EMERGENCY RESPONSE PREPAREDNESS IN E&P INDUSTRY

OISD – GDN – 227
First Edition, August 2007

Oil Industry Safety Directorate
Government of India
Ministry of Petroleum & Natural Gas
8th Floor, OIDB Bhavan, Plot No. 2, Sector – 73, Noida – 201301 (U.P.)
Website: www.oisd.gov.in
Tele: 0120-2593800, Fax: 0120-2593802
EMERGENCY RESPONSE PREPAREDNESS IN E&P INDUSTRY

Prepared by

FUNCTIONAL COMMITTEE ON EMERGENCY RESPONSE PREPAREDNESS IN E&P INDUSTRY

OIL INDUSTRY SAFETY DIRECTORATE

8th Floor, OIDB Bhavan,
Plot No. 2, Sector - 73
Noida – 201301 (U.P.)
Preamble

Indian petroleum industry is the energy lifeline of the nation and its continuous performance is essential for sovereignty and prosperity of the country. As the industry essentially deals with inherently inflammable substances throughout its value chain – upstream, midstream and downstream – Safety is of paramount importance to this industry as only safe performance at all times can ensure optimum ROI of these national assets and resources including sustainability.

While statutory organizations were in place all along to oversee safety aspects of Indian petroleum industry, Oil Industry Safety Directorate (OISD) was set up in 1986 Ministry of Petroleum and Natural Gas, Government of India as a knowledge centre for formulation of constantly updated world-scale standards for design, layout and operation of various equipment, facility and activities involved in this industry. Moreover, OISD was also given responsibility of monitoring implementation status of these standards through safety audits.

In more than 25 years of its existence, OISD has developed a rigorous, multi-layer, iterative and participative process of development of standards – starting with research by in-house experts and iterating through seeking & validating inputs from all stake-holders – operators, designers, national level knowledge authorities and public at large – with a feedback loop of constant update based on ground level experience obtained through audits, incident analysis and environment scanning.

The participative process followed in standard formulation has resulted in excellent level of compliance by the industry culminating in a safer environment in the industry. OISD – except in the Upstream Petroleum Sector – is still a regulatory (and not a statutory) body but that has not affected implementation of the OISD standards. It also goes to prove the old adage that self-regulation is the best regulation. The quality and relevance of OISD standards had been further endorsed by their adoption in various statutory rules of the land.

Petroleum industry in India is significantly globalized at present in terms of technology content requiring its operation to keep pace with the relevant world scale standards & practices. This matches the OISD philosophy of continuous improvement keeping pace with the global developments in its target environment. To this end, OISD keeps track of changes through participation as member in large number of International and national level Knowledge Organizations – both in the field of standard development and implementation & monitoring in addition to updation of internal knowledge base through continuous research and application surveillance, thereby ensuring that this OISD Standard, along with all other extant ones, remains relevant, updated and effective on a real time basis in the applicable areas.

Together we strive to achieve NIL incidents in the entire Hydrocarbon Value Chain. This, besides other issues, calls for total engagement from all levels of the stake holder organizations, which we, at OISD, fervently look forward to.

Jai Hind!!!

Executive Director

Oil Industry Safety Directorate
Foreword

The Oil Industry in India is more than 100 years old. Because of various collaboration agreements, a variety of international codes, standards and practices have been in vogue. Standardisation in design philosophies and operation and maintenance practices at a national level was hardly in existence. This coupled with feed back from some serious accidents that occurred in the recent past in India and abroad, emphasised the need for the industry to review the existing state- of- the-art in designing, operating and maintaining oil and gas installations.

With this in view, the Ministry of Petroleum and Natural Gas in 1986 constituted a Safety Council assisted by the Oil Industry Safety Directorate (OISD) staffers from within the industry, in formulating and implementing a series of self regulatory measures aimed at removing obsolescence, standardising and upgrading the existing standards to ensure safe operations. Accordingly, OISD constituted a number of functional committees of experts nominated from the industry to draw up standards and guidelines on various subjects.

The present guidelines on “Emergency Response Preparedness in E&P Industry” has been prepared by the Functional Committee. The document is based on the accumulated knowledge and experience of industry members and the national / international codes and practices.

This document will help in adopting a systematic approach to emergency response by considering the various stages of an emergency and how each of these stages can be most effectively managed, to reduce losses. The Guidelines allow the users to choose the relevant provisions and adapt them in light of their particular circumstances.

Suggestions are invited from the users after it is put into practice to improve the document further. Suggestions for amendments to this document should be addressed to:

The Coordinator
Functional Committee on
“Guidelines for Emergency Response Preparedness in E&P Industry”,
Oil Industry Safety Directorate
8th Floor, OIDB Bhavan,
Plot No. 2, Sector - 73,
Noida – 201301 (U.P.)
Note

OISD (Oil Industry Safety Directorate) publications are prepared for use in the Oil and Gas Industry under Ministry of Petroleum & Natural Gas. These are the property of Ministry of Petroleum & Natural Gas and shall not be reproduced or copied and loaned or exhibited to others without written consent from OISD.

Though every effort has been made to assure the accuracy and reliability of the data contained in the document, OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from their use.

