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Guidance on Practice for Major Hazard and Risk Register Development

DWGOM-GP 48-0099

DWGOM
SITE TECHNICAL PRACTICES

EXHIBIT NO. 270

Foreword

This is the first issue of Site Technical Practice (STP) DWGOM-GP 48-0099 which is now renumbered from DWGOM-GP 76-0099.

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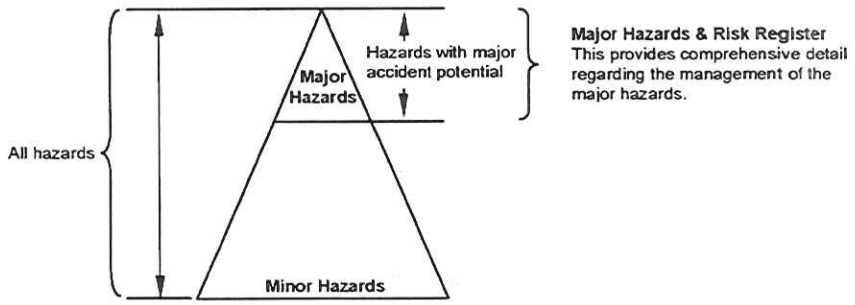
1. General

1.1. Conformance

This Site Technical Practice (STP) provides practitioners with guidelines for the development of the Major Hazard and Risk Registers addressing requirements defined in the *Major Hazard and Risk Management Policy UPS-US-SW-GOM-HSE-DOC-00439-2*, herein referred to as the *Risk Management Policy*. The STP also references the *Major Hazard and Risk Register Summary Table* and the *Major Hazard Bow-ties* that support the management and communication of major hazards.

Figure 1 schematically illustrates the range of hazards that an operation or Facility might be exposed to, ranked from minor to major hazards. This STP provides guidance for developing the Major Hazard and Risk Register. The register will support identification of the top 20 ~ 30 major hazards for each facility, major project or non-major project, and subsequently the SPU, in accordance with *Risk Management Policy* requirements.

Figure 1 : Major Hazards in Relation to all Hazards



1.2. Purpose

The purpose of the Major Hazard and Risk Register, and the supporting documentation in Figure 1, is to:

a. Provide demonstration that the major hazards are managed by documenting the hazard management controls.

b. Provide high level descriptions of the hazard management controls required to manage major hazards and link the controls to key documents supporting hazards management. Key documents include:

   1. Hazard management studies
   2. Performance standards defining functionality, reliability, and survivability of controls
   3. Codes and standards applicable to BP, including BP standards, governing controls

c. Provide detailed supporting information to bow-ties that diagrammatically depict the management of major hazards

d. Provide a framework for linking Safe Operating Procedures, maintenance activities etc. to the controls responsible for managing major hazards

1.3. Scope

a. The Major Hazard and Risk Register addresses only those hazards with major accident potential.

b. The Major Hazard and Risk Register applies to all GoM SPU groups and includes, but is not limited to:

- Seismic
- Exploration
- Drilling
- Completion
- Well interventions
- Reservoir and wells function
- Construction
- Transportation
- Installation
- Marine
- Subsea
- Production
- Pipelines
- Logistics
- Activities required to support new and ongoing operations including simultaneous operations

1.4. Limitations

a) Processes for identifying Major Hazards are not described in this Site Technical Practice.

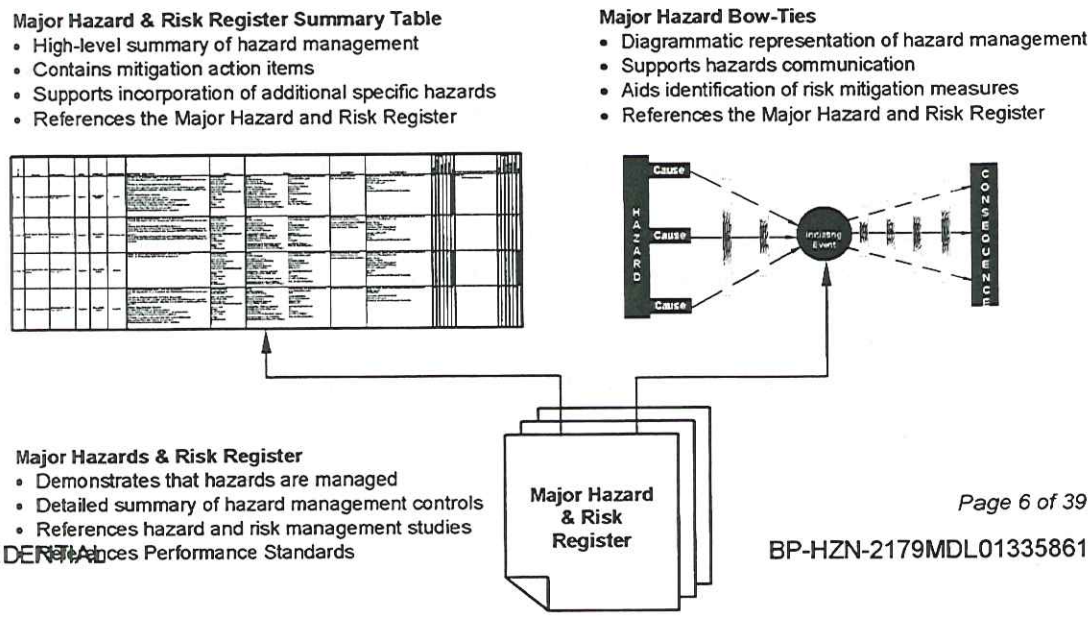
b) The Major Hazard and Risk Register does not address hazards having no potential to cause major accidents

c) Execution risks, such as schedule slippages, cost over-runs, etc. associated with project execution are excluded

1.5. Major Hazard and Risk Register Relations

The Major Hazard and Risk Register contains a wealth of information describing a Facility's or Project's hazards and associated hazard management controls. Because of the esoteric nature of the register, different forms of presenting the same information are used to support the communication and management of major hazards. The different presentation methods, and their relationships, are presented in Figure 2. This STP only provides guidance on the development of the Major Hazard and Risk Register. Annex A provides examples of a completed Major Hazard Scenario Sheet, a Summary Table and a Bow-Tie.

Figure 2 : Major Hazard and Risk Register Relations



2. Normative References

The following normative documents contain requirements that, through reference in this text, constitute the requirements of this Site Technical Practice. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this Site Technical Practice are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies.

GRP STD 001	BP Group Standards Integrity Management
	Integrity Management Standard: Implementation in E&P
GP 48-50	Major Accident Risk Process
DWGOM GP 48-0005	Guidance on Practice for Hazard Identification (HAZID) Study
DWGOM-GP 48-0001	Guidance on Practice for Protective System Identification

UPS-US-SW-GOM-HSE-DOC-00439-2 Major Hazard and Risk Management Policy

UPS-US-SW-OM-HSE-DOC-00444-2 S&OI Action Item Tracking Management Process

3. Terms and Definitions

Facility includes fixed or mobile structures including drilling units, or equipment for the duration where BP is the operator on record.

A **Hazard** is a condition or practice with the potential to cause harm to people, the environment, property or BP's reputation.

Operations refers to the organization that manages the day-to-day activities of the Facility.

Performance Standards are documents which outline the role expected of a protective system in terms of specifications for system functionality, reliability, and survivability. They also detail assurance activities such as design verification tasks, and inspection and testing requirements needed to demonstrate that the protective system is capable.

A **Major Project** is a project with BP net investment >$100 million or of strategic significance.

Major Hazards are those with the potential to create **Major Accidents** resulting in one or more of the following outcomes:

- Multiple injuries or fatalities
- Catastrophic loss of the Facility
- Irreparable damage to the environment
- Damage to corporate reputation

Management refers to positions described in the *Risk Management Policy* with specific accountabilities and responsibilities for managing major hazards.

Risk is the probability (or likelihood) that a given hazard outcome (or consequence) might occur and is assessed (high, medium or CRR) according to the GoM SPU Risk Matrix in the *Risk Management Policy*.

