis, the results of deviations from the intended operations procedure shall be analysed.

B.5.3 Expected Input
The basis for a system HAZOP is normally general arrangement drawings and P&ID drawings, together with system specifications. Often also the system operations procedure is available as basis for a system HAZOP. All documents and drawings shall be at an advanced stage of engineering.

B.5.4 Performance
The system HAZOP technique is a systematic step-by-step method where the main principle is the definition of "design intent" and the use of suitable predetermined parameters and guide words in order to try to identify possible deviations from the "design intent". Emphasis shall be put on identification of contingencies.

The same principle requirements as for a procedure HAZOP apply, see Appendix B7. Differences from a procedure HAZOP are highlighted below.

The HAZOP should be planned with sufficient time to allow addressing all topics that might be of importance.

B.5.5 Deliverables
The requirements to reporting and follow-up as outlined for a procedure HAZOP apply also for system HAZOP, see Appendix B7. Reporting is commonly performed on HAZOP record sheets of matrix format.

B.5.6 Planning
The timing for a system HAZOP is typically in an advanced stage of engineering, before the design is fully finalised and the system built. It is important that the implementation of the results from the HAZOP in the design is possible without high consequential costs or rework.

A detailed agenda shall be prepared and issued by the HAZOP Leader in due time before the system HAZOP as explained for procedure HAZOP, ref. Appendix B7, allowing adequate time to cover the scope of the HAZOP.

For the purpose of a system HAZOP the following initial tasks apply:

- Select a set of suitable guidewords and parameters
- Define system limits
- Define system elements, sections or nodes suitable for detailed examination
- Define operation modus
- Define phase

B.5.7 HAZOP Participants
In order to achieve a successful system HAZOP the key personnel involved in the design and operation in the system shall participate. In addition personnel with a broad understanding of the system and the interface with other relevant systems, including safety systems, shall participate. Complying with these principles the team for a system HAZOP should be kept as small as possible and not exceed 10 persons, including HAZOP Leader and Secretary.

B.5.8 Guidewords and Parameters
A typical set of guidewords for a system HAZOP is presented in Table B2. Typical parameters are presented in Table B3. Additional or other guidewords and parameter may be applicable.

Table B2 – Guidewords

<table>
<thead>
<tr>
<th>Guidewords</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>No/Not/Don’t</td>
<td>The intended material is not present. No substitute material is present. The intended activity does not occur. No direct substitute activity takes place.</td>
</tr>
<tr>
<td>More</td>
<td>A higher quantity of material than intended e.g. weight or volume. Higher physical condition e.g. higher pressure. A higher activity than intended e.g. flow rate, pressure rise, heat input, chemical reaction or duration of activity.</td>
</tr>
<tr>
<td>Less</td>
<td>A smaller quantity of material than intended e.g. weight or volume. Lower physical condition e.g. lower pressure. A lower activity than intended e.g. flow rate, pressure decrease, heat input, chemical reaction or duration of activity.</td>
</tr>
<tr>
<td>As well as</td>
<td>An additional component present, an additional physical condition and/or an additional activity. Unwanted side reactions.</td>
</tr>
<tr>
<td>Other than</td>
<td>A totally different material, physical condition or activity.</td>
</tr>
<tr>
<td>Part of</td>
<td>One or more intended components or desired activities are missing. Some desired physical condition is absent.</td>
</tr>
</tbody>
</table>
### Guidewords

<table>
<thead>
<tr>
<th>Guidewords</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reverse</td>
<td>The logical opposite of the desired material, physical condition or desired activity.</td>
</tr>
<tr>
<td>Sooner/Later</td>
<td>Sooner or later than intended.</td>
</tr>
</tbody>
</table>

### Table B3 – Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical parameters related to input medium properties</td>
<td>Parameters selected for a structured examination of the intended medium itself and its properties and characteristics.</td>
</tr>
<tr>
<td>Physical parameters for possible deviations of the medium condition</td>
<td>Parameters selected to study possible deviations from the intended condition (mass, volume, pressure, temperature, etc.) of the medium</td>
</tr>
<tr>
<td>Physical parameters related to system dynamics</td>
<td>Parameters selected to study the dynamics of the system.</td>
</tr>
<tr>
<td>Non-physical tangible parameters related to batch type processes</td>
<td>Timing and duration.</td>
</tr>
<tr>
<td>Parameters related to system operation</td>
<td>Parameters not necessarily used in conjunction with the guideword list, such as.</td>
</tr>
<tr>
<td>− Instrumentation</td>
<td></td>
</tr>
<tr>
<td>− Relief</td>
<td></td>
</tr>
<tr>
<td>− Start-up(shut-down)</td>
<td></td>
</tr>
<tr>
<td>− Maintenance</td>
<td></td>
</tr>
<tr>
<td>− Safety/contingency</td>
<td></td>
</tr>
<tr>
<td>− Sampling</td>
<td></td>
</tr>
</tbody>
</table>

### B.5.9 System Elements or Nodes

In addition system elements or nodes should be defined. Typical system HAZOP elements and nodes are:

- Pumps
- Compressors
- Separators
- Interconnecting pipework

### B.5.10 Operating Modus

The definition of operating modus is an important input in formulating the design intent.

In cases where a system or a system element changes from one operation modus to another, it may be applicable to examine the various stages or phases the system undergoes.

In such cases on would start with an initial stage with the initial system configuration, going through a transient stage where the system condition and dynamics go into the final stage at a certain rate. In such cases the definition of stages will be part of the basis for formulating the design intent.

### B.6 FMEA/FMECA

#### B.6.1 Objective

FMEA is a structured review technique with the purpose to identify and analyse all significant failure modes and effects associated with the particular system under consideration.

FMECA is a FMEA where also criticality is subjectively assessed.

#### B.6.2 Application

FMEA is an analytical technique used to identify failure modes and associated effects (hazards) that will without adequate precautions give rise to a hazardous event. FMEA work sheets may be directly used as part of the project risk register.

#### B.6.3 Expected Input

The input the a FMEA/FMECA is a detailed system description (general arrangement drawings, P&IDs, specifications, etc.) and operational procedures.
B.6.4 Performance
The process normally adopted is first to identify all possible undesirable consequences that could occur and then to identify failure modes and hazards which, when realised, would cause that consequence. All reasonably foreseeable failure modes and hazards shall be included. The ALARP principle shall be implemented to the extent possible.