The document is intended to supplement rather than replace the prevailing statutory requirements.
Functional Committee for Guidelines on
“Emergency Response Preparedness in E&P Industry”

<table>
<thead>
<tr>
<th>Name</th>
<th>Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LEADER</strong></td>
<td></td>
</tr>
<tr>
<td>Shri K. Satyanarayana</td>
<td>Oil &amp; Natural Gas Corporation Limited</td>
</tr>
<tr>
<td><strong>MEMBERS</strong></td>
<td></td>
</tr>
<tr>
<td>Shri D.K.Rajkhowa</td>
<td>Oil India Limited</td>
</tr>
<tr>
<td>Shri M.K.Manocha</td>
<td>Oil &amp; Natural Gas Corporation Limited</td>
</tr>
<tr>
<td>Shri B.M.Chaurasia</td>
<td>Oil &amp; Natural Gas Corporation Limited</td>
</tr>
<tr>
<td>Shri M.Sahay</td>
<td>Oil &amp; Natural Gas Corporation Limited</td>
</tr>
<tr>
<td>Shri D.K.Varshney</td>
<td>Oil Industry Safety Directorate</td>
</tr>
<tr>
<td><strong>MEMBER CO-ORDINATOR</strong></td>
<td></td>
</tr>
<tr>
<td>Shri H.C.Taneja</td>
<td>Oil Industry Safety Directorate</td>
</tr>
</tbody>
</table>

In addition to the above, several other experts from Industry contributed in the preparation, review and finalisation of the Guidelines.
## Emergency Response Preparedness in E&P Industry

### CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Introduction</td>
<td>01</td>
</tr>
<tr>
<td>2.0</td>
<td>Scope</td>
<td>01</td>
</tr>
<tr>
<td>3.0</td>
<td>Definitions</td>
<td>01</td>
</tr>
<tr>
<td>4.0</td>
<td>Statutory requirements</td>
<td>03</td>
</tr>
<tr>
<td>5.0</td>
<td>Emergency response preparedness</td>
<td>04</td>
</tr>
<tr>
<td>6.0</td>
<td>Identification of emergency scenarios</td>
<td>04</td>
</tr>
<tr>
<td>6.1</td>
<td>Hazard identification and risk assessment</td>
<td>06</td>
</tr>
<tr>
<td>6.2</td>
<td>Emergencies</td>
<td>10</td>
</tr>
<tr>
<td>7.0</td>
<td>Emergency response planning</td>
<td>11</td>
</tr>
<tr>
<td>7.1</td>
<td>Emergency response strategy (ERS)</td>
<td>11</td>
</tr>
<tr>
<td>7.2</td>
<td>Emergency response measures</td>
<td>12</td>
</tr>
<tr>
<td>7.3</td>
<td>Emergency response plan</td>
<td>14</td>
</tr>
<tr>
<td>8.0</td>
<td>Competence and training</td>
<td>21</td>
</tr>
<tr>
<td>8.1</td>
<td>Competence</td>
<td>21</td>
</tr>
<tr>
<td>8.2</td>
<td>Training</td>
<td>22</td>
</tr>
<tr>
<td>9.0</td>
<td>Emergency Drills and Exercises</td>
<td>23</td>
</tr>
<tr>
<td>10.0</td>
<td>Maintenance of emergency response equipment and systems</td>
<td>23</td>
</tr>
<tr>
<td>11.0</td>
<td>References</td>
<td>25</td>
</tr>
</tbody>
</table>
Emergency Response Preparedness in E&P Industry

1.0 Introduction

Despite numerous safety measures adopted by the industry, some of the hazards may lead to incidents due to human factors, equipment failure, procedures failure, planning failure, risk assessment failure and organisational management (control, cooperation, communication, competence, monitoring, review) failure. Some of the incidents in the past have led to disasters like Piper Alpha, Mumbai High North and Kielland. Necessity of emergency preparedness to minimise the consequences to health, environment and assets in the event of foreseeable incidents is well recognised by the industry. Emergency response management is a critical component of safety management system.

This document has been prepared with an objective of providing guidance to the organisations to mitigate adverse effects of incidents through effective emergency preparedness and incident response. Organisations can use these general guidelines to develop effective emergency response plan for any potential hazard, which are location and scenario specific. This document should also be referred during design stage of new E&P installations.

2.0 Scope

This document lays down guidelines for development of emergency response preparedness in E&P Industry.

3.0 Definitions

abandonment
act of personnel leaving an installation in an emergency

acute pollution
unplanned discharge of pollutants

control station
place on the installation from which personnel can monitor the status of the installation, initiate appropriate shutdown actions and undertake emergency communication

disaster
any unexpected event causing significant harm to person(s) or environment / facilities

emergency
any unexpected event of whatever nature with the potential to harm person or environment / facilities

emergency preparedness
technical, operational and organisational measures that are planned to be implemented under the management of the emergency organisation in case hazardous or accidental situations occur, in order to protect human and environmental resources and assets

"OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines."
emergency response
action taken by personnel on or off the installation to control or mitigate a hazardous event or initiate and execute abandonment

emergency response measure
anything provided to facilitate the management of an emergency

emergency response plan
a formal written plan, which, on the basis of identified potential accidents together with their consequences, describes how such accidents and their consequences, should be handled, either on-site or off-site.

escape
act of personnel moving away from a hazardous event to a place where its effects are reduced or removed

escape route
route leading to the place where personnel muster, or to an area from which personnel may leave the installation in an emergency

essential safety system
system which has a major role in the control and mitigation of a hazardous event and in any subsequent evacuation, escape and rescue activities

evacuation
planned method of leaving the installation in an emergency

evacuation route
escape route which leads from the muster area to the place(s) used for primary or secondary evacuation from the installation

hazard
an inherent property of a substance, agent, source of energy or situation having the potential of causing undesirable consequences for human injury, damage to the environment, damage to property or a combination of these

hazard analysis
identification of individual hazards of a system, determination of the mechanisms by which they could give rise to undesired events, and evaluation of the consequences of these events on health (including public health), environment and property

mitigation
limitation of the undesirable effects of a particular event

muster
movement of personnel to a designated area so that the person in overall charge can account for all personnel and thereby facilitate subsequent emergency response actions

muster area
designated area to which personnel report when required to do so in an emergency

"OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines."
**performance standard**
is a statement which can be expressed in qualitative or quantitative terms, of the performance required of a system, item of equipment, person or procedure, and which is used as the basis for managing the hazard – inter alia planning, measuring, control or audit – through the life cycle of the installation