4. Symbols and abbreviations

For the purpose this STP, the following symbols and abbreviations apply:

CVP	Capital Value Process
CRR	Continuous Risk Reduction
E&P	Exploration & Production
ESD	Emergency Shutdown
ETP	Engineering Technical Practice
GoM	Gulf of Mexico
GP	Guidance on Practice
MoC	Management of Change
MPcp	Major Projects Common Process
P & ID	Process and Instrumentation Diagram
SAFE	Safety Analysis Function Evaluation
SCE	Safety Critical Equipment
S&OI	Safety and Operational Integrity
STP	Site Technical Practice
ToR	Terms of Reference

5. General

5.1. Accountabilities and Responsibilities

a. Unless specified otherwise, the term *management* within this document refers to:

   1. The Project Manager, or responsible delivery manager, for new projects or major modifications to existing facilities.
   2. The Operations Manager for activities related to an existing facility not classified as a Major Project.
   3. The responsible drilling manager for exploration, drilling, completion and well operations

b. Management shall sponsor *Major Hazard and Risk Register* reviews and ensure that they have the appropriate priority and are completed in time frames defined in the Risk Management Policy.

c. Management shall sponsor quarterly (preferably monthly) reviews of the *Major Hazard and Risk Register Summary Table* to provide accurate information for SPU risk status meetings.

d. Management shall ensure that appropriate resources are available to perform the Major Hazard and Risk Register reviews.

e. Management shall assign responsibility to individuals within their respective organizations for the development and maintenance of the *Major Hazard and Risk Register Summary Table* and the *Major Hazard Bow-Ties*. See Figure A.1 which illustrates the relationship between Major Hazard and Risk Register presentation formats.

f. Management shall seek approvals for the risks identified in the Major Hazards and Risk Register in accordance with the requirements of the *Risk Management Policy*.

g. Management shall ensure that actions identified during Major Hazard and Risk Register reviews are managed in accordance with the *S&OI Action Item Tracking Management Process UPS-US-SW-OM-HSE-DOC-00444-2*.

h. For Major Projects:

   1. The project Engineering Authority shall endorse the Major Hazard and Risk Register prior to transitioning between CVP stage gates.

   2. The Project Manager, and Wells Program Manager where appropriate, shall approve the Major Hazard and Risk Register.

i. For existing Facilities:

   1. The SPU Engineering Authority shall endorse the Major Hazard and Risk Register.

   2. The Facility Manager shall endorse the Major Hazard and Risk Register.

   3. The Operations Manager, and Wells Program Manager where appropriate, shall approve the Major Hazard and Risk Register.

5.2. Initial Generation and Updates

a. Major Hazard and Risk Registers shall initially be developed for Major Projects at the CVP Select stage, updated at each stage and provided to Operations at the CVP Operate stage.

b. A HAZID (DWGOM GP 48-0005) shall be performed to generate the Major Hazard and Risk Register for Facilities without an existing register. The HAZID will identify additional studies required to fully understand the Major Hazards.

c. Findings from the MAR assessment should be incorporated as representative scenarios in the Major Hazard and Risk Register.

d. The *Risk Management Policy* defines the timing for generating and reviewing the Major Hazard and Risk Register and triggers that prompt register updates.

e. The Major Hazard and Risk Register is a controlled document and any updates will utilize the appropriate information management process.

6. Major Hazard and Risk Register

6.1. Overview

a. A Major Hazard and Risk Register shall be developed for all BP GoM SPU Facilities and Major Projects that have major accident potential.

b. The Major Hazard and Risk Register is a document which catalogues major accident hazards and comprises:

1. A list of hazards with major accident potential
2. A list of hazard scenarios, characterising the hazards with major accident potential
3. A risk matrix (Annex E) with the major accident scenarios annotated (defining their likelihood and severity levels) based on existing studies such as a HAZID.
4. A compendium of Major Hazard and Risk Scenario sheets
5. A list of the hazard management studies referenced in the scenario sheets
6. A list of the performance standards referenced in the register
7. An update log that documents reasons for updating the Major Hazard and Risk Register
8. A list of recommendations generated during the update or review.

c. The Major Hazard and Risk Register contains key specific Facility information and provides a useful reference to Facility Engineers and Operations Managers regarding the systems required to manage hazards.

d. The number of Major Hazard and Risk Scenario sheets within the Major Hazard and Risk Register shall be sufficient to describe the Facility hazards and the controls responsible to manage them.

There needs to be a practical balance in the number of hazard scenario sheets used to describe hazards management for a Facility. Too few sheets do not permit sufficient resolution, whereas too many become unmanageable.

As guidance, hazard scenario sheets for a specific hazard, such as hydrocarbons under pressure in a given area of a Facility, are preferred compared to hazard scenario sheets for specific production equipment items in the module, or the facility in its entirety. Generating hazard scenario sheets for various outcomes, such as pool fires, jet fires or explosions for the production module example results in considerable duplication of information on each sheet and is discouraged. Where specific barriers address one of a series of hazards, such as bunds for pool fires, mention should be made of this in the major hazard and risk register.

Scenarios that are unique to a facility because of its design, for example, should be represented as single scenario sheets.

e. If high risk Major Hazards are identified, Legal shall review the contents of the Major Hazard and Risk Register.

High risk major hazards are those whose hazard scenarios plot in the red region of the GoM SPU risk matrix.

f. The completed Major Hazard and Risk Register shall be assigned a document reference number and entered into a document management system, such as DW Docs, for retrieval and future reference.

6.2. Major Hazard and Risk Scenario Sheet Contents

a. The Major Hazard Scenario Sheets within the register shall provide an accurate and true reflection of the systems responsible for managing hazards. This is accomplished through high-level information supported by referenced documents, including, but not limited to:

1. Hazard management studies

2. Design criteria and supporting studies
3. Industry standards applicable to BP
4. Company specifications
5. Performance standards

b. The Major Hazard and Risk Scenario sheet in Annex A shall be used to collate information describing the management of Major Hazards.

c. Information entered into the Major Hazard and Risk Scenario sheet should be brief, accurate, supported by references, and preferably in bullet point format to improve legibility.

d. The Major Hazard and Risk Scenario sheets comprise seven principal sections outlining the hazard scenario and its management, namely:

1. Hazard information
2. Inherent safety in design
3. Hazard causes
4. Prevention Measures (to hazard causes)
5. Severity Control
6. Escalation minimization
7. Emergency response

e. Hazard scenarios characterizing the major hazards shall be plotted on the GoM SPU Risk Matrix to provide two risk rankings addressing the risk associated with:

- the immediate impact of the scenario, and,
- an escalation of the scenario.

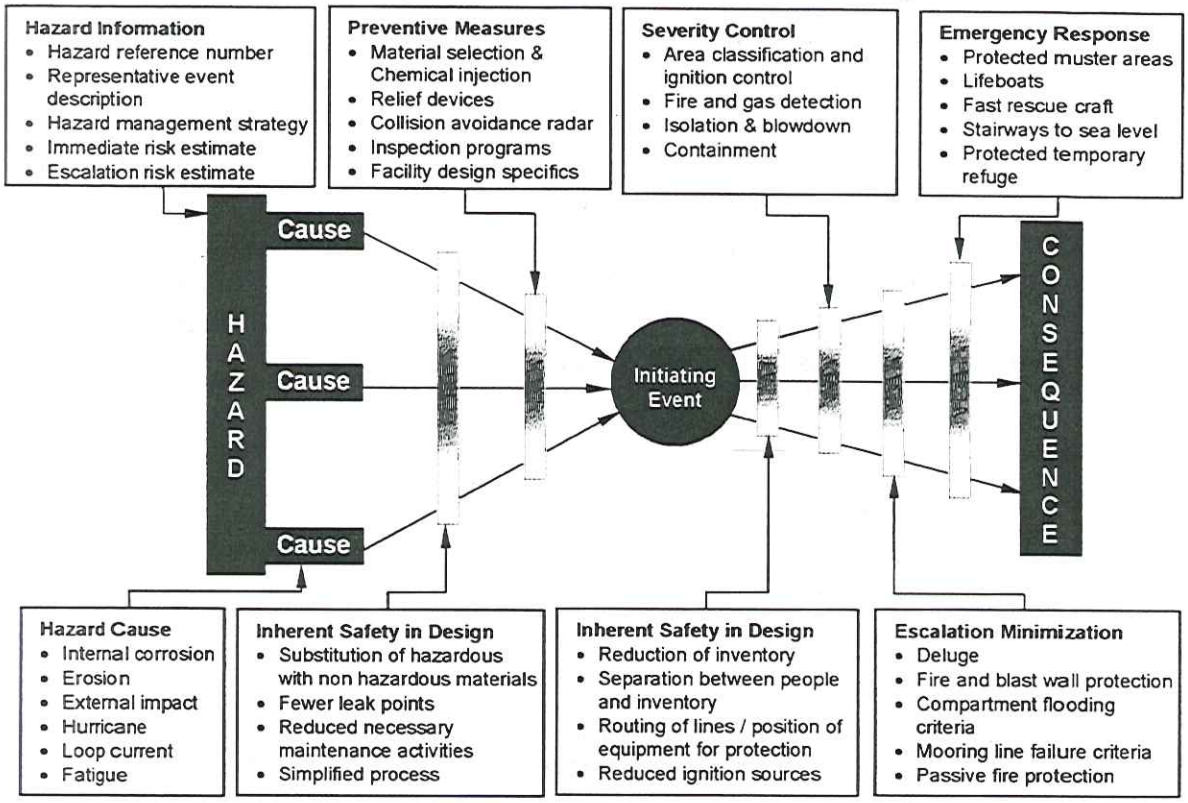
A range of scenarios can be selected to reflect possible outcomes. For example, the initial incident for a hydrocarbon release may be characterized by a ½" instrument connection failure and a 4" process line failure. Example escalation scenario incidents may include escalation involving structural collapse due to fire impingement of critical structural members, or an explosion that impairs the temporary refuge / living quarters. All scenarios, namely the immediate impact and the escalation scenario, should be reflected on the register.

f. The Bow-Tie in the figure below provides a diagrammatic representation of hazard management and example information that should appear in the Major Hazard Scenario sheets addressing the seven principal sections listed in 6.2 (d).