Table B4 - FMEA/FMECA Work Sheet

<table>
<thead>
<tr>
<th>Activity no.</th>
<th>Equipment/ component name</th>
<th>Function</th>
<th>Id. no</th>
<th>Failure mode</th>
<th>Failure effect – local</th>
<th>Failure effect – end effect</th>
<th>Failure detection</th>
<th>Alternative provisions/ redundancy</th>
<th>Risk value PxR (for FMECA only)</th>
<th>Remarks</th>
</tr>
</thead>
</table>

B.6.5 Deliverables
FMEA/FMECA is normally reported in tables typically formatted as illustrated in Table B4.

B.7 Procedure HAZOP
B.7.1 Purpose
The procedure HAZOP is a tool used in order to avoid accidents and incidents i.e. fulfil the zero accident/incident target philosophy:
- Avoid incidents, i.e. fulfil the zero incident target philosophy
- Increase safety during the operations
- Reduce sources for operational delays
- Identify areas of improvement.

In addition a procedure HAZOP can be regarded as a natural part of the familiarisation process and hence be regarded as a technical team building for key personnel.

B.7.2 Application
Procedure HAZOP analysis is applicable to all marine operations. In procedure HAZOP analysis, an interdisciplinary team uses a systematic approach to identify hazards and operability problems as a result of missing information, errors or deviations from a procedure which may result in an undesired event.

All issues relevant to identification of hazards shall be subject to discussions to the extent necessary to conclude the identification. Emphasis shall be put on identification of contingencies/back-up solutions. It is, however, not within the scope of a HAZOP to solve the problem, i.e. a limited amount of time shall be spent on discussing solutions. The HAZOP as developed and used today is a tool to identify hazards and potential operational problems, and unless the solutions to these possible problems are immediately evident, the HAZOP shall refrain from finding solutions and carrying out redesign.

HAZOPs shall focus on consequences. Typically the discussions shall centre around “what if?” questions and around the application of the ALARP principle to the consequence of an identified hazard. The ALARP principle shall also be adopted on probabilities in order to minimise the risk.

B.7.3 Expected Input
The input/basis for a procedure HAZOP is an operations procedure. The operations procedure shall be at an advanced stage, i.e. be fully complete and reflect all relevant aspects of the operation in detail.

B.7.4 Planning
A HAZOP shall be properly planned. Such planning shall include:
- Detailed timing, sufficient time shall be allowed to adequately cover the scope of the HAZOP.
- Base documents (operations procedure, etc.) to be available
- Selection of HAZOP Leader and HAZOP Secretary
- Identification of participants
- Preparation and issuance of a detailed agenda to all participants
- Preparation of guidewords list

The timing for a procedure HAZOP is typically 4 – 6 weeks before mobilisation. It is important that there is sufficient time after the HAZOP has been performed to implement the results from the HAZOP in the procedure and operations planning without any consequential delays to the operation.
B.7.5 Deliverables

The results from a HAZOP can be categorised as recommendations (actions) and observations. The HAZOP report shall list all recommendations (actions) and state the person responsible for closing the action and the corresponding deadline. For the information of personnel not participating in the HAZOP and also for future reference, it is essential to record the outcome of important discussions, or the closing of identified hazards or problem areas, where no actions occurred (observations). The HAZOP report may comprise HAZOP records in a matrix form. Such forms should not be made too comprehensive, since the most important results from a HAZOP are the recommendations and the observations.

All HAZOP recommendations (actions) shall be followed up by a written response within the agreed deadline. Dedicated HAZOP recommendation response sheets may be developed for this or a CAR system (see Appendix A7) may be adopted to suit. The HAZOP Leader has the duty to ensure that only items that were covered during the HAZOP are reflected by the report. In the event that additional items are included these shall be in the form of post-HAZOP notes and particularly highlighted.

B.7.6 HAZOP Leader

The HAZOP Leader shall have an independent role in the project. He shall be from an independent organisation or come from an independent department within the company. The HAZOP Leader shall be well familiar with typical marine operations similar to the operations subject to the HAZOP and also have a thorough knowledge of the procedure HAZOP objectives and methodology. Typically a HAZOP Leader shall have a minimum of 5 years experience with marine operations and should have participated in a minimum of 10 HAZOPs as a HAZOP secretary or participant. The HAZOP Leader is responsible for the successful execution of the HAZOP. He is further responsible for preparing and issuing the detailed agenda and for the HAZOP report.

B.7.7 HAZOP Secretary

A HAZOP secretary should be nominated for the HAZOP being responsible for recording the results from the sessions. The HAZOP secretary should also have some knowledge to marine operations and HAZOP methodology in order to avoid unnecessary delays during the execution.

B.7.8 HAZOP Participants

In order to achieve a successful HAZOP the key personnel involved in the planning and execution of the marine operations need to be present. Operations personnel are typically operations managers, vessels’ captains, vessels’ superintendents and supervisors. In addition relevant engineering personnel being responsible for the design and the operational procedures shall be present. In the event that key operations personnel are not available to participate in the HAZOP shall be rescheduled to ensure the proper participation.

There shall be no strict requirement to limit the HAZOP team to an absolute minimum for a procedure HAZOP, since this can be regarded also as a technical team building for the personnel involved. All members of the HAZOP Team have the duty to contribute to the HAZOP with an open mind and constructively contribute to fulfil the HAZOP objectives.

B.7.9 Performance

The success of a HAZOP is to a large extent dependent on the HAZOP Leader. He shall act as a catalyst to the HAZOP Team and stimulate discussions in an effort to identify potential hazards and operability problems. It is the HAZOP Leaders duty to abort irrelevant discussions, e.g. those of a contractual or solution orientated nature or those on non-relevant topics. Every effort shall be put on executing the HAZOP in an efficient manner thereby contributing to a dedicated and interested HAZOP team.