**rescue**
process by which persons who are marooned in the hazardous situation (such as when persons have entered the sea directly or in survival craft / life rafts in case of offshore) are retrieved to a place where medical assistance is available

**risk**
combination of the chance that a specified hazardous event will occur and the severity of the consequences of the event

**risk assessment**
overall process of risk analysis and risk evaluation against risk acceptance criteria

**safety management system**
the part of an organisation’s general management system that includes the organisational structure, responsibilities, practices, procedures, processes, and resources for determining and implementing an accident prevention policy. The safety management system normally addresses a number of issues including, but not limited to: organisation and personnel; identification and evaluation of hazards and risks; operational control; management of change; planning for emergencies; monitoring performance; audit and review

**shall**
indicates requirements / provisions that are obligatory in nature

**should**
indicates requirements / provisions that are recommended but not obligatory in nature

**temporary refuge**
place provided where personnel can take refuge for a predetermined period whilst investigations, emergency response and evacuation preparations are undertaken

**validation**
is system of initial tests or trials prior to implementation of new or modified arrangements to demonstrate that the performance standards are actually achievable

### 4.0 Statutory requirements
Relevant statutory requirements, as per the following, as amended from time to time, inter alia, are applicable for emergency response preparedness in E&P industry:

#### 4.1 Oil Mines Regulation 1984 (OMR)

#### 4.2 The Indian Electricity Rules 1956 (IER)

#### 4.3 Manufacture, Storage and Import of Hazardous Chemicals Rules 1989 (MSHIC)

“OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines.”
4.4 The Chemical Accidents (Emergency Planning, Preparedness and Response) Rules 1996

Additionally, all statutory requirements notified by the Central Government or States, from time to time, shall be complied with, as applicable.

5.0 Emergency response preparedness

Emergency management cycle has three components:

- Prevention-avoiding incidents
- Preparedness-being alert, ready and trained prior to incident
- Response-managing the consequences of an incident and providing immediate relief as well as taking steps towards restoring and returning to normal

For preparedness and response to hazards in E&P industry the focus is on:

- Securing effective response to emergencies on the installations
- Protecting persons from the effects of any emergency that occurs
- Reducing losses to the facility
- Minimising damage to the environment

This can be achieved by developing an approach to risk management based on hazard identification and risk assessment, preventing hazardous events occurrence, detecting if these have occurred, controlling their escalation and mitigating their consequences. The basis for the emergency preparedness plan shall be derived from hazard analysis and the consequences of identified maximum credible accident scenario, which is also known as the emergency response strategy. Emergency response measures should be based on the evaluation that takes into account possible failures of the control and mitigation measures.

Various steps involved in emergency response preparedness are: identifying emergency scenarios, emergency response planning (includes strategy, measures and plan), competence and training, emergency drills and exercises, and maintenance of emergency response equipment and systems.

6.0 Identification of emergency scenarios

The organisation shall establish and maintain procedures to identify foreseeable emergencies by systematic review and analysis of hazards during all life cycle stages of the installation.

Risk assessment process includes:

- Identification of initiating events
- Identification of possible accident sequences
- Estimation of the probability of occurrence of sequence events and
- Assessment of the consequences
Flow chart of risk assessment process

1. **System Description**
   - Hazard Identification
     - Accident Case Development

2. **Frequency Estimation**
3. **Consequence Analysis**

4. **Risk Calculation**

5. **Risk Assessment**
   - (are risks acceptable?)
   - **NO:** Apply frequency reduction measures
   - **NO:** Apply consequence reduction measures

6. **Yes**

"OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines."
The organisation shall ensure that the assessment of the risk by evaluation of the likelihood and consequences of foreseeable events is performed; for identification and assessment of emergency scenarios.

6.1 Hazard identification and risk assessment

At every installation/plant appropriate hazard identification and analysis technique(s) shall be used for identification of the emergency scenarios associated with the installation.

6.1.1 Some of the methods/techniques of hazard identification and risk assessment are described below.

a. Hazard identification methods – The following techniques are commonly used to identify hazards:

i. Preliminary hazard analysis (PHA) – an analytical technique used to identify hazards, which will result into hazardous event in the absence of adequate precautions / controls. The PHA is often used to evaluate hazards early in a project, carried out at the conceptual and front end engineering stages, helping in selection of the most advantageous arrangement of facilities and equipment.

Function of PHA is to minimise the likelihood of the occurrence and the consequences of hazardous event by identifying, evaluating and controlling the events that could lead to the incident. The factors like quantities, susceptibility to failure, mode of failure, proximity, severity, process complexity, operating history etc. should be considered while establishing priority.

PHA is often followed by more detailed Failure modes and effects analysis (FMEA), and Hazard and operability study (Hazop) at a later stage of the design process.

ii. What-if analysis – a brainstorming approach using broad, loosely structured questioning to:

- Postulate potential upsets that may result in mishaps or system performance problems
- Ensure that appropriate safeguards against these upsets are in place.

It can be used alone but most often is used to supplement other more structured techniques like Hazard checklist.

iii. Hazard checklist – a systematic evaluation against pre-established criteria in the form of one or more checklists. The technique is frequently used as a supplement to or integral part of another method to address specific requirements.

iv. Hazard and operability study (HAZOP) – HAZOP study, as the name indicates, is a combination of “Hazard analysis” and “Operability study” used to review the design and operation of a hazardous process facility.

“OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines.”
Operability study identifies the hazardous or unacceptable situations (causes of deviation from design intention i.e. normal safe operation) and hazard analysis qualifies the effects (consequences). Basically, it is used to identify all causes of deviation from normal safe operation, which could lead to any safety hazards or operability problems, and to define any action required to deal with it.