Example information presented in the figure below largely addresses hydrocarbon releases. This for illustration purposes only. Similar information for hazard scenarios related to other hazards should be reflected in the hazard scenario sheets.

g. Further guidance regarding the content of information within the Major Hazard Scenario Sheet is provided in Annex B.

Figure 3 : Bow-Tie diagrammatic representation of hazard management



6.3. Uses

a. The Major Hazard and Risk Register facilitates:

1. Structured reviews of hazards management controls addressing the major hazards to seek continuous risk reduction opportunities.
2. Referencing documents linking hazard management studies to hazard management controls to aid identification of studies requiring updates as a result of MoCs.
3. The selection of hazard management control key performance indicators based on the potential Major Accident Hazards and supporting performance standards.
4. Facilitation of the creation of performance standards for Safety Critical Equipment.
5. Hazard management communication to Operations and Project Management.
6. Demonstration of hazard management as part of CVP stage gate assurance reviews.

7. Major Hazard and Risk Register Generation

7.1. Major Projects

a. The MPcp Design Safety roadmap requires that Major Projects identify major hazards during the Appraise stage. This is normally accomplished through a HAZID study.

b. Hazard identification studies are subsequently performed during the Select stage for preferred concept options. These studies could include additional HAZIDs, revalidation of the Appraise HAZID, and other hazard analyses to identify major hazards.

c. The Select stage hazard identification analysis identifies hazards with major accident potentials. These analyses shall be used to develop the initial Major Hazard and Risk Register which is a Select stage gate requirement.

d. The Project Manager is accountable for assigning responsibility to an individual within the project team for the development and maintenance of the Major Hazards and Risk Register within the project organization.

e. The Project Management is accountable for the execution of workshops that review the current Major Hazard and Risk Register prior to MPcp stage gates to verify that the register correctly reflects the design and design philosophies addressing hazards management. The workshop will involve project personnel familiar with the Facility or development.

f. The updated Major Hazard and Risk Register shall be issued prior to each MPcp gate transition reflecting hazard analyses performed between gates.

7.2. Existing Facility without a Major Hazard and Risk Register

a. Major Hazard and Risk Registers are developed in a two stage process. First, a HAZID is performed to identify Facility hazards with major accident potential and pre-populate Major Hazard & Risk Register scenario sheets. Second, a workshop is conducted to validate the accuracy of statements and incorporate additional controls not identified in the HAZID.

The second review allows the addition and verification or controls responsible for managing major hazards that may not be captured in a facilitated HAZID session. For example, details about hydrocarbon contents of vessels that address conscious approaches introduced to incorporate Inherently Safer Design, or specific set points for gas alarms or specific vessel design parameters for floating structures..

b. Facility HAZID:

1. The Facility HAZID shall be performed using DWGOM GP 48-0005.
2. The HAZID shall review all hazards but only develop those with major accident potential.
3. Pre-existing hazard management studies that provide input to the HAZID shall be made available to the HAZID facilitator at least three (3) weeks prior to the HAZID to allow incorporation into study preparations.
4. The HAZID shall be used as base information to pre-populate the Major Hazard and Risk Register Scenario sheets.

c. Major Hazard and Risk Register workshop

1. The Operations Manager is accountable for assigning responsibility to an individual within operations for the pre-population of Major Hazard and Risk Register scenario sheets.
2. The Operations Manager shall sponsor a workshop to validate the accuracy of pre-populated major Hazard and Risk Register scenario sheets and include additional information as appropriate.
3. The workshop shall be attended by Facility personnel knowledgeable of the Facility and associated operations.

4. Refer to the Terms of Reference (Annex C) for specific information regarding the Pre-Workshop, Workshop, and Post-Workshop methodology, and personnel responsibilities

8. Major Hazard and Risk Register Updates

8.1. Current Major Hazard and Risk Register

a. A current Major Hazard and Risk Register is a register that correctly reflects the major hazard risks, has not exceeded the revalidation period defined in the *Risk Management Policy*, and has been updated according to stage gate requirements for Major Projects.

b. Information in scenario sheets (likelihood, severity, controls etc.) shall be updated with input from Operations or Major Project personnel. The update shall consider, but not be limited to:

1. Closure of action items addressing Major Hazards not already addressed
2. Changes of controls responsible for managing risk, to potentially increase or reduce risk levels.
3. Changes to manning levels.
4. Modifications to the Facility, such as tie-backs.
5. Incidents on the current Facility, other similar facilities, that could have a bearing on the current Facility risk.
6. The application of new technology to improve risk management.
7. Engineering Technical Practices, Site Technical Practices or Group Practices that have a bearing on the Facility risks.

8.2. Outdated Major Hazard and Risk Register

a. An outdated Major Hazard and Risk Register is a register that has exceeded its revalidation period defined in the *Risk Management Policy*, has not been updated according to stage gate requirements for Major Projects or was not originally performed in accordance with this STP.

b. Information contained within the register shall be revalidated and updated in a workshop to address changes to the Facility, Operations or wells for an existing Facility, or design concept and associated layout details or wells for a Major Project. An example workshop Terms of Reference is provided in Annex C.

c. The Operations Manager or Major Project Manager shall sponsor a new HAZID, or revalidation of an existing HAZID, with workshop facilitation and additional support provided by Process Safety Engineers.

d. The workshop needs to:

1. Revalidate or update risks in the Major Hazard and Risk Register considering, where appropriate:
   a) Closure of action items addressing Major Hazards not already addressed
   b) Changes of controls responsible for managing risk, to potentially increase or reduce risk levels.
   c) Changes to manning levels.
   d) Modifications to the Facility, such as tie-backs.

e) Incidents on the current Facility, other similar facilities, which could have a bearing on the current Facility risk.

f) The application of new technology to improve risk management.

g) Engineering Technical Practices, Site Technical Practices or Group Practices that have a bearing on the Facility risks.

2. Revalidate Major Hazard and Risk Scenario sheet contents in relation to the accuracy of statements made.

9. Major Hazard and Risk Register Summary Table

a. Figure A.1 illustrates the relationship between Major Hazard and Risk Register presentation formats

b. The Major Hazard and Risk Register Summary table is a management tool that provides succinct information about the major hazards and risks, the plans to reduce risk, and progress towards achieving the risk reduction plans.

c. The individual designated with the responsibility for maintaining the *Major Hazard and Risk Register Summary* table shall ensure that its contents are reviewed quarterly, as a minimum, (preferably monthly) to provide accurate information for SPU risk status meetings.

10. Major Hazard Bow-ties

a. Figure A.1 illustrates the relationship between Major Hazard and Risk Register presentation formats

b. The Major Hazard Bow-Ties provide a visual depiction of the controls required to manage hazards that supports hazard management communication and identification of risk reduction opportunities.

c. The individual designated with the responsibility for maintaining the Major Hazard Bow-Ties shall ensure that they correctly depict the management of hazards and are utilized in workshops designed to identify risk reduction opportunities and communicate major hazard management to operations.

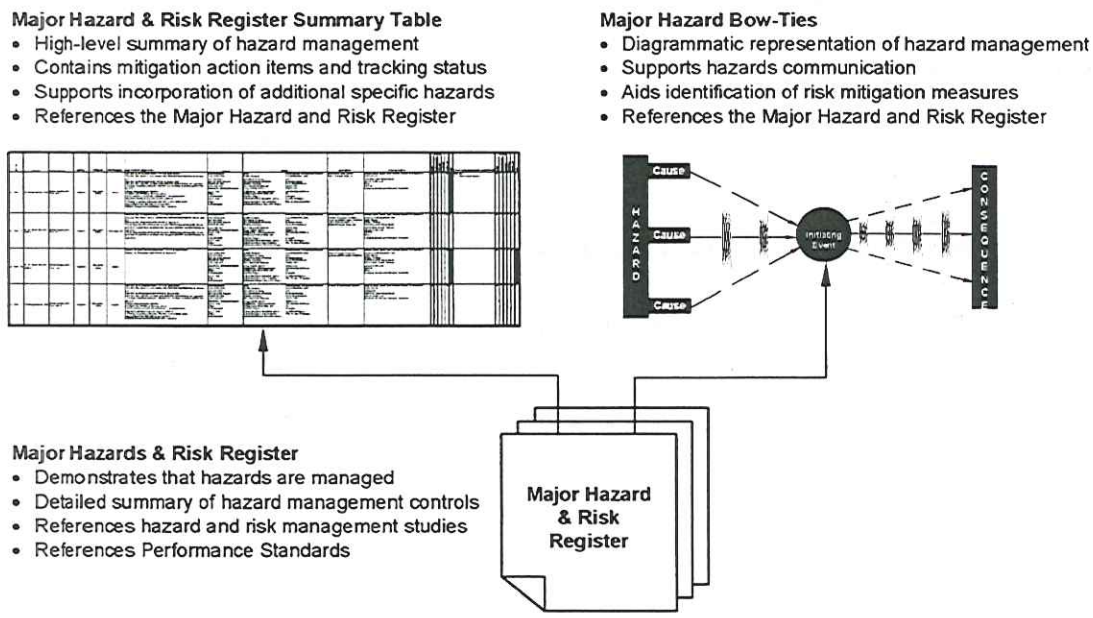
Annex A
Major Hazard and Risk Register Presentation