The most important aspect of the HAZOP is the process itself. It is therefore important to manage the HAZOP in such a way as to ensure a high quality process and fruitful discussions within the HAZOP Team rather than manage the HAZOP through a rigid pre-defined reporting format. It is generally not recommended to let the HAZOP Team be a part of the formulation of recommendations and observations during the sessions, as this is time consuming and non-efficient. However, recommendations and observations should be summarised at the end of HAZOP in order to ensure full agreement within the HAZOP Team.

For the purpose of a procedure HAZOP the operations to be analysed shall be broken down into:

- Activities
- Steps.

For each activity a short presentation of the main steps shall always be given by the person responsible for the procedure or a person equally familiar with the procedure, in order to update and inform the HAZOP team on the latest status and details, before the systematic HAZOP is performed.

B.7.10 Agenda

A detailed agenda shall be prepared and issued by the HAZOP Leader in due time before the HAZOP and should be forwarded to all HAZOP participants as basis for their preparations. The agenda shall typically comprise:

- Presentation of agenda (Responsible: HAZOP Leader)
- Presentation of HAZOP team personnel (Responsible: HAZOP Leader)
- Presentation of purpose and methodology of HAZOP (Responsible: HAZOP Leader)
- Presentation of Activity no. 1 with corresponding steps (Responsible: Activity/procedure responsible)
- HAZOP of Activity no. 1 with corresponding steps (Responsible: HAZOP Leader/HAZOP Team)
- Presentation of Activity no. 2 with corresponding steps (Responsible: Activity/procedure responsible)
B.7.11 Guidewords
A set of guidewords shall be used during the HAZOP sessions in order to ensure that all safety aspects and potential hazards or deviations from procedures, which could cause problems, are identified and satisfactory dealt with. A typical set of guidewords for a marine operation procedure HAZOP is presented in Table B5. Additional or other guidewords may be applicable:

Table B5– Guidewords

<table>
<thead>
<tr>
<th>Guideword</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weather</td>
<td>Unclear weather restrictions or unexpected deterioration of weather. Weather forecasting</td>
</tr>
<tr>
<td>Impact</td>
<td>Impact between objects</td>
</tr>
<tr>
<td>Position</td>
<td>Object, grillage or barge not in correct position</td>
</tr>
<tr>
<td>Drop</td>
<td>Drop of objects from a higher level</td>
</tr>
<tr>
<td>Power</td>
<td>No power or insufficient power</td>
</tr>
<tr>
<td>Instruments</td>
<td>Malfunction or lack of instruments</td>
</tr>
<tr>
<td>Communication</td>
<td>Malfunction or lack of communication equipment. Communication lines</td>
</tr>
<tr>
<td>Movement</td>
<td>Objects or vessels move in an uncontrolled way</td>
</tr>
<tr>
<td>Stability</td>
<td>Unstable conditions</td>
</tr>
<tr>
<td>Tolerances</td>
<td>Tolerances for positioning, grillage tolerances, barge tolerances, etc.</td>
</tr>
<tr>
<td>Stuck</td>
<td>Movement cannot be performed</td>
</tr>
<tr>
<td>Rupture</td>
<td>Rupture of critical equipment</td>
</tr>
<tr>
<td>Access</td>
<td>Insufficient access</td>
</tr>
<tr>
<td>Not cut</td>
<td>No or insufficient cutting of items to be cut before an activity can start</td>
</tr>
<tr>
<td>Barriers</td>
<td>No or insufficient barriers</td>
</tr>
<tr>
<td>Tension</td>
<td>High tension in e.g. running wires or wire slings</td>
</tr>
<tr>
<td>Execution</td>
<td>A work task is executed in a wrong way</td>
</tr>
<tr>
<td>Procedures</td>
<td>Missing or unclear procedures</td>
</tr>
<tr>
<td>Environmental</td>
<td>Potential environmental pollution</td>
</tr>
</tbody>
</table>

B.8 Semi-Quantitative Risk Assessments

B.8.1 Purpose
The main purpose of the SQRA is to subjectively assess the risk and criticality of operations in order to identify the most critical activities.

B.8.2 Application
In an SQRA the risks are semi-quantitatively assessed for each undesired event identified in a hazard review (EPH, HAZID and/or HAZOP) and reported as part of the corresponding hazard review. Typical acceptance criteria for SQRA are given in Appendix D3.

B.8.3 Performance
Risk/criticality's are subjectively assessed normally by an evaluation team consisting of several qualified persons.

B.8.4 Deliverables
Relative risks are assessed. Ranking of the most critical activities and operations, which may form the basis for project risk registers, "top ten" lists etc.

B.9 Safe Job Analysis

B.9.1 Purpose
SJA shall ensure timely HSE evaluation such that work is accomplished safely without accidents. SJA shall be used to cover any work of an unusual/uncertain character. Usage of SJA shall be considered in connection with, for example:

- Procedures: Non-conformance with/deviation from established practice, deficient procedures with regard to HSE assessment.
- Situations: tight spaces, tanks, difficult access/escape, by the sea, high elevation/several levels.
- Materials; Radioactive sources, hazardous substances (health or pollution danger).
- Systems; High pressure, fire/explosion danger, high-voltage electricity.
- Equipment and tools; Cranes, vehicles, winches, rotating machinery.
- Operations; Lifting, handling, winch operations, simultaneous activities.
- Simple or detailed tasks where HAZID and HAZOP have not been performed
B.9.2 Application

SJAs are applicable for the following:

- Review of detailed method/procedure not covered in the general documentation
- For work involving several groups with different work tasks in the same area
- In case of deviations from an already approved procedure

B.9.3 Expected Input

Input may be operational procedures, drawings or verbal descriptions of the planned activity or operation being subject to the SJA.

B.9.4 Performance

Supervisors together with their workforces shall prepare a SJA to cover any work of an unusual or uncertain character.

Typical actions as part of a SJA are:

- Set the boundaries for the analysis.
- Define the activities step by step.
- Identify the risk elements.
- Evaluate the risk.
- Establish risk management and relevant preparedness functions.