- **Procedural HAZOP** - a version of HAZOP applied to review procedures and sequential operations including safety-critical operations, such as, rig-moves, heavy lifts, etc.

- **Drillers’ HAZOP** - a version of HAZOP developed for drilling operations.

v. **Failure modes and effects analysis (FMEA)** - a systematic review of facility equipment items, their potential failure modes and the effects of these failures on the equipment or facility. It is an inductive reasoning approach best suited for review of mechanical and electrical hardware systems. The failure mode is simply a description of what caused the equipment to fail. FMEA can be used for analyzing the situations of single failure, which may result in hazardous event. A failure mode, effects and criticality analysis (FMECA) is the same as an FMEA except that the relative ranking (criticality) of each failure mode is included in the analysis.

vi. **Cause-consequence analysis (CCA)** - combines the inductive features of Event tree analysis (ETA) with the deductive features of Fault tree analysis (FTA). This technique is primarily used to find out whether a failure on component level is the cause for system failure or not. A cause-consequence diagram is used to display graphically the relationship between the incident consequences and their basic causes. It contains elements of both Fault tree and Event tree analysis. It can be developed in either direction: forward toward the consequences or backward toward the basic causes. The forward direction is similar to ETA and the backward direction is similar to FTA.

vii. **Human factors** – such as interface between the human operators and the systems they operate, should be considered during hazard identification. Human contribution to risk due to error can be reduced by training.

b. **Frequency estimation methods** – The following techniques may be used for frequency assessment:

i. **Fault tree analysis (FTA)** – FTA is a deductive technique that focuses on one particular accident event, often called a top event and then construct a logical diagram of all conceivable events sequence (both mechanical and human), which could lead to that accident event, along with assigning probability values to the conceived events. FTA is useful because it breaks an accident down into the basic failure and errors that could cause an accident. Fault tree analysis can be used for the analysis of complex systems. FTA is used primarily as a tool in reliability and
availability assessment. By reviewing the fault tree, it is possible to identify the different combination of failures or malfunctions, which give rise to the hazardous event. It is most effectively used to analyse system failures caused by relatively complex combinations of events.

ii. Event tree analysis (ETA) - a logical representation of the various events, which may follow from an initiating hazardous event, such as a failure of equipment or human error. It is tree-like diagram used to determine alternative potential scenarios arising from a particular hazardous event. The potential scenarios are assigned probability values. Event tree analysis can be used for analyzing complex processes with several layers of safety systems and developing emergency procedures to respond to specific initiating event.

iii. Analysis of historical data – frequency can be assigned to an event based on frequency data relating to the event being analysed, from industry database. A thoughtful analysis (data source, size of data set and local operating conditions) of the data should be performed to determine its applicability.

iv. Human reliability analysis – where human performance issues contribute to the likelihood of an end event occurring, methods for estimating human reliability are needed. One of the best-known techniques to assess human errors is Human reliability analysis. Human errors can be identified and their probability estimated for those actions that can contribute to the scenario being studied, such as personnel safety, loss of the system and environmental damage. The listing of tasks relating to the scenario, the list of likely human errors and their probability, the error reduction strategies and the other information generated as part of human reliability study can all be integrated into the risk assessment study.

c. Consequence analysis methods - consequent modeling typically involves the use of analytical models to predict the effect of a particular event of concern. Consequent models include source term models, atmospheric dispersion models, blast and thermal radiation models, aquatic transport models and mitigation models. Every tree analysis can be used for frequency assessment as well as for consequence assessment. Consequent modeling involves the activities of:

- Characterising the source of the material or energy associated with the hazard being analysed
- Measuring or estimating the transport of the material and/or the propagation of the energy in the environment to the target of interest
- Identifying the effects of the propagation of energy or material on the target of interest
- Quantifying the health, safety, environmental and economic impacts on the target of interest

“OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines.”
d. **Quantitative risk assessment (QRA)** – is a means of objectively measuring the risks from hazardous activities of a facility or operation. The risks are quantified in terms of their probability and consequences (combination of b & c above). By comparison with suitable risk criteria, the results can be used to help decide whether the facility is acceptable from safety viewpoint, or improvements are necessary. It provides input to design to enhance the safety.

e. **Acute environmental impact assessment** – is an evaluation of the possible effects on the environment of acute accidental discharges or releases. Having determined possible release scenarios, which are usually characterized by release rate and duration, or sometimes just by a total release amount, the effect on the environment is assessed. Following approaches describe the consequences of acute pollution:

- Exposure based analysis, based upon the duration and rate of the release as well as an assessment of the drift using a drift simulation model (generally used for offshore)

- Damage based analysis, a more detailed approach, in which the consequences of acute pollution are assessed based on a consideration of the duration and rate of release, the drift and the potential effect on the natural environment. The consequences are normally related to the most vulnerable populations.

f. **Escape, evacuation and rescue analysis (EERA)** – is a technique to evaluate the performance of the emergency response facilities and procedures. It is most effectively undertaken in conjunction with PEM or QRA and consists of a structured review of the performance of the escape, evacuation and rescue facilities and procedures in representative scenarios.

6.1.2 Although wide range of potential major accident events can be identified, focus shall be on the events, which are reasonably foreseeable. The assessment process should identify the factors, which influence the way an event may occur and develop, as these will affect the ability of any measure put in place to deal with the hazard.

6.1.3 Preventive measures such as using inherently safer designs and ensuring asset integrity shall be ensured as far as practicable.

6.1.4 The joint involvement of supervisor, staff, safety officers and other who matters is crucial in identifying hazard. Often, each participant is aware of different aspects of the tasks and the associated hazards, and thus contributes complementary perspectives towards finding good solutions.