A.1. Introduction

The Major Hazard and Risk Register contains information describing the controls required to manage hazards. Providing this information to Operations and Major Project personnel generates the awareness which is a precursor to identifying steps towards selecting opportunities to reduce risks. However, the Major Hazard and Risk Scenario sheets tend to be complex, and while the information contained within them is suitable for some, it is not in a format that is readily understood by all people either impacted by, or in the position to make hazard management decisions. To improve the dissemination of hazard information three different presentation formats are used, Figure A.1. The different presentation formats are discussed in the remaining sections of this Annex.

Within an operating Facility for example, Facility Engineers and Operations Managers might find the detail in the Major Hazard and Risk Register useful when addressing Facility changes, whereas the Major Hazards and Risk Register Summary Table provides these individuals, and other Leadership Team members, a useful summary to track hazards management progress. The visual nature of the bow-tie readily supports hazard management communication discussions with Facility personnel.

Figure A.1: Major Hazard and Risk Register Presentation Formats



A.2 Major Hazard and Risk Register Presentation Formats

A.2.1 Major Hazards and Risk Register

This represents the most detailed form of information describing the hazard management controls. It is also the format that this STP provides guidance regarding documenting major hazards and risk management. Figure A.2 provides an example of a complete Major Hazard and Risk Register scenario sheet.

Figure A.2 : Example Major Hazard and Risk Register

Production Module Area P1 – Liquid spray fire hazard – H-01.01

2. FIRE CASE	3. STRATEGY	4. INITIAL INCIDENT	5. ESCALATION/ TR EXPOSURE
Oil spray from LP Separators MDB1140/1240 on lower level C1 Oil spray from Flowline launcher receivers ZBA-0500/0510/0520/0530/0540 on the upper level	1. Minimize the likelihood of leakage by design integrity 2. Minimize ignition probability by minimizing ignition sources 3. Isolate and depressurize to minimize escalation 4. Inherent design features 5. Shelter in TR or possible evacuation for large oil releases	LIKELIHOOD: 4 SEVERITY: C High Risk	LIKELIHOOD: 3 SEVERITY: B High Risk

6. INHERENT SAFETY FEATURE	7. CONTRIBUTION TO HAZARD ELIMINATION	8. REF	9. PERF. STD
Process conditions	The available inventory in each LP separator is 92,000 lb at 50% full. Potential for oil spray fire exists until pressure reduces to 60 psig. This will take under 15 minutes with normal operation of blowdown and isolation system. Significant portion of liquid inventory is process water due to 3-phase separation. The available oil release for the flowlines is below 5,000 lb.	1,11,19	-
Separation between isolatable gas volumes on the Topsides and Primary and Secondary Muster areas in the Hull	The distance between the Muster and Embarkation areas and the high-risk hydrocarbon inventories in zone C1 has been maximized as far as practicable. The primary and secondary muster stations and primary and secondary embarkation stations are located at hull deck level on opposite corners of the hull main deck. Both embarkation areas are located at the hull main deck level outboard of the process areas. There is a plated deck beneath Production, Compression and Generation Modules with a second plated Hull Main deck. There are no connections that carry hazardous process fluid between Hull and Topsides.	3,5,6	PS-1
C1 area open on three sides and open to area C2 on fourth side – natural ventilation	There are no solid barriers (e.g., firewalls) between fire zones C1 and C2 and C1 is open on the other three sides with grated decks used for the upper deck. This maximizes the ventilation, which minimizes the potential for the accumulation of gas (i.e., flammable/explosive atmospheres) reducing the potential for ignition.	3,17	PS-1
Low operating pressure for process	Selection of intermediate pressure (450 psig) for flowlines, and IP separation and use of low pressure (150 psig) for LP separation reduces the potential for failure and subsequent release of hydrocarbons.	1,19	

10. HAZARD CAUSE	11. PREVENTION MEASURE	12. REF	13. PERF. STD
Leakage of valves, flanges, fittings, instruments, etc.	Optimization of number of valves, flanges, fittings, instruments and other leak sources by design. Also reduction in leaks due to use of welded rather than screwed fittings below 150lbs where practicable. Flanged connections between skids have been minimized where possible (e.g., use of single skid limit block valve).	14	-
Corrosion/erosion	Material selection for process fluids, corrosion allowance or increased pipe/vessel wall thickness, no significant sand/particulates, velocities below that required to cause erosion. Equipment has been designed with appropriate corrosion allowances for expected carbon dioxide levels. Although no hydrogen sulfide is present in early field life the process pipework and vessels are designed for sour service to allow for possible souring of process fluids in later field life.	14	PS-2
Inadequate isolation during maintenance	Appropriate isolation for pressure, control of activities through PTW and JSA, competence and training. Provision of appropriate connection for safe isolation of equipment as defined in the isolation philosophy.	12,14	-

Mechanical Integrity of process systems	Preventative maintenance program for equipment. Inspection and monitoring program for equipment and piping for corrosion and erosion. QA program to ensure as built equipment matches design.	14	-
Dropped object	Crane operating procedures include the planning, and communications between the crane operators and deck crews. The critical inspection, testing and maintenance of all lifting equipment. Monorail system in place to minimize need for equipment lift.	10,14	PS-3
Internal overpressure	Pipework rated for pressure or protected by suitably sized relief valve and other pressure control instrumentation.	1,14	-
Process deviation (e.g. pressure, temperature, etc.)	Process design, process controls, indications and alarms and operator response to alarms, process interlocks trigger process shutdown (PSD), Oil system shutdown (OSD), and utility shutdown (USD). Adequacy of the design for process deviation was evaluated in depth during HAZOP studies. The emergency support system operates ESD and PSD the process control system operates OSD and USD	13,14,16	PS-4
Activities	Permit controls, competence, training and supervision, Simops plan, MOC process.	14	-
14. SEVERITY CONTROL	**15. SEVERITY REDUCTION DESCRIPTION**	**16. REF**	**17. PERF. STD**
Area classification and ignition source minimization	Prevention of ignition by suitably rated electrical equipment for hazardous area operation. There are no fired heaters on the Topsides. All equipment designed for minimum of zone 2. All motor drives are electrically driven in place of turbine driven. The only turbines present are for power generation and are located in zone G1 away from primary gas inventories. Area classification will be in accordance with API 500/505.	1,3,20	PS-5
ESD on gas detection	Location of gas detectors based on minimum cloud size driven by explosion analysis. Line of sight and point source detectors are used in the design. A 1ooN signal will alarm in the CCR. Gas detection is designed to initiate ESD (isolation and blowdown) on a 2ooN signal. This will start isolation and blowdown thereby reducing hazard dimension and duration of heat loadings if ignition does occur. Will also reduce potential for ignition.	8,16	PS-6
ESD on Triple IR fire detection	Flame detectors location is hazard based rather than a uniform distribution. A 1ooN signal will alarm in the CCR. A 2ooN signal will from triple IR will actuate an ESD, open the deluge valve and initiate blowdown systems through the ESS	8,16	PS-7
ESD on Fusible plug fire/heat detection	Location of fusible plugs is based on leak potential of equipment rather than a uniform distribution. Each fire zone has a single fusible plug loop. Depressurization of fusible plug loop will cause an ESD	8,16	PS-8
Liquid isolation	SDV-11404 on waterside of MDB-1140 and XV-11403 on oil line to crude heaters are closed by PSD. Both valves are located as close as possible to LP separator (single flange) SDV-12404 on waterside of MDB-1240 and XV-12403 on oil line to crude heaters are closed by PSD. Both valves are located as close as possible to LP separator (single flange)	1	PS-9
Rapid automatic depressurization of gas pad above liquid	Design to reduce pressure on isolatable volumes to 100 psig or 50% of initial pressure in 7 minutes (except 10 minutes for Export compressor and production flowlines and manifolds) in place of API standard of 15 minutes. This reduces the gas pas pressure and rapidly lowers pressure to below spray fire transition pressure changing fire hazard to pool fire, so spray fires are unlikely to cause escalation and the possibility of failure or rupture due to heating of plant is minimized. All significant isolatable volumes are blowdown simultaneously. This reduces the hazard potential if escalation does occur outside of the isolatable volume in which the leak occurred.	11,16,38	PS-10