See also Table B6.
Table B6 - Typical Aide-Memoire for SJA

<table>
<thead>
<tr>
<th>Risk Element</th>
<th>No</th>
<th>Yes</th>
<th>Necessary Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedures / Practices / Preparation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adequate procedures / instructions found with regard to prevention of HSE problems?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work operation well known?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personnel qualifications / experience?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experience data / incident records?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulations exist?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-conformance with / deviation from established procedure?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal protective equipment?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety plan / Safety system?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire prevention?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire watch</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boarding watch?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Records of substances and products / HSE data sheets?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tagging, Sign posting, Closing off?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tidiness and cleaning?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Situations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tight space / tank?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Escape?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>By the sea?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elevation / several levels / dropped objects?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light / emergency lighting?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ventilation?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Materials</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radioactive sources / Radiation danger?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hazard. Substances (health/pollution danger)?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas – liquid – suffocation danger?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spillage to water / air?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure / temperature?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire- explosion- risk?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electric current - high voltage?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment and tools</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cranes – lifting equipment?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicles?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Machinery protection?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simultaneous activities?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Action / handling / transportation?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**B.9.5 Deliverables**

The results from a SJA shall be formally documented. Typically worksheets as outlined in Table B7 below may be used. All personnel who have participated in the SJA shall sign the worksheets in order to document their concurrence and their participation.
Table B7 - SJA Worksheet

<table>
<thead>
<tr>
<th>Safe Job Analysis – Worksheet</th>
<th>Date:</th>
<th>Rev.:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job Description</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity:</th>
<th>Failure Mode</th>
<th>Risk Evaluation (High, Medium, Low)</th>
<th>Risk Reducing Action</th>
<th>Responsible/ deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Participants**

Name Signature

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
Appendix C. - Risk Reducing Activities

C.1 General

C.1.1 Objectives
The objective with this section is to list and describe risk-reducing activities recommended for risk assessment and management of marine operations. Their application as well as suggested methods and tools are described.

C.2 Operational Feasibility Assessments

C.2.1 Purpose
It is important to document operational feasibility at an early project stage in order to avoid extra costs due to reinforcements, change of vessels or equipment, or change of marine operations concept at a late stage. It is also important to identify and highlight potentially critical activities at an early stage. All objects shall be designed with due consideration to the forthcoming marine operations. The objects shall be designed to resist characteristic loads and conditions as well as be practicable to handle during the marine operations.

C.2.2 Application
All marine operations shall be confirmed to be feasible.

C.2.3 Expected Input
Input to the feasibility assessment is an operations method description where vessels, sites, equipment and method of handling the objects is described to some detail.

C.2.4 Performance
Operational feasibility studies may be performed through studies supplemented by e.g. HAZIDs or EPHs.

C.2.5 Deliverables
Operational feasibility shall be documented, preferably in a self-contained report. Critical aspects or elements revealed during the assessment to be recorded.

C.3 Document Verification

C.3.1 Purpose
Document verification is essential as a quality assurance element in marine operations. The purpose of such verification is to avoid design or planning errors that may lead to unsuccessful marine operations.

C.3.2 Application
All main operational procedures shall be subject to verification. Engineering documentation and drawings shall be verified as agreed between the client and the verifier, based on the Master Document Register (MDR) for the project.

C.3.3 Expected Input
A Master Document Register (MDR) shall be established for all projects. A MDR shall list all documents and drawings with title and planned time for the various revisions. A MDR forms the basis for determining which documents that shall be subjected to external verification. A MDR shall be established early in a project and be issued to the external verification company for mark-up as early as practicable.

For marine operations where a Certificate of Approval (Declaration) is required either by the client as part of their quality assurance system and/or by the insurance, the independent third party company (warranty surveyor) will determine which documents that shall be subject to his review.

C.3.4 Performance
DNV will use Ref. /1/ as basis for document verifications.

C.3.5 Deliverables
The results of the document verification shall be given in review reports or review notes. Status codes shall be given on all response. The following status codes are used by DNV:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>Recommendation (action required)</td>
</tr>
<tr>
<td>IR</td>
<td>Information required</td>
</tr>
<tr>
<td>AC</td>
<td>Accepted with comment (advice – no action required)</td>
</tr>
<tr>
<td>A</td>
<td>Accepted</td>
</tr>
</tbody>
</table>

C.4 Familiarisation

C.4.1 Purpose
Thorough familiarisation of personnel is a key issue to successful marine operations. It is essential that all involved personnel have in-depth understanding of their work tasks, authority and responsibility before and during the operations. This shall also involve all vessels’ marine crew.

C.4.2 Application
All personnel involved in the execution of marine operations shall be familiar with the operation.

C.4.3 Expected Input
Input to familiarisation is operations manuals, detailed drawings, field charts and other relevant project and operations information. Input should also be experience reports and videos from similar operations.

C.4.4 Performance
The familiarisation shall be properly planned as part of the risk management planning.
A familiarisation meeting with all relevant personnel shall be held in due time before start of the operation, preferably minimum one week in advance. Relevant project information such as organisation and communication charts, general arrangement drawings, schedule information, main operational steps, field charts, etc. shall be handed out to all participants.

In addition, participation in Procedure HAZOPs is regarded as part of the familiarisation process for key personnel.

Familiarisation meetings shall be supplemented with toolbox talks, which normally takes place immediately before specific work tasks are started. Also proper hand-over meetings between shifts shall be organised for continuous operations.

C.4.5 Deliverables
Familiarisation packages shall normally be developed and issued to all relevant personnel as part of the familiarisation.

C.5 Personnel Safety Plans

C.5.1 Purpose
The purpose of preparing personnel safety plans, defining escape routes and safe access, is to ensure and verify safe access at all times for personnel working on vessels, objects, platforms or part thereof.

C.5.2 Application
The preparation of safety plans applies to marine operations and work on vessels, objects, platforms or part thereof where personnel are involved.

C.5.3 Expected Input
Input is layout drawings of the vessel, object, platform or part thereof.

C.5.4 Performance
Safety plans are normally prepared by HSE project personnel responsible for the vessel, object, platform or part thereof. As a follow-up of the preparation of the safety plans the escape routes and safe access-ways shall be adequately marked with signs, paint-marks, chain, etc.

C.5.5 Deliverables
Deliverables are safety plans showing escape routes and safe access-ways.

C.6 Emergency Preparedness

C.6.1 Purpose
A system for emergency preparedness is essential in order to minimise time, and ensure efficient and adequate response, should an incident or accident occur.