6.1.5 The organisation shall repeat as often as may be appropriate, an assessment process for identification of the various events, which could

"OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines."
give rise to a major accident. The following can be the events requiring updating of assessment:

- Major modifications and changes in facilities
- Experience from accidents, analysis of causes
- Organisational changes
- Changed regulatory requirements

6.1.6 Records of hazard identification and risk assessment shall be maintained and updated, as required.

6.2 Emergencies

Emergencies / disasters which may be considered, as applicable, while preparing response plans by the organisations are:

6.2.1 Onshore

a. Failure of
   i. key controls (e.g. loss of well control)
   ii. power sources
   iii. critical equipment / services
b. Loss of Containment: Process, Pipeline
c. Fire & explosion
d. Toxic gas release like H₂S
e. Spills and unplanned releases of product or other materials leading to pollution
f. Loss of radioactive material
g. Fatality / serious injury / medivac
h. Security breaches and sabotage / terrorism
i. Civil disorder and military actions
j. Natural events like earthquake, floods, cyclones, lightning, land / mud slide, wildland fire, epidemic etc.
k. Other emergency events highlighted by hazards and effects identification
l. Likely emergencies in neighbourhood facilities.

6.2.2 Offshore

a. Failure of
   i. key controls (e.g. loss of well control)
   ii. power sources
   iii. critical equipment / services
b. Loss of Containment: Process, Pipeline
c. Ship / platform collision
d. Structural failures
e. Loss of containment- process, pipeline including underwater.
f. Fire & explosion
g. Helicopter crash
h. Toxic gas release like H₂S

“OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines.”
i. Loss of radioactive material
j. Spills and unplanned releases of product or other materials / pollution
k. Marine
l. Abandonment / evacuation
m. Diving
n. Man overboard or missing person situations
o. Loss of position
p. Safety zone infringement / terrorism
q. Natural events like inclement weather, tsunami, lightning, tropical storms etc.
r. Civil disorder and military actions
s. Other emergency events highlighted by hazards and effects identification
t. Likely emergencies in neighbourhood facilities.

7.0 Emergency response planning

The objective of emergency response planning is to have clear written procedures for expected actions during anticipated emergencies. Emergency response plan includes operational and procedural requirements for various emergency scenarios that are relevant for the installation.

7.1 Emergency response strategy (ERS)

Emergency response strategies are the documented decisions, of required emergency response measures for identified emergencies, based on risk evaluation and assessment process. It shall consider all statutory requirements applicable to the installation.

Objective of ERS is to identify the means to be used to secure adequate emergency response. It provides basis for monitoring of the adequacy of the emergency response measures so that they can be modified when essential.

ERS shall include appropriate standard of performance for response measures associated with each type of identified major accident hazard and installation specific factors.

ERS should:
- Define and explain the objectives of the emergency response
- Explain in general how these objectives are to be achieved
- Define the role of resources and should consider any installation & location specific factors that have significant influence on emergency response

ERS should include the following elements:
- Organisation
- Procedures
- Equipment
- Information
- Competency building measures (Training & refresher courses and Drills & exercises) and
- The role of any other measure essential for achieving successful emergency response

“OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines.”
Installation ERS shall also include the following scenarios:

- Fire and explosion
- Evacuation, escape and rescue
- Uncontrolled flow from well
- Oil spill

The ERS should describe the role and functional requirement for each system of emergency response. Functional requirements for emergency response measures shall be set at appropriate levels, against which the adequacy of the measures can be evaluated. Performance standards should relate to the purpose of the system, item of equipment, procedure etc. They may be described in terms of functionality, survivability, reliability and availability. They should be measurable and auditable. Following should be considered:

- The functional parameters of the particular system, statement of the purpose and essential function to be performed
- The integrity, reliability and availability of the system
- The survivability of the system under emergency conditions under which it is to be operated
- The dependency on other systems that may not be available in an emergency

Inputs for ERS are dependent on scale (the size of activities / facilities) and life cycle stage (design, commissioning, operation, modification, decommissioning) of the installation. Design process of new installations should be integrated with emergency response strategy for the selection of design, which so far as is reasonably practicable, minimizes the risks.

ERS shall be periodically reviewed for appropriateness and updated every five years. Also, ERS shall be reviewed in case of change to the installation or external situation that may significantly affect the contents of the strategy.

Assumptions used in emergency response strategy should be documented for validation.

ERS should be based on maximum number of persons who may be involved in an emergency. During modification / construction work the number of persons on the installation can be significantly higher than considered in strategy; in such cases impact of increase in number should be assessed and required additional measures are to be implemented before number of persons is increased.

7.2 Emergency response measures

Emergency response measures include hardware-equipment provided to deal with emergencies and the planning, management and organisational aspects required to successfully carry out emergency response actions.

Emergency response measures should take into account the possible failures of the controls and mitigation measures. Broad issues should be considered to ensure that the measures selected are capable to perform their function when required to do so.

“OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines.”
Procedure for designing emergency response measures should be based on:

- Integration of emergency response with into design and operations
- Automatic or remotely operated safety systems to mitigate the effects of an incident
- Emergency response organisation structure

The assessment of emergency response measures includes analysis of their performance followed by a judgment on their adequacy. The role of different measures should be considered in an integrated manner so that the functioning of one measure does not prevent another from meeting its required performance standard.

Emergency response assessment may consider the following parameters and variables:

- Type of hydrocarbons and their properties (including operating temperature and pressure)
- Reservoir conditions and fluids
- Production rates
- Inventories
- Complexity and layout of equipment on the installation
- Integrity of the structure
- Inbuilt safety systems
- Environmental conditions
- Environmental sensitivities including anticipated ambient conditions
- Human factors including human behavior under stress
- Immediate effects of the incident on the installation and personnel
- Development of heat and smoke in the event of fire and explosion

Measures for major accidents should be assessed more extensively as compared to measures for emergencies that have limited potential to escalate.

For measures to remain effective in an emergency, the organisation shall consider suitable contingency arrangements, including redundancy in protective systems.