Two layers of plated deck between Topsides and Hull	The underside of the Compression module, Production and Generation modules have a plated deck. Intermediate areas between modules are sealed. The Hull Main deck is plated. Penetrations in the riser bay area have been minimized. 9-foot gap between the main deck and lower deck has no connections or hydrocarbon piping. This prevents passage of flames from fires between the Topsides and the Hull.	3, 17	-
18. MITIGATION DAMAGE/ EXPOSURE/ESCALATION	**19. EXPOSURE/VULNERABILITY AND ESCALATION LIMITATION**	**20. REF**	**21. PERF. STD**
Active fire protection systems	Equipment specific water spray systems are provided to limit the exposure of personnel to hazardous incidents while providing mitigation to those identified incidents. Equipment specific water spray application is provided for major equipment items in zone C1 at a minimum rate of 0.25 gpm/sq ft Activation of the fusible plug loop in zone C1 will automatically start all equipment specific water spray in zone C1. The water spray can also be activated from the CCR and remote I/O panels. The fire areas for the Production and Compression modules divide the modules vertically into three fire areas each, so that each fire area will contain more than one level. Design takes into consideration the possibility of a fire event spreading in the vertical direction. Curbing is used to limit the spread of liquids in the horizontal direction. Water spray protection of adjacent fire areas C2 and P3 will initiate on a time delay to minimize the risk of escalation of the fire. The time delay allows water to pressurize all the nozzles in the involved system before the initiating flow in the other systems All areas can be covered from two fire hose locations. NOTE: Water spray and hose reels will have minimal benefit on equipment, which is directly impinged by spray fires.	2,8,16,21	PS-11
Structural integrity in credible fire scenarios	Fire degradation study demonstrates the structural integrity of topsides structures members/equipment for credible fire scenarios for a minimum period of 45 minutes allowing for a controlled evacuation. The application of passive fire protection is not required on topsides.	7	PS-12
Firewalls	Two layers of Solid deck between the Topsides and the main deck. North and West face of the Deck house are H-60 rated; other faces are A-60 rated. Deckhouse roof is A-60 fire rated.	3,17	PS-12
22. EMERGENCY RESPONSE, COMMAND & CONTROL, ESCAPE & EVACUATION	**23. INJURY/FATALITY LIMITATION AND ESCAPE/EVACUATION**	**24. REF**	**25. PERF. STD**
Automation of safety systems	ESD (Isolation and blowdown), operation of deluge, and other primary safety systems are automatic on confirmed fire detections. Operator intervention is not required to ensure survivability of escape routes, the Temporary refuge, secondary muster area, or embarkation areas for the 45 minute endurance period.	2,4,8,11,16	PS-13
Escape routes	Escape routes allow safe access to primary and secondary muster areas. There are two escape routes from all locations. At least one escape route is viable for all credible fire scenarios for at least 30 minutes. Photoluminescent stripes have been added along the perimeter of escape routes.	4,5, 42	PS-14
Separation between Topsides Hazards and muster and embarkation areas located on the Hull.	Survivability of the primary and secondary muster and embarkation areas for 45 minutes. The primary and secondary muster stations and embarkation stations are located at hull main deck level at opposite corners. The hull main deck is separated from the hazardous inventories on the Topsides by plated decks underneath each module. The embarkation area on the north side is lower than the prod deck level, but not separated by the deck. The area on the south side is on the opposite side of the facility and well shielded from process events. The areas are located such that at least one of the muster and embarkation areas will be available for all scenarios.	3,4	PS-1

Primary muster station on the Hull (Temporary refuge TR)	For Non-Responders, this is the Mess Hall on the South East corner, second level deck house on the Hull. The incident command center is in the control room in the deck box. Provides a place where personnel can muster safely in an emergency and from which monitoring, control and command functions can be safely undertaken. The design and protection of the muster area is such that persons within are protected against the effects of fire, smoke, gas and fumes for the required endurance time. That is, either the duration of an incident or for a time sufficient to allow muster of all personnel, monitoring, control, command functions and communications to be undertaken, and if necessary, evacuation of the installation to be safely undertaken. These areas are also designed to withstand credible blast scenarios.	4,5,16	PS-1
Secondary muster station in the Hull	Secondary Muster Area for non-responders is located in the North West Column on the Tween deck in the Hull. The secondary incident command center is located in this area. Provides a place where personnel can muster safely in an emergency and from which monitoring, control and command functions can be safely undertaken. The design and protection of the TR is such that persons within are protected against the effects of fire, smoke, gas and fumes for the required endurance time. That is, either the duration of an incident or for a time sufficient to allow muster of all personnel, monitoring, control, command functions and communications to be undertaken, and if necessary, evacuation of the installation to be safely undertaken. These areas are also designed to withstand credible blast scenarios.	4,5,16	PS-1
Incident command centers located in Hull	The primary emergency response area where Emergency Response Teams will gather to assess the incident is the Incident Command Center (conference room Q1221) located next to the Control Room in the Accommodation area of the Deckbox. There is a Secondary/Alternate Control Room and Tactical Command Post located in the North West Column.	4,5	PS-1
Evacuation routes in the Hull	Enable persons to reach the primary and secondary evacuation systems from the primary and secondary muster areas. There is a single evacuation route from each muster area to the adjacent embarkation area. If this is impaired personnel can travel from one muster area to the other muster area through the well-protected main escape route on the lower deck level in the deck box. If this area is impaired, alternate routes are available through the Topsides decks. This provides a minimum of two evacuation routes from either muster area to the primary and secondary evacuation systems, with at least one evacuation route to the lifeboats remaining unimpaired for all fire scenarios.	4,5,6, 17, 30	PS-14
Primary evacuation systems in the Hull	Evacuation by helicopter may not be feasible during a hydrocarbon release or other short-term emergency and helicopters have not been considered as a primary means of evacuation. Evacuation by 50-man lifeboat (TEMPSC) is the primary means of embarkation. The embarkation areas are protected, by location on the South side behind the Deck House and MCC building. The secondary embarkation area is located on the North side of the hull. There are two 50-men TEMPSC at each of the embarkation areas with total capacity of 2 x 100 for a normal POB of 60. There is also a fast rescue boat on the primary embarkation area. The TEMPSC can be lowered during the worst-case 20-degree hypothetical incline.	4,5,6, 16	PS-14
Secondary evacuation systems in the Hull	Evacuation by Davit launched 25-man life raft is the secondary means of embarkation. The embarkation areas are protected, by location on the South side behind the Deck House and MCC building. The secondary embarkation area is located on the North side of the hull. There are two 25-man davit launched liferafts at each of the embarkation areas with a total capacity of 100 for a normal POB of 60. The Liferafts can be lowered during the worst-case 20-degree hypothetical incline.	4,5,6, 16	PS-14

Tertiary evacuation systems	The final evacuation method is directly into the sea is available for those who are stranded. This is comprised of two ladders to sea located at the NW and SE corner of the PQ adjacent to the muster areas.	4,5,6, 16	PS-15
Lifejackets, smoke hoods, PPE	There are a total of 210 Life jackets stowed ready for use. On for each berth in the cabins (60) and 75 at each embarkation area. Life jackets will be put on as part of platform evacuation. Smoke hood are provided (one per bed in the LQ, 6 in the control room and others at locations though the PQ.	4, 5,6, 16	PS-16
Rescue and recovery	Lifeboat and life rafts have the facility to survive for a minimum of 24 hours under all weather conditions prior to rescue. Fast Rescue craft available to rescue personnel who fall overboard. 3rd parties (many other offshore facility close by) and nearby Mad Dog to provide a safe location and additional assistance fro the rescue and recovery of persons.	4,5,6	PS-17
26. Comments: Notes For Operations			

A.2.2 Major Hazard and Risk Register Summary Table

This is a tabular summary of the Major Hazards and Risk Register. The summary table contains the following headings:

- **Item Number** *a unique reference for the major hazard line item in the table.*
- **Hazard** *selected from the hazard categories of Annex D.*
- **Reference** Source *linking information to the more detailed Major Hazard and Risk Register.*
- **System** *the system containing the hazard.*
- **Facility Area** *where the major hazard resides.*
- **Hazard Scenario** *the generic nature of the hazard.*
- **Representative Equipment Items** *from which the major hazard arises.*
- **Causes** *that result in the release of the hazard.*
- **Barriers** *that prevent the hazard from being released.*
- **Consequences** *that could potentially result when the hazard is released.*
- **Recovery Controls** *that limit the magnitude or severity of the potential consequences.*
- **Representative Scenario** *is a scenario that characterizes how a hazard may materialize in practice. This aids conceptualization of the hazard and the discussion of mitigation plans.*
- **Risk Ranking** *before risk modification factors.*
- **Mitigation Measures** *activities that serve to reduce risks, or control increased risks during higher occupancy levels, for example.*
- **Risk Ranking** *which addresses the risk modification factors and could represent a risk increase or reduction.*

An example summary table is presented in Figure A.3

A.2.3 Major Hazard Bow-Tie

The bow-tie is a diagrammatic representation that links hazards to potential consequences. As such it illustrates the evolution of a hazardous event from basic failure modes, or causes, to the final

consequences as shown in Figure A.4. The bow-tie represents the combination of a fault tree (causal analysis) on the left, and an event tree (consequence analysis) on the right. The Initiating Event, central to the diagram, represents the loss of control and links the fault and event tree. The various controls (Barriers and Recovery Measures) represent the systems responsible for controlling the occurrence of the Initiating Event and the potential consequences. In Figure A.4, references to major hazards and risk register scenario sheet boxes of Annex B are included to demonstrate the linkage between the bow-tie and the Major Hazard and Risk Register contents. An example of a bow-tie is presented in Figure A.5.