C.6.2 Application
A system for emergency preparedness shall be in force for all marine operations and cover all vessels and personnel involved. Normally the various companies involved in the marine operations have their own individual emergency preparedness system. These systems shall be linked by an emergency preparedness bridging document.

C.6.3 Expected Input
Input to the emergency preparedness bridging document is telephone numbers and call signs to vessels and emergency preparedness organisation on land, including main rescue central, client and contractor organisations, nearby sites or platforms, local authorities and on-duty doctors.

C.6.4 Performance
Often several companies are involved in a marine operation, each of which has their individual emergency preparedness systems. In such cases, a bridging document shall be developed linking the various emergency preparedness systems together. Such a bridging document shall comprise the following minimum information:

- Vessels and installations participating in the operation, including call signs, communication channels (VHF/UHF) and telephone numbers
- Organisation and reporting lines in an emergency situation
- All relevant telephone numbers in an emergency situation, including main rescue centre, emergency preparedness centre, guard centre, etc.
- Bridging Document must clearly define who has prime responsibility at each stage of a marine operation and if appropriate, how and when it changes.
- Before start of an operation a communication check shall always be performed to ensure that all communication lines are working properly.
- Emergency preparedness table-top exercises may be an efficient tool for operations with many parties, vessels and/or installations involved. Such analyses shall describe an incident scenario as basis for the exercise and record how the various parties respond to their described communication and recording duties. Corrective actions shall be implemented as appropriate.
- All involved companies shall have an on-duty 24-hour watch system. All relevant duty personnel in the emergency organisation shall be adequately briefed before an operation is commenced.

C.6.5 Deliverables
Emergency preparedness systems are described in manuals. The emergency preparedness bridging document comprises bridging information, with the emergency preparedness flowchart as a central part. This flowchart is normally presented as a drawing.
C.7 Marine Readiness Verification

C.7.1 Purpose
Typical purposes for Marine Readiness Verifications (MRVs) are to verify:

- Readiness for the planned marine operations including all involved parties (i.e. company, contractors, sub-contractors, etc.)
- That risks associated with the marine operations are identified and managed during the operations
- That the marine operations are well planned, understood by personnel involved and will be carried out in a safe and efficient manner
- That adequate emergency preparedness will be implemented during the operations
- A simplified MRV performed as part of a mobilisation, where the following items are particularly relevant:
  - Check that all actions from HAZOPs, etc. are closed
  - Check that all check-list/punch-list actions are properly managed or closed

C.7.2 Application
MRVs apply for all marine operations.

C.7.3 Expected Input
Information gathering is normally through presentations and interviews with project team members together with a review of key documentation such as operations manuals, HAZOP reports, etc.

C.7.4 Performance
Marine Readiness Verification (MRV) is performed late in a project and may be performed by licence group members, operators or contractors. A MRV is normally performed as a service to the project manager. Accordingly he may issue a mandate to the MRV team.

The MRV team shall consist of personnel not directly involved in the execution of the operation. A team leader shall be nominated. All personnel shall have experience from marine operations and have experience with similar tasks.

MRVs shall be properly planned and notifications given to the relevant personnel in due time before commencement. Control areas for the MRV shall be pre-defined. Typical control areas are:

- Operational and physical interfaces
- Organisation
- Operation schedule
- Risk management, including RMP
- Documentation
- Third party services
- HSE programme
- Emergency preparedness system
- Total quality assurance activities
- Table top exercises

C.7.5 Deliverables
The results from the MRV are normally in the form of recommendations (actions) and observations. A typical result and follow-up matrix is given in Table C1.

Table C1- MRV Follow-up Matrix

<table>
<thead>
<tr>
<th>No.</th>
<th>Recommendation (action)</th>
<th>Observation</th>
<th>Action by/timing</th>
<th>Priority (1, 2 or 3)</th>
</tr>
</thead>
</table>

**Priority 1** - Fundamental: Important to be carried out before the marine operation activity to which the recommendation pertains.

**Priority 2** - Significant: Recommended to be carried out before the relevant marine operation to ensure the expected quality of the activity.

**Priority 3** - Less important: Desirable to be carried out.

C.8 Inspection and Testing

C.8.1 Purpose
The main purpose of testing is to verify the intended functionality and capacity of systems and equipment. Another purpose may be to familiarise operators with the system or equipment.

C.8.2 Application
All essential systems and equipment shall be inspected and tested as appropriate before start of a marine operation.

C.8.3 Expected Input
All tests shall be performed according to an approved test procedure.

C.8.4 Performance
Permanent systems and equipment onboard vessels or platforms normally follow a regulatory test programme determined by their Class and international and/or national regulations. An inspection of these items will hence normally be a check that all certificates are valid during the duration of the operation.
Temporary systems and equipment are often used during marine operations. Experience shows that the majority of mechanical failures are related to temporary equipment. This is often due to lack of testing, poor maintenance, damages during transport and mal-operation. For temporary systems like e.g. winches the following testing apply:

- Individual component tests
- Function integration testing
- Full capacity testing
- Testing of metering systems, etc.
- Test of back-up systems, including switch over from main system to back-up

Remotely Operated Vehicles (ROVs) shall also be tested both dry and in water, including deep water testing as far as practicable in order to avoid delays during the operation. Compatible components shall be selected. The ROVs shall be tested with all remotely operated tools to be used during the operation, in order to ensure adequate capacity and no interference between the various ROV systems and tools.

Testing of communication lines shall be performed before start of an operation. This includes radio channels and telephone lines and is a check on the equipment and application in the surroundings of intended use. Particular attention shall be paid to selection of communication equipment for use in noisy conditions and when working close to platforms (shadow effect). Additional external antennas may be required.

In situations where complex reporting or logging is to be performed a test on this may be found relevant, in order to avoid delays in the operation due to logging.

Mobilisation operations are normally very hectic. In order to minimise the time for testing, a detailed test programme shall be established in due time before the mobilisation. Systems and components that may be tested before mobilisation shall be checked out well in advance of the mobilisation. For extensive mobilisation operations a separate task force may be established following up the testing.