Essential safety system (such as control stations, temporary refuge, muster areas, fire pumps) shall be located where they are least likely to be affected by fires and explosions.

Fire control cannot be achieved until the source of fuel and ignition is isolated. An emergency shut down (ESD) system shall be provided to isolate the installation from the major hydrocarbon inventories within pipelines and reservoirs, which if released on failure, would pose an intolerable risk to personnel, environment and the equipment / assets.

ESD system shall be designed such that it is capable of fulfilling its function under the conditions of incident. If installation is in operation, the essential shutdown functions shall be available during maintenance activities, which affect the operation of the ESD system. ESD system shall contain facilities for testing of both input/output devices and internal functions.

"OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines."
Critical resources of emergency response include:

- Emergency power systems
- Fire and gas detection systems
- Active fire protection
- Passive fire protection
- Shutdown system
- Explosion mitigation and protection systems
- Evacuation, escape and rescue arrangements

The reliability and availability of safety equipment and system shall be ensured.

Following issues should be considered for functional requirements of emergency response equipment:

- Reliability and availability including spare capacity
- Procedures to be followed when equipment is not available due to any reason
- Accessibility and survivability under emergency conditions
- Ease of use
- Maintenance and training requirements

Emergency response measures shall consider the available resources as below:

- Installation resources: these resources are immediately available on the installation and are under control of installation incharge. These include personnel and equipment that can be assigned emergency role.

- Area resources: these resources are available on the installations in the vicinity, with in same area and are not under control of installation incharge. The resources may be available with the parent organisation or available by a mutual aid or cooperation agreement.

- External resources: these resources are available by a mutual aid or cooperation agreement at regional, national or international level and include organisations, professional bodies, resource persons.

7.3 Emergency response plan

The organisations shall ensure that response plans for anticipated emergencies are in place and are ready for immediate implementation. Emergency response plan shall cover all stages of emergency response, from detection of the emergency until the emergency is over and persons are considered to be in a place of safety.

The emergency response plan shall cover:

i. Organisation set up
ii. Procedures for emergency response
iii. Role of Government authorities / other agencies

Response plan should contain sufficient information, for the guidance of such persons who have been assigned roles and responsibilities, for implementing the plan.

“OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines.”
The plan should refer to all the detailed procedures required for different types of reasonably foreseeable emergencies; who does what, when, where, how and to what effect.

Plan should be concise, readable and in a format which can be used readily in real emergencies, as well as in training and drills.

The authorities / other agencies with specific role during the emergency response shall be consulted during preparation of the emergency response plan. These authorities / other agencies will have an opportunity to input their expertise and experience into the plan and it will ensure that they are familiar with what is required of them during on-site / off-site emergency.

The emergency response plans, for responding to identified potential emergencies, should be communicated to:

- Command and control personnel
- ‘Emergency services’ providers
- Employees and contractors who may be affected, including others likely to be impacted

In case of combined / simultaneous operations, the emergency response plans of various involved agencies should be integrated, with an explicit command structure.

### 7.3.1 Organisation set up

The plan shall include:

- Chain of command
- The roles and responsibilities of key persons
- Communication strategy and arrangements (internal and external)
- The actions to be taken in response to specific emergencies.

The measures provided for command and control shall ensure that an effective command structure is established and is flexible enough to cope with the full range of emergencies and remains effective throughout all stages.

Key points to be considered are:

- Process for reporting emergencies
- Assigned authority to a qualified person at the facility / installation for initiating emergency response
- Formal command structure (including second line of command), which is clear and well understood by all the persons on the installation
- Control procedures, including effective coordination with area and external resources

"OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines."
7.3.1.1 Emergency response control center

Emergency response plan should designate an Emergency response control center (incident command center) with alternate center for each installation. Emergency response control center should be equipped with the following facilities:

- Communication facilities
- Documents: copy of ERP, Mutual Aid Plan (if any), Fire Fighting arrangements etc.
- Personal Protective Equipment
- Recording (video and audio) system
- Support services such as medical, vehicles / marine vessels / helicopter etc.

7.3.1.2 Evaluation and Review

Emergency response plan and its associated procedures shall be evaluated and reviewed periodically to ensure that the emergency requirements of the installation and its surroundings are met. The emergency response plan shall be reviewed and revised following changes to operations, plant and equipment etc.

7.3.2 Procedures for emergency response

Procedures should include general procedures for everyone and detailed procedures for those with specific duties in an emergency.

Key points for development of procedures are:

- Communicating with authorities, media, relatives of affected personnel and others
- Mobilising company equipment, resources and personnel
- Mobilising third party resources for emergency support
- Evacuation, rescue and rehabilitation
- Preventing, mitigating and monitoring adverse environmental effects due to emergency actions
- Managing media
- Arrangements for training response teams and for testing the emergency systems and procedures

The key elements for emergency response are:

7.3.2.1 Incident Detection

The method and speed of response of the system used to detect the need for emergency response shall be based on an understanding of the speed with which the incident can escalate.

"OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines."
The detection system should be adequately maintained and contingency arrangements which may require limiting operational activities should be established for situations where all or part of a detection system is not available for example during maintenance.

The alarm and communication systems provided should be appropriate for the range of identified reasonably foreseeable emergencies and capable of performing their function during the emergency. They should be capable of transmitting clear information to personnel, wherever they are likely to be on the installation, taking account of the conditions likely to be encountered in an emergency. Alarms should include audible and visual alarms and voice communication systems.

Everyone on the installation shall be aware of the meaning of different alarm signals. Key point to be considered is that alarm systems are maintained in operating conditions for identifying emergencies.

Decision on appropriate type of alarm should be based on their location, the environment in which they are expected to work, the speed with which the incident is likely to escalate, and expected number of personnel at the installation and their locations.