Figure A.4: Schematic Bow-Tie Diagram

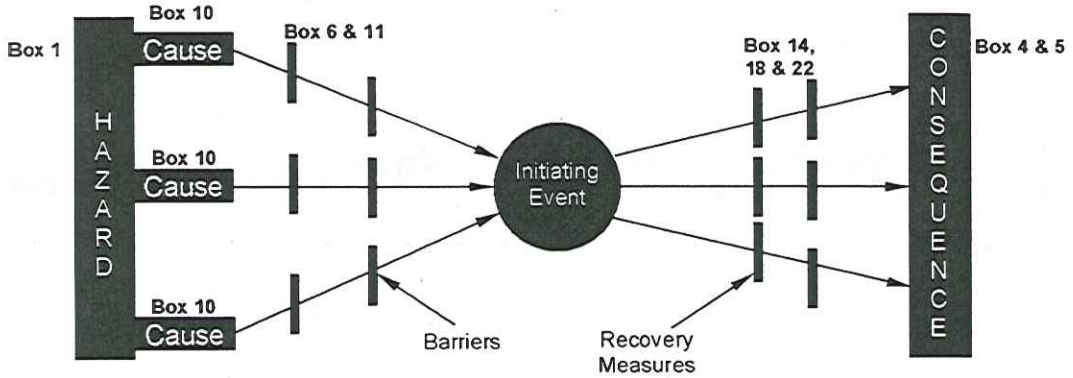
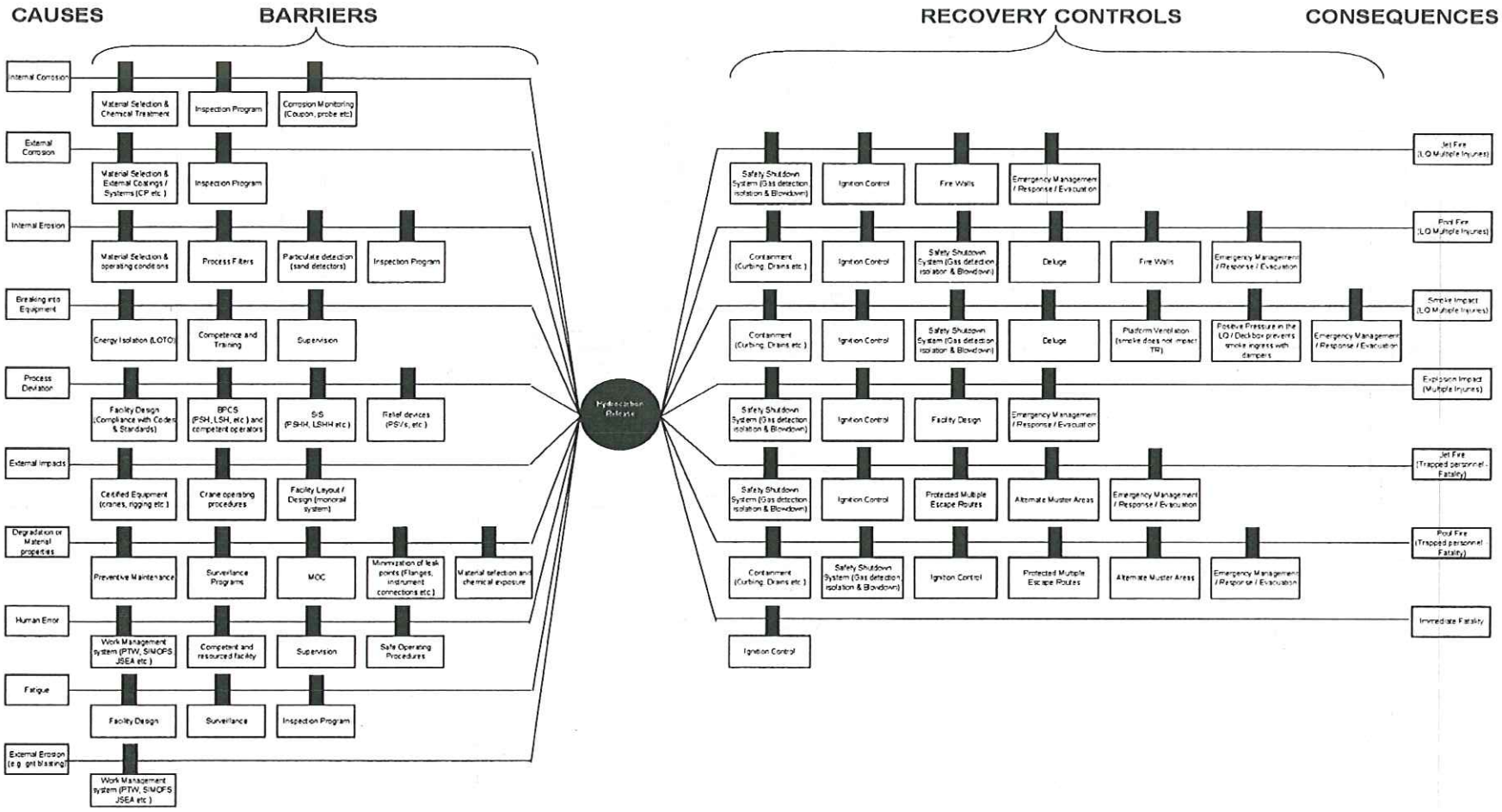