A good system for transport, maintenance and storage of temporary systems shall be in force. The use and maintenance of temporary systems and equipment shall be traceable.

C.8.5 Deliverables
The results of testing shall be documented in test reports.

C.9 Survey of Vessels

C.9.1 Purpose
Survey of vessels is primarily performed to document the suitability for the intended use.

On/off-hire surveys may be conducted to assess the condition before and after use, being a basis for claims in case of damages and to determine consumption of fuel, lubes, water, etc.

C.9.2 Application
All vessels having a key role shall be surveyed before start of a marine operation.

C.9.3 Expected Input
The survey will be performed onboard the vessel in question. A check that all vessel certificates are valid is normally a part of the survey.

C.9.4 Performance
Vessels normally follow a regulatory certification programme determined by their Class and international and/or national regulations. A vessel survey will hence normally be a check that all certificates are valid during the duration of the operation. Additionally it is recommended that the survey also include inspection of maintenance records and towing logs for tow vessels. It is also advised that the vessel track/performance records, including safety culture, organisation of work and are checked, i.e. previous performance within same projects or for same company.

Suitability surveys may be conducted in order to verify adequacy for intended use at an early stage.

C.9.5 Deliverables
Surveys shall be documented by a survey report.

C.10 Toolbox Talk

C.10.1 Purpose
Toolbox talks are performed by operations personnel to ensure timely detailed knowledge of all relevant operations activities, such that the work is accomplished safely without accidents.

C.10.2 Application
Toolbox talks are applicable for all marine activities and should be performed before commencement of such activities.

C.10.3 Expected Input
Input may be operational procedures, drawings, verbal descriptions of the planned activity or operation or lessons learnt from previous activities.

C.10.4 Performance
Supervisors should perform toolbox talks together with their workforces.

Typical activities as part of a toolbox talk are:

- Define the activities step by step.
- Identify the risk elements.
- Describe work activities in detail.
C.10.5 Deliverables
There is usually no written deliverables from a toolbox talk. It should, however, be stated in the vessel’s log/operations log that such an activity has taken place.

C.11 Survey of Operations

C.11.1 Purpose
Survey of the preparations for the operations, including the prevailing weather and forecast, is an essential part of the verification of the operations. It shall be verified that all outstanding actions and items have been adequately addressed and closed before start of the operation.

Survey of operations is normally performed to check that all approved procedures are strictly adhered to during the operations. In addition the presence of a surveyor imply that deviations may be approved during the operations.

C.11.2 Application
Survey of operations by an independent marine surveyor is required for medium and high risk operations.

C.11.3 Expected Input
Approved operations procedures are the input to the survey activities.

C.11.4 Performance
For marine operations where a Certificate of Approval (Declaration) is required either by the client as part of their quality assurance system and/or by the insurance, the client and the external marine verification company (warranty surveyor) will agree which operations that shall be subject to his survey.

DNV will use Ref. /1/ as basis for surveys.

C.11.5 Deliverables
Surveys shall be documented by a survey report.
Appendix D. - Miscellaneous

D.1 Document Basis - Cross References

<table>
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<th></th>
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<th></th>
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<td>- Sec. 3,</td>
<td>- Sect. 5.2,</td>
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<td></td>
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<td>- Sect. 5.1</td>
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<td>- Appendix A, B, C</td>
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<td>- Sect 5.3</td>
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<td>- Sec. 5.3,</td>
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<td></td>
<td>- Annex B (gen.)</td>
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<td>- Appendix A, B, C</td>
<td></td>
<td>- Sec. 3, Sec. 5.4,</td>
<td>- Sect. 5.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Annex B (gen.)</td>
<td></td>
</tr>
</tbody>
</table>
D.2 Methodology - Flow Chart

1. Need for Marine Operation realised
   - Define objects to be handled
   - Define required operations for each object

2. For each operation conclude on potential risk based on assessment of the parameters listed in table 1.1
   - For each object summarise and conclude on potential risk.
   Conclusions:
   High, Medium, Low potential risk

3. Prepare first part of Risk Management Plan specifying Risk Reducing Activities and detailed Risk Identification Activities. Plan will be a function of defined category (higher risk will result in a more comprehensive plan).
   Overall Goal
   Define Risk ID and reducing activities, place them in time and clearly assign responsibilities
   Define main activity, and detailed follow up Check Lists to form part of Risk Management Plan

4. Perform detailed risk identification activities as specified in Risk Management Plan (Hazop, Hazid……)

5. Category OK?
   No
   Re-assess operation and specified activities if major revision of methods and/or change of contractors
   Yes

6. Define screening/accept criteria

7. Assessment Form

Overall Process Activities
General QA Activities
Detailed risk identification and reduction activities (Hazops, Hazids ++)
Activity Check list format and guidance

Table 2.2, 2.3 & 2.4
Appendix D3 & D5
Appendix D4
D.3 Risk Accept Criteria Form (Sample)

<table>
<thead>
<tr>
<th>Consequence</th>
<th>Probability (increasing probability →)</th>
<th>Description</th>
<th>Remote (A) Has occurred - not likely</th>
<th>Unlikely (B) Could occur</th>
<th>Likely (C) Easy to postulate</th>
<th>Frequent (D) Occur regularly</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>A1 = S</td>
<td>B1 = S</td>
<td>C1 = U</td>
<td>D1 = U</td>
</tr>
<tr>
<td>1. Extensive</td>
<td></td>
<td>Personnels</td>
<td>Global or national effect. Restoration time &gt; 10 yr.</td>
<td>Project/Prod consequence costs &gt; USD 10 mill</td>
<td>International impact/neg. exposure.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Environment</td>
<td>Remote (A) Has occurred - not likely</td>
<td>Unlikely (B) Could occur</td>
<td>Likely (C) Easy to postulate</td>
<td>Frequent (D) Occur regularly</td>
</tr>
<tr>
<td>2. Severe</td>
<td></td>
<td>Assets</td>
<td>Project/Prod consequence costs &gt; USD 1 mill</td>
<td>Project/Prod consequence costs &gt; USD 1 mill</td>
<td>Extensive National impact</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A2 = A</td>
<td>B2 = S</td>
<td>C2 = S</td>
<td>D2 = U</td>
</tr>
<tr>
<td>3. Moderate</td>
<td></td>
<td>Restoration time &gt; 1 yr. Restoration cost &gt; USD 1 mill.</td>
<td>Project/Prod consequence costs &gt; USD 1 mill</td>
<td>Project/Prod consequence costs &gt; USD 1 mill</td>
<td>Limited National impact</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A3 = A</td>
<td>B3 = A</td>
<td>C3 = S</td>
<td>D3 = S</td>
</tr>
<tr>
<td>4. Minor</td>
<td></td>
<td>Restoration time &lt; 1 md. Restoration cost &lt; USD 1 K.</td>
<td>Project/Prod consequence costs &lt; USD 1 K</td>
<td>Project/Prod consequence costs &lt; USD 1 K</td>
<td>Local impact</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A4 = A</td>
<td>B4 = A</td>
<td>C4 = A</td>
<td>D4 = S</td>
</tr>
</tbody>
</table>