In the cases when it is not reasonable to make provision of automatic alarm, clear procedure should be there for communicating with appropriate person when an incident is detected.

The detection system should provide sufficient information on the nature and location of the incident so that appropriate response activities are initiated.

7.3.2.2 Assessment of incident and activation of control

Assess the impact and consequences of the incident.

Provisions of timely and effective shutdown of systems, which could escalate an emergency, shall be ensured. Emergency shutdown shall be capable of initiation from the control point.

Control points shall be adequately protected.

7.3.2.3 Communications

Emergency response relies upon effective and reliable communication between all personnel involved in response.

Communication systems shall:

- Provide sufficient reliable information / alarm to personnel on the installation to enable them to take the appropriate emergency actions.

“OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines.”
Provide means for those on the installation to communicate with the person in overall charge.

Provide reliable arrangements to allow the person in overall charge to communicate with all personnel on the installation regarding the nature of any emergency and the actions they are required to take.

Provide reliable means to allow the person in overall charge to communicate with area and external resources who have a role in emergency response.

Suitable equipment, information processing and procedures shall be in place to enable effective communications. The means of communication shall be selected based on the need for communication in likely scenarios including operational conditions under which they are to function like, noise, ambient conditions and susceptibility to damage. So far as reasonable, communication arrangements should remain available throughout the emergency.

Communications related to emergency response shall be given in a manner that will be readily understood by the recipient.

The following factors should be considered and included in the communication procedures for each type of incident:

a. What information needs relaying?
b. Who needs this information?
c. When is the information required?
d. How long will communications be required?
e. Information overload from non-essential information.

Adequate provision for communicating with persons at other locations who may have to take action in an emergency and with possible sources of external assistance should be ensured.

Alarm signals used and their meanings should be described in the emergency response plan along with the procedures to be followed in the event of an alarm. Persons should be provided with adequate information to allow them to, initiate alarms where necessary, distinguish between alarms and respond to alarms.

7.3.2.3.1 External Enquiries

Procedures and training for communication with next of kin / family members of injured / deceased, media and other external agencies shall be ensured.

The media should have ready and continuous access to designated officials with relevant information, in order to provide essential and accurate information to the public throughout the emergency and to help avoid confusion.

“OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines.”
Emergency response center shall also liaise with external agencies like contractors, statutory and other government agencies.

Arrangements should be considered for the maintenance of a secure telephone system during an emergency, and for handling high volume of telephone enquiries.

7.3.2.4 Evacuation, escape and rescue

Evacuation and escape routes shall be provided from all areas of an installation where personnel may be expected to be present during their normal activities. Alternative means to allow persons to safely leave the installation in an emergency shall be provided.

Evacuation and escape routes shall have adequate illumination with emergency lighting and shall be marked to ensure that they can be used during emergency conditions. All escape routes shall be unobstructed (including vertical clearance) and readily accessible.

It shall be ensured that each of the evacuation routes provide sufficient capacity to enable all persons to evacuate the installation to a place of safety in identified reasonably foreseeable emergencies.

Any constraint on the use of the arrangements for evacuation due to factors such as the weather conditions, the nature & location of the emergency and the time available to evacuate, shall be considered.

In offshore installations, recovery and rescue arrangements should be appropriate to cope with all reasonably foreseeable events likely to lead to the need for evacuation/escape. Organisation shall ensure that enough means of escape are available for all personnel who may have to use them. Effective arrangements should be capable of ensuring that persons evacuating or escaping from the installation are recovered or rescued and taken to a place of safety.

All installations shall have designated muster areas and places for temporary refuge, including alternate locations wherever necessary. These designated places should remain useable and routes thereto and there from passable for the time required to evacuate personnel.

Facilities for communication shall be provided in these areas.

Personnel should be given appropriate information about the location of their muster station, including alternatives and arrangements for mustering as soon as they arrive on the installation.
7.3.2.5 Emergency medical treatment

Arrangements for emergency medical treatment shall consider injuries to persons as a result of minor accidents & major accidental events, illness of persons on installation, transportation & evacuation of sick and injured personnel.

Controlled medicines shall be stored in a secure place accessible only to those who are trained to administer these.

The level of medical facilities and trained personnel provided should be in line with the requirements identified in emergency response strategy.

Key points to be considered are identified medical facilities / hospitals.

For details, OISD-GDN-204 on “Medical requirements, emergency evacuation and facilities (for upstream)” may be referred.

7.3.2.6 Personal protective equipment (PPE)

Personal protective equipment for use in major accident hazards should be suitable for the circumstances in which it may have to be used and the individuals who may have to use it.

PPE for use in an emergency should be for all persons on the installation for use in condition of fire, heat, gas escape or smoke to enable them to reach muster areas, temporary refuges and evacuation or escape points. Those with specific emergency duties shall also be provided appropriate PPE for use like fire suits and breathing apparatus etc.

In offshore, PPE like life jackets and survival suits (wherever needed), shall be available in sufficient quantity at accommodation and other suitable locations so that all persons will have ready access to them in the event of evacuation or escape. ‘Sufficient quantity’ and ‘suitable locations’ shall be based on risk assessment besides applicable regulations / guidelines.

7.3.2.7 Site security and control

During emergency, security arrangements shall ensure that unauthorised persons do not enter the incident site by controlling assess and if need arises the area around the site can be evacuated and cordoned to ensure safety of the persons.
7.3.2.8 Environmental emergency

Designing the environmental emergency response should be based on an evaluation of environmental hazards in the event of unplanned discharge. Criteria should be based on available scientific data. These data may vary with the seasons and should be factored in the basis for establishing the emergency response.