Figure A.3: Example Major Hazard and Risk Register Summary Table

														Risk Before						Risk After					
														Severity						Severity					
Item No.	Hazard	Source Reference	System	Facility Area	Hazard Scenario	Area : Hazard Scenario	Representative Equipment Items	Causes	Barriers		Consequences	Recovery Controls	Representative Scenario	Safety	Environment	Financial	Reputation	Likelihood	Risk	Safety	Environment	Financial	Reputation	Likelihood	Risk
AT - HSE - 1	H-01 08 -Hydrocarbon Gas	Atlantis -Hazard Management Plan Table 2, 8, 10	Topsides	Compression Module	Jet Fire	Compression Module Jet Fire	- Gas leak on LP Separators MC8111A01240 on lower level C1 - Gas leak from flowline launcher receivers ZBA-0509/0510/0520/0530/0540 on the upper level - Gas leak on IP Separators MC8112A01220 on lower level C2 - Gas leak from production manifolds receivers GAY-0210/0220/0230 on the upper level - 1st Stage Export Compressors No 1 CBA- 2620 and 2nd Stage Export Compressor - No 1 CBA- 2610 - Booster Compressor No 1 CBA- 2230 - Fuel gas and 222- 3500 on lower and mid level - Gas export lines and Essex gas metering 222- 4100 on lower level - Glycol dehydration equipment on lower and mid level - 1st Stage Export Compressor No 2 CBA- 3720 and 2nd Stage Export - Compressor - No 2 CBA- 3770 on the upper level - Booster Compressor No 22 CBA- 3320 on the upper level	- Internal Corrosion - External Corrosion - Internal Erosion - Breaking into Equipment - Process Deviation - External Impact - Degradation of Material Properties - Human Error - Fatigue - External Erosion - Human error - Fatigue - External Erosion	- BPCS - Certified Equipment - Competence & Training - Competent & Pressure Facility - Corrosion Monitoring - Crane Operating Procedures - Energy Isolation (LOTO) - Facility Design - Codes & Standards - Facility Layout - Crane lifting paths - Inspection Program - Material Selection & Chemical Exposure - Material Selection & External Coatings - Material Selection and Chemical Treatment	- Material selection and operating conditions - Minimization of leak points - NOC - Particulate detection - Preventive Maintenance - Process Filters - Relief devices - Safe Operating Procedures - SIS - Supervision - Surveillance Programs - Work Management Systems	- Jet Fire (LO Multiple Injured) - Jet Fire (Trapped Personnel)	- Safety Shutdown System (Gas detection, isolation and Blowdown) - Ignition Control - Protected Multiple Escape Routes - Alternate Muster Areas - Deluge - Fire Walls - Emergency Management / Response / Evacuation	- LP Connection failure resulting in rigid hot release and injuries / fatalities of personnel in the immediate vicinity	C				4	M		C				4	M
AT - HSE - 2	H-01 08 -Hydrocarbon Gas	Atlantis -Hazard Management Plan Table 2, 8, 10	Topsides	Compression Module	Jet Fire	Compression Module Jet Fire	- Gas leak on LP Separators MC8111A01240 on lower level C1 - Gas leak from flowline launcher receivers ZBA-0509/0510/0520/0530/0540 on the upper level - Gas leak on IP Separators MC8112A01220 on lower level C2 - Gas leak from production manifolds receivers GAY-0210/0220/0230 on the upper level - 1st Stage Export Compressors No 1 CBA- 2620 and 2nd Stage Export Compressor - No 1 CBA- 2610 - Booster Compressor No 1 CBA- 2230 - Fuel gas and 222- 3500 on lower and mid level - Gas export lines and Essex gas metering 222- 4100 on lower level - Glycol dehydration equipment on lower and mid level - 1st Stage Export Compressor No 2 CBA- 3720 and 2nd Stage Export - Compressor - No 2 CBA- 3770 on the upper level - Booster Compressor No 22 CBA- 3320 on the upper level	- Internal Corrosion - External Corrosion - Internal Erosion - Breaking into Equipment - Process Deviation - External Impact - Degradation of Material Properties - Human Error - Fatigue - External Erosion - Human Error - Fatigue - External Erosion	- BPCS - Certified Equipment - Competence & Training - Competent & Pressure Facility - Corrosion Monitoring - Crane Operating Procedures - Energy Isolation (LOTO) - Facility Design - Codes & Standards - Facility Layout - Crane lifting paths - Inspection Program - Material Selection & Chemical Exposure - Material Selection & External Coatings - Material Selection and Chemical Treatment	- Material selection and operating conditions - Minimization of leak points - NOC - Particulate detection - Preventive Maintenance - Process Filters - Relief devices - Safe Operating Procedures - SIS - Supervision - Surveillance Programs - Work Management Systems	- Jet Fire (LO Multiple Injured) - Jet Fire (Trapped Personnel)	- Safety Shutdown System (Gas detection, isolation and Blowdown) - Ignition Control - Protected Multiple Escape Routes - Alternate Muster Areas - Deluge - Fire Walls - Emergency Management / Response / Evacuation	- LP Connection failure resulting in rigid hot release and injuries / fatalities of personnel in the immediate vicinity, and beyond via evacuation	C				4	M		C				4	M
AT - HSE - 3	H-01 01 Crude Oil under pressure	Atlantis -Hazard Management Plan Table 3, 7, 11	Topsides	Compression Module	Liquid Spray Fire	Compression Module Liquid Spray Fire	- Oil spray from LP Separators MC8111A01240 on lower level C1 - Oil spray from Flowline launcher receivers ZBA-0509/0510/0520/0530/0540 on the upper level - Oil spray from IP Separators MC8112A01220 on lower level - Liquid spray from Compressor suction scrubbers (Booster Compressor suction scrubber MBF- 2210, Export 1st and 2nd stage suction scrubbers MBF- 2610 and MBF- 2680, on the upper level - Liquid spray from Compressor suction scrubbers (Booster Compressor suction scrubber MBF- 2210, Export 1st and 2nd stage suction scrubbers MBF- 3710 and MBF- 3780, on the upper level	- Internal Corrosion - External Corrosion - Internal Erosion - Breaking into Equipment - Process Deviation - External Impact - Degradation of Material Properties - Human Error - Fatigue - External Erosion - Human Error - Fatigue - External Erosion	- BPCS - Certified Equipment - Competence & Training - Competent & Pressure Facility - Corrosion Monitoring - Crane Operating Procedures - Energy Isolation (LOTO) - Facility Design - Codes & Standards - Facility Layout - Crane lifting paths - Inspection Program - Material Selection & Chemical Exposure - Material Selection & External Coatings - Material Selection and Chemical Treatment	- Material selection and operating conditions - Minimization of leak points - NOC - Particulate detection - Preventive Maintenance - Process Filters - Relief devices - Safe Operating Procedures - SIS - Supervision - Surveillance Programs - Work Management Systems	- Jet Fire (LO Multiple Injured) - Pool Fire (LO Multiple Fatalities) - Smoke Impact (LO Multiple Fatalities) - Jet Fire (Trapped Personnel) - Pool Fire (Trapped Personnel)	- Safety Shutdown System (Gas detection, isolation and Blowdown) - Containment (Kerbing, Drains etc.) - Ignition Control - Platform Ventilation - Protected Multiple Escape Routes - Positive Pressure in LQ / Control Room - Alternate Muster Areas - Fire Walls - Deluge - Emergency Management / Response / Evacuation	- LP Connection failure resulting in rigid hot release and injuries / fatalities of personnel in the immediate vicinity	C				4	M		C				4	M
AT - HSE - 4	H-01 01 Crude Oil under pressure	Atlantis -Hazard Management Plan Table 3, 7, 11	Topsides	Compression Module	Liquid Spray Fire	Compression Module Liquid Spray Fire	- Oil spray from LP Separators MC8111A01240 on lower level C1 - Oil spray from Flowline launcher receivers ZBA-0509/0510/0520/0530/0540 on the upper level - Oil spray from IP Separators MC8112A01220 on lower level - Liquid spray from Compressor suction scrubbers (Booster Compressor suction scrubber MBF- 2210, Export 1st and 2nd stage suction scrubbers MBF- 2610 and MBF- 2680, on the upper level - Liquid spray from Compressor suction scrubbers (Booster Compressor suction scrubber MBF- 2210, Export 1st and 2nd stage suction scrubbers MBF- 3710 and MBF- 3780, on the upper level	- Internal Corrosion - External Corrosion - Internal Erosion - Breaking into Equipment - Process Deviation - External Impact - Degradation of Material Properties - Human Error - Fatigue - External Erosion - Human Error - Fatigue - External Erosion	- BPCS - Certified Equipment - Competence & Training - Competent & Pressure Facility - Corrosion Monitoring - Crane Operating Procedures - Energy Isolation (LOTO) - Facility Design - Codes & Standards - Facility Layout - Crane lifting paths - Inspection Program - Material Selection & Chemical Exposure - Material Selection & External Coatings - Material Selection and Chemical Treatment	- Material selection and operating conditions - Minimization of leak points - NOC - Particulate detection - Preventive Maintenance - Process Filters - Relief devices - Safe Operating Procedures - SIS - Supervision - Surveillance Programs - Work Management Systems	- Jet Fire (LO Multiple Injured) - Pool Fire (LO Multiple Fatalities) - Smoke Impact (LO Multiple Fatalities) - Jet Fire (Trapped Personnel) - Pool Fire (Trapped Personnel)	- Safety Shutdown System (Gas detection, isolation and Blowdown) - Containment (Kerbing, Drains etc.) - Ignition Control - Platform Ventilation - Protected Multiple Escape Routes - Positive Pressure in LQ / Control Room - Alternate Muster Areas - Fire Walls - Deluge - Emergency Management / Response / Evacuation	- LP Connection failure resulting in rigid hot release and injuries / fatalities of personnel in the immediate vicinity, and beyond via evacuation	C	C			4	M		C	C			4	M
AT - HSE - 5	H-01 01 Crude Oil under pressure	Atlantis -Hazard Management Plan Table 4, 8, 12	Topsides	Compression Module	Pool Fire	Compression Module Pool Fire	- Oil leak on of side of LP Separators MC8111A01240 on lower level C1 - Oil leak on IP Separators MC8112A01220 on lower level	- Internal Corrosion - External Corrosion - Internal Erosion - Breaking into Equipment - Process Deviation - External Impact - Degradation of Material Properties - Human Error - Fatigue - External Erosion - Human Error - Fatigue - External Erosion	- BPCS - Certified Equipment - Competence & Training - Competent & Pressure Facility - Corrosion Monitoring - Crane Operating Procedures - Energy Isolation (LOTO) - Facility Design - Codes & Standards - Facility Layout - Crane lifting paths - Inspection Program - Material Selection & Chemical Exposure - Material Selection & External Coatings - Material Selection and Chemical Treatment	- Material selection and operating conditions - Minimization of leak points - NOC - Particulate detection - Preventive Maintenance - Process Filters - Relief devices - Safe Operating Procedures - SIS - Supervision - Surveillance Programs - Work Management Systems	- Pool Fire (LO Multiple Fatalities) - Pool Fire (Trapped Personnel) - Smoke Impact (LO Multiple Fatalities)	- Safety Shutdown System (Gas detection, isolation and Blowdown) - Containment (Kerbing, Drains etc.) - Ignition Control - Platform Ventilation - Protected Multiple Escape Routes - Positive Pressure in LQ / Control Room - Alternate Muster Areas - Fire Walls - Deluge - Emergency Management / Response / Evacuation	- LP Connection failure resulting in rigid hot release and injuries / fatalities of personnel in the immediate vicinity	F				1	H		F				1	H
AT - HSE - 6	H-01 01 Crude Oil under pressure	Atlantis -Hazard Management Plan Table 4, 8, 12	Topsides	Compression Module	Pool Fire	Compression Module Pool Fire	- Oil leak on of side of LP Separators MC8111A01240 on lower level C1 - Oil leak on IP Separators MC8112A01220 on lower level	- Internal Corrosion - External Corrosion - Internal Erosion - Breaking into Equipment - Process Deviation - External Impact - Degradation of Material Properties - Human Error - Fatigue - External Erosion - Human Error - Fatigue - External Erosion	- BPCS - Certified Equipment - Competence & Training - Competent & Pressure Facility - Corrosion Monitoring - Crane Operating Procedures - Energy Isolation (LOTO) - Facility Design - Codes & Standards - Facility Layout - Crane lifting paths - Inspection Program - Material Selection & Chemical Exposure - Material Selection & External Coatings - Material Selection and Chemical Treatment	- Material selection and operating conditions - Minimization of leak points - NOC - Particulate detection - Preventive Maintenance - Process Filters - Relief devices - Safe Operating Procedures - SIS - Supervision - Surveillance Programs - Work Management Systems	- Pool Fire (LO Multiple Fatalities) - Pool Fire (Trapped Personnel) - Smoke Impact (LO Multiple Fatalities)	- Safety Shutdown System (Gas detection, isolation and Blowdown) - Containment (Kerbing, Drains etc.) - Ignition Control - Platform Ventilation - Protected Multiple Escape Routes - Positive Pressure in LQ / Control Room - Alternate Muster Areas - Fire Walls - Deluge - Emergency Management / Response / Evacuation	- LP Connection failure resulting in rigid hot release and injuries / fatalities of personnel in the immediate vicinity, and beyond via evacuation	C				1	M		C				1	M