High Risk
If the undesired event after mitigating measures is evaluated to have unacceptable risk (U) the operation shall not be carried out. If the operation is still to be carried out, formal application for deviation shall be filed according to established procedures.

Medium Risk
Operation can be executed after cost efficient measures are implemented and the analyses team has found the risk satisfactory (S).

Low Risk
Acceptable risk (A) subject to application of the principle of ALARP and those activities as specified in this RP.
D.4 Risk Management Plan - Check List (Sample)

Note:
This sample combines all elements into one list.
D.5 Risk Category Assessment Forms (Samples)

The overall assessment and categorisation of required operations will be based on the principles and methodology of HAZID, see Appendix B2. The assessment parameters and keywords should be according to Table 1.1. The assessment process should be considered as iterative and to be reviewed at defined milestones to reflect progress, revised methods and/or operational seasons, new contractors, etc.

It is recommended that this overall risk assessment is performed as early as possible, preferably as part of concept evaluations, feasibility evaluations or FEED phases.
DNV Recommended Practice for Risk Management in Marine- and Subsea Operations

Risk Category Assessment Form

Object: Object 01.01
Operation: Object xxxx
Date: 2002-03-03

Conclusion:
The specified operation was concluded as an operation within the potential risk category:

- [ ] High Risk
- [ ] Medium Risk
- [ ] Low Risk

Potential Risk Category (H/M/L):

<table>
<thead>
<tr>
<th>Assessment Parameter</th>
<th>Personnel Exposure</th>
<th>Environment</th>
<th>Assets</th>
<th>Reputation</th>
<th>Weighting</th>
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</thead>
<tbody>
<tr>
<td>Personnel Exposure</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>3</td>
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<tr>
<td>Overall Project Particulars</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
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<tr>
<td>Existing Field Infrastructure</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td></td>
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<tr>
<td>Handled Object</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>2</td>
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<tr>
<td>Marine Operations Method</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>1</td>
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<td>Equipment</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
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<td>Operational Aspects</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>2</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Recommended Risk Category</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>L</td>
<td>12</td>
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</tbody>
</table>

Assessment group

Per Ø Henrik Geir

Particular Highlights & Comments

Criteria for Assessment

Guidance

<table>
<thead>
<tr>
<th>Consequence Descriptive</th>
<th>Exposure of Personnel</th>
<th>Environment</th>
<th>Assets</th>
<th>Reputation</th>
<th>Marine Operation Potential Risk Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extensive</td>
<td>&gt;10</td>
<td>Global or national eff.</td>
<td>&gt;100 mill.</td>
<td>Intenational imp./expos.</td>
<td>High (H)</td>
</tr>
<tr>
<td>Severe</td>
<td>&gt;2</td>
<td>Local eff. At site (&gt;10mill)</td>
<td>&gt;10 mill.</td>
<td>Extensiv national imp.</td>
<td>Medium (M)</td>
</tr>
<tr>
<td>Moderate</td>
<td>&lt;2</td>
<td>Local eff. At site (&lt;10mill)</td>
<td>&lt;10 mill.</td>
<td>Limited national imp.</td>
<td>Low (L)</td>
</tr>
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</table>
D.6 Appendix Risk Management Plan (Sample)
## RISK MANAGEMENT PLAN

<table>
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<th>Date of first issue:</th>
<th>Project No.:</th>
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<tr>
<td>2002-08-30</td>
<td>73670101</td>
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</table>

**Approved by:**

Øyvind Lundby  
Head of Section

**Organisational unit:**

Marine Operations

**Client:**

JIP Group

**Client ref.:**


**Summary:**

As part of the JIP for developing a DNV RP for risk management during marine operations a sample Risk Management Plan has been requested. This document is a first proposal for the a layout and disposition of such plan.

---

### Report No.: Subject Group:

Report title:

**DNV Recommended Practice**

Risk Management Plan

Sample

**Work carried out by:**

Øyvind Lundby/Geir Edvardsen

**Work verified by:**


**Date of this revision:**

2002-08-30

**Rev. No.:**

01

**Number of pages:**

xx + Appendix

**Indexing terms**

- Marine Operations
- Quality Assurance

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Head Office: Veritasveien 1 N-1322 Havik Norway
Revision Page

Revision 01 Issued 2002-08-30
This is the first revision of this document. The purpose with this revision is to present a first proposal for a lay out and disposition of a Risk Management Plan.
DNV RECOMMENDED PRACTICE
RISK MANAGEMENT IN MARINE- AND SUBSEA OPERATIONS
RISK MANAGEMENT PLAN - SAMPLE

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Appendix
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Appendix B
Appendix C
1 INTRODUCTION

1.1 OBJECTIVES
The main objectives with this Risk Management Plan is to describe, communicate and document all activities necessary to manage and control, through all project phases, the risks involved for all marine operations required for the XXXXX Development Project, i.e. this document will describe the:
- planned risk management process
- organisation and allocation of responsibilities
- activities for identifying and reducing risks
- means for monitoring of status

This document will also be part of the "as build" for the project as documentation of the risk management process.