Environmental emergency response should consider:

- Oil-pollution control equipment that should be located on the installation
- Environmental conditions that may be present when the equipment is deployed
- Capacity of the oil recovery system
- Characteristics of the oil / emulsion to be recovered
- Means to identify the extent of the spill
- Facilities to handle any recovered oil

International conventions have introduced the requirements to develop national plans for oil-spill response in offshore, and organisations should ensure that their installations' emergency response plans are aligned with the national requirements.

7.3.3 Role of Government authorities / other agencies

The emergency response plan shall describe the role of civil authorities such as District Collector and Public Authorities and other agencies.

In case of offshore, the emergency response shall include the role of concerned agencies like Indian Coast Guard, Indian Navy, Port Authority, Directorate General of Shipping and Directorate General of Civil Aviation.

8.0 Competence and training

8.1 Competence

Human are often the only means for effectively responding to abnormal situations as they have the capability to reason and then to override automatic reactions of machines. Humans have the capacity to forecast action, integrate complex and fuzzy information and understand how to address unusual situations based on experience and training.

Realistic assumptions shall be made for likely pattern of human behavior in an emergency like reduced performance level under stress. Persons shall not be assigned multiple conflicting roles for emergency response.

“OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines.”
Competencies required, in all those responsible for decision making or involved in executing the emergency response plan, shall be identified and documented. Requisite competence shall be ensured through training, experience and knowledge, backed up by practice and refresher training.

Emergency response organisation structure shall ensure command by competent persons, which can be maintained, so far as is practicable, throughout an emergency.

Key persons such as the installation incharge and shift incharge/ control room operator shall be assessed for required competence to perform emergencies duties before assigning of duties. As far as possible, assessment should be under simulated emergency conditions.

Organisation shall ensure sufficient number of competent persons at all times on the manned installation to undertake emergency duties and operate relevant equipment.

All persons on an installation should have at least basic training in emergency response, basic first aid, use of life saving appliances and fire fighting. Individual competencies shall be periodically tested to identify further requirement of training and knowledge to perform emergency duties.

Organisation shall ensure that every person who may be called upon to assist in implementing the emergency response plan is provided with adequate instructions and written information to be used during the emergency.

Adequate safety briefing should be provided to short-term contractors who may have to carry out particular activities during emergencies.

8.2 Training

All persons on the installation or in connected activities (including contractor’s personnel) shall be trained periodically for emergency response and evacuation procedures. Organisation shall ensure that information, training and instructions given are sufficient for personnel to be able to respond in an appropriate manner.

Training for employees having assigned roles in emergency response shall be completed before they are called upon to perform in real emergencies. Such trainings should include the various elements of emergency response plan, standard operating procedures for handling emergencies, emergency equipment operations and the PPE to be worn.

It shall be ensured that all persons new to the installation are given such instructions or training in the aspects of the emergency response plan, which are related to them during their stay on the installation.

Training programmes shall be periodically reviewed.
9.0 Emergency Drills and Exercises

The effectiveness of emergency response shall be demonstrated through a programme of drills and tabletop exercises that:

- Tests and develops the command structure and communication arrangements including offsite support
- Tests emergency equipment under realistic conditions
- Maintains and develops individual competencies in emergency response, including command and control activities
- Monitors the performance of individuals to identify areas of improvement and any additional training requirements
- Verifies data and assumptions used in the emergency response assessment

Where it can be safely undertaken, consideration should be given to conducting some drills without pre-warning in order to test the effectiveness of the emergency response procedures.

The drills need to address the readiness of personnel and their familiarity/proficiency with emergency equipment and procedures. All personnel on the installation involved including contractor’s employees should participate in the drills. Scenarios should be varied to avoid drills being perceived as monotonous.

Safety shall be of prime consideration while carrying out these exercises and management judgment shall be exercised to ensure that unnecessary risks are avoided.

An analysis and critique of each drill and exercise has to be documented to identify and correct weaknesses.

Emergency response plan shall be reviewed and revised as appropriate in line with the findings from drills and tabletop exercises.

The drills and tabletop exercises shall be carried out as often as appropriate, against documented schedule. The organisation shall carry out drills and tabletop exercises, which requires involvement of authorities / other agencies, at suitable intervals, against documented schedule.

10.0 Maintenance of emergency response equipment and systems

Effective operations, inspection, testing and maintenance procedures shall be established to ensure that the functional requirements of the equipment and systems provided for emergency response are maintained.

A written scheme shall be prepared, detailing the inspection, testing and maintenance routines and frequencies to be followed. All emergency equipment and systems shall be thoroughly inspected, following established procedures. Adequate records of the results of the inspection, testing and maintenance shall be kept and shall be periodically reviewed to confirm that the written scheme is appropriate and is being adequately implemented.

Persons who are competent to perform this role and interpret the results of any tests should only undertake maintenance, inspection and testing of emergency equipment and systems. In some
cases this may require resources from the supplier of equipment or other expertise not routinely available on the installation.

Performance standards related to emergency equipment and systems shall be established.

Detailed performance standards shall be identified based on the following hierarchy:

a. Identify those major equipment and systems whose overall performance is particularly important in the achievement of the overall strategic objectives.
b. Identify from the analysis the most important factors contributing to the success of those major equipment and systems.
c. Identify the key components or subsystems within the major equipment and systems, the performance of which strongly influence and essentially determine the overall system performance.

Key elements of functionality, survivability, reliability and availability shall be included in performance standards. Achievability of performance standards should be validated.
11.0 References:

1. API 14 J: Recommended Practice for Design and Hazards Analysis for Offshore Production Facilities.


3. API RP-750: Management of process hazards.


5. Guidance notes on Risk Assessment: Applications for the marine and offshore oil and gas industries, American Bureau of Shipping (ABS).

6. HSE Books HSG65: Successful health and safety management.


15. OISD-GDN-204: Medical requirements, emergency evacuation and facilities (for upstream).


"OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines."
18. UKOOA “Guidelines for the Management of Competence and Training in Emergency.”