1.2 RISK MANAGEMENT METHOD
Basis for this Risk Management Plan is recommendations and formats as given in /1/. The overall structure are as follows;
- An overall risk assessment of define operations
- Define specific and detailed risk identification activities based on the overall assessment
- Reduction of risk to an acceptable level through specified risk reducing activities

Risks within marine operations will be assessed against criteria for (see also 2.2):
- Personnel safety
- Environment
- Assets
- Reputation

1.3 OVERALL RESPONSIBILITY
Company has the overall responsibility for establishing and follow-up of the Risk Management process and activities. This responsibility is assigned to:

NNNN (QA Responsible)
Contact particulars xxxxx

This responsibility encompass:
- Activities required for developing the Risk Management Plan
- Initiation of defined activities
- Monthly monitoring and maintenance of this plan
- Follow up of close outs
2 HSE PHILOSOPHY AND STRATEGY

2.1 GENERAL

The HSE goal for the marine operations required for the xxx development project is:

To perform required marine operations with no incident, accidents or losses.

The strategy to reach this goal will be to:
- plan for safe, robust and efficient operations,
- maintain focus on feasibility and installability of operations, and
- optimise planning of marine operations in order to:
  - Minimise vessel delays
  - Improve vessel utilisation and efficiency
  - Minimise costs for the marine operations

The method applied to reach the goal will be through:
Identification of project technical and commercial risks through a defined risk identification process. Identified risks will be controlled through:
- A thorough and systematic risk identification/traction process.
- Planning of the operations according to recognised industry standards.
- Proper coordination of vessels.
- Systematic use of emergency preparedness table top exercises.
- Use of recognised technical standards and references.
- Ensure adequate marine verification.
- Execution and presence of qualified personnel during the operations.

2.2 RISK ACCEPT CRITERIA

During assessment risk assessments categorisation will be based on both consequence and probability categories. The criteria for each category are given in Figure 1.
## DNV RECOMMENDED PRACTICE

**RISK MANAGEMENT IN MARINE- AND SUBSEA OPERATIONS**  
**RISK MANAGEMENT PLAN - SAMPLE**

### Figure 1 - Defined Risk Categories

<table>
<thead>
<tr>
<th>Consequence</th>
<th>Probability (increasing probability →)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Remote (A)</td>
</tr>
<tr>
<td></td>
<td>Has occurred</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Descriptiv e</th>
<th>Personnel</th>
<th>Environment</th>
<th>Assets</th>
<th>Reputation</th>
<th>Remote (A)</th>
<th>Unlikely (B)</th>
<th>Likely (C)</th>
<th>Frequent (D)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Extensive</td>
<td>Fatalities</td>
<td>Global or national effect. Restoration time &gt; 10 yr.</td>
<td>Project/Production costs &gt; USD 10 mil</td>
<td>Extensive impact/neg. exposure</td>
<td>A1 = S</td>
<td>B1 = S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Severe</td>
<td>Major Injuries</td>
<td>Restoration time &gt; 1 yr. Restoration cost &gt; USD 1 mil.</td>
<td>Project/Production costs &gt; USD 1 mil</td>
<td>Extensive National impact</td>
<td>A2 = A</td>
<td>B2 = S</td>
<td>C2 = S</td>
<td></td>
</tr>
<tr>
<td>3. Moderate</td>
<td>Minor Injuries</td>
<td>Restoration time &gt; 1.0d. Restoration cost &lt; USD 1K</td>
<td>Project/Production costs &gt; USD 100 K</td>
<td>Limited National impact</td>
<td>A3 = A</td>
<td>B3 = A</td>
<td>C3 = S</td>
<td>D3 = S</td>
</tr>
<tr>
<td>4. Minor</td>
<td>Illness or slight injury</td>
<td>Restoration time &lt; 1.0d. Restoration cost &lt; USD 1K</td>
<td>Project/Production costs &lt; USD 1 K</td>
<td>Local impact</td>
<td>A4 = A</td>
<td>B4 = A</td>
<td>C4 = A</td>
<td>D4 = S</td>
</tr>
</tbody>
</table>

**High Risk**  
If the undesired event after mitigating measures is evaluated to have unacceptable risk (U) the operation shall not be carried out. If the operation is still to be carried out, formal application for deviation shall be filed according to established procedures.

**Medium Risk**  
Operation can be executed after cost efficient measures are implemented and the analyses team has found the risk satisfactory (S).

**Low Risk**  
Acceptable risk subject to application of the principle of ALARP and those activities as specified in the RP.
4 OBJECTS AND OPERATIONS

4.1 PROJECT DESCRIPTION

The xxx development project initiated in order to updated the XXX field to accommodate and increased xxxxx. The modification work encompass installation of:
- New xxx module
- An xxx subsea structure
- Pipelines and umbilicals between the platform and the subsea structure

The project was initiated 2002, and is planned completed 2004. The following major milestones are planned:

2003 - June  Installation of subsea structure
2004 - June  Installation of module
2004 - August Installation of pipelines and umbilicals
2004 - August Hookup/tie in

4.2 OBJECTS, OPERATIONS AND POTENTIAL RISK CATEGORY

Defined objects and operations were this RMP apply are defined in appendix A1. Defined start and end points for each operation are stated as well as the potential risk category. The Potential Risk Category Assessment Forms are enclosed in appendix B1.
5 PROCESS, RISK IDENTIFICATION AND RISK REDUCING ACTIVITIES

5.1 PROCESS CHECKLIST

The activities required for establishing the risk management process, general QA activities, detailed risk identification and risk reducing activities are defined in the RMP checklist enclosed in appendix C1, as well as responsibilities, deadlines. The checklist was established through a joint session xxx-xx-xx.

5.2 CLOSE OUT REPORT

All planned activities relevant for one specific operation should be checked out with an acceptable status before start of an operation. The activities should be confirmed with acceptable status by the signature of the responsible. The filled in and signed checklists, with enclosed certificate and declaration shall form the “as build” documentation for the Project Risk Management Process.
6 REFERENCES


/2/ DNV Rules for Planning and Execution of Marine Operations
Appendix
Appendix A
A1 Objects and Operations

Appendix B
B1 Risk Assessment Forms
List of Contractors

Appendix C
C1 Risk Management Plan - Checklists
Appendix A1
Objects and Operations
Appendix B1
Risk Assessment Forms
Appendix C1
Risk Management Plan - Check List

See copy included in RP appendix B3