Figure A.5: Example Major Hazard and Risk Register Summary Table



Annex B
Major Hazard Scenario Sheet contents

B.1. Introduction

The Major Hazard and Risk Scenario Sheets provide key information pertaining to the Major Hazards associated with a Facility or Major Project. This annex provides guidance on the contents required to complete the Major Hazard and Risk Scenario sheet of Figure B.1 and an example is provided in Annex A. The Scenario sheet of Figure B.1 illustrates the seven key areas of Hazards management.

1. Hazard information (Fields 1 through 5)
2. Inherent safety in design (Fields 6 through 9)
3. Hazard causes (Field 10)
4. Prevention measures (to hazard causes) (Fields 11 through 13)
5. Severity control (Fields 14 through 17)
6. Escalation minimization (Fields 18 through 21)
7. Emergency response (Fields 22 through 25)

Figure B.1: Scenario Sheet

1. Area and Generic Hazard Category:			Rev. xx
2. HAZARD SCENARIO	3. STRATEGY	4. INITIAL INCIDENT	5. ESCALATION/ TR EXPOSURE
6. INHERENT SAFETY FEATURE FOR HAZARD ELIMINATION	7. CONTRIBUTION TO HAZARD ELIMINATION / IMPLICATION	8. REF.	9. PERF. STD.
10. HAZARD CAUSE	11. PREVENTION MEASURE	12. REF.	13. PERF. STD.
14. SEVERITY CONTROL	15. SEVERITY REDUCTION DESCRIPTION	16. REF.	17. PERF. STD.
18. MITIGATION DAMAGE / EXPOSURE / ESCALATION	19. EXPOSURE/VULNERABILITY AND ESCALATION LIMITATION	20. REF.	21. PERF. STD.
22. EMERGENCY RESPONSE, COMMAND & CONTROL, ESCAPE & EVACUATION	23. INJURY/FATALITY LIMITATION AND ESCAPE/EVACUATION	24. REF	25. PERF. STD.

1. Area and Generic Hazard Category:	Rev. xx
26. COMMENTS:	

B.2. Scenario Sheet Contents

a. The guidance provided below does not address fields in the Major Hazard and Risk Scenario sheets pertaining to study references or performance standards. Guidance on the generation of performance standards is provided in DWGOM-GP 48-0001.

b. **Hazard information** occupies fields 1 through 5 of the Major Hazard Scenario Sheet in Figure 4.

1. Field 1 indicates the Facility area where the potential Major Hazard exists and the hazard category. Hazard categories are defined in Annex D.

   An example description would be 'Holstein Production Deck: H-01:06 Hydrocarbons Gas Under Pressure'

2. Field 2 defines the hazard scenario(s) that represents credible events characterizing the hazard. The descriptions should identify the operating mode, phase of the operation or equipment and provide succinct information regarding the characteristics of the event.

   An example hazard scenario would be '2 in. process line release in the compression module resulting in potential fatalities, equipment damage, business interruption and reputation damage.'

3. Field 3 provides a high-level summary of the hazard management strategy incorporated into the design, and maintained through the lifecycle, addressing aspects of hazard elimination, substitution, prevention, control, mitigation and emergency response.

   An example would be 'minimization of the number of flanges between modules' or 'platform ventilation maximized through vessel orientations in relation to prevailing winds'

4. Fields 4 and 5 estimate risks from the initial event and escalation of the initial event. The purpose for including both scenarios is to characterize the potential range of hazard scenario risks, recognizing that an initial event may escalate to more serious consequences.

   Ignition of the '2 in. process line release in the compression module' could cause serious injuries or fatalities of personnel in the immediate area of the event, whereas continuation of the fire could escalate into structural collapse of critical structural members and release of additional hydrocarbons. The escalation event potentially impacts a greater number of personnel.

5. Field 4 defines the risk associated with the initial event expressed in terms of the Risk Matrix of Annex E. The evaluation of risk should include the severity, likelihood and the resulting risk level. The estimated risk should be associated with scenarios used to characterize the Major Hazard.

   For the scenario "Ignited 2 in. process release resulting in fire and potentially an explosion" the initial incident risk might be Likelihood = 4, Severity = C resulting in a High risk level.

6. Field 5 defines the risk associated with the escalation of the initial event and its impact. Escalation shall address the impact on the ability to evacuate and Temporary Refuge if relevant, expressed using the Integrity Management Standard Risk Matrix. The evaluation of risk should include the severity, likelihood and the resulting risk level.

   For the scenario "Ignited 2 in. process release resulting in fire and potentially an explosion" the escalation incident risk that results in a failure of the blast wall impacting the Temporary Refuge might be Likelihood = 2, Severity = B resulting in a Medium risk level.

c. **Inherent safety in design** features are documented in fields 6 through 9 of the Major Hazard Scenario Sheet.

   1. Field 6 identifies key design features that serve to eliminate or minimize the major accident hazard potential.

      Examples might include: substitution of chemicals to minimize environmental hazards, elimination of crude oil storage, minimization of explosion overpressures through facility layout considerations, and, maximization of separation distances between hazardous and populated areas.

   2. Field 7 describes the contribution the inherent safety in design features makes towards reducing major hazard risks. The description should be specific in terms of design features that have been implemented to reduce risk such as specifying process conditions, separation distances, minimization of hazardous inventories, etc. Compliance with codes and standards is not considered to reflect the principals of Inherent Safer Design. Compliance with Codes and Standards is considered standard engineering practice.

      Examples might include: storage of crude oil on the deck and use of oil in the process train to perform subsea system displacement operations eliminates the need for oil storage in the hull, or minimization of explosion overpressures through Facility layouts that maximize air ventilation rates

d. **Hazard causes** are documented in field 10 of the Major Hazard Scenario Sheet.

   1. Field 10 identifies the potential causes that could result in the realization of the hazard. The list of causes should be generic.

      Examples might include: errant vessels (resulting in ship impacts), mooring line failure, corrosion, overpressure, external impact, thermal expansion, erosion or process deviation

e. **Prevention Measures** are documented in fields 11 through 13 of the Major Hazard Scenario Sheet.

   1. Field 11 provides a high-level description of the features of the Facility design that are responsible for controlling potential causes. The descriptions can be generic or specific. Where possible the level of detail should default to Facility specific information.

      Examples might include: corrosion injection and monitoring program for subsea equipment or crane stops for the port forward crane prevents lifting over high pressure risers

f. **Severity controls** are documented in fields 14 through 17 of the Major Hazard Scenario Sheet. In the context of the Major Hazard and Risk Register, severity controls are those that provide control over the initiating event, prior to any escalation

   1. Field 14 lists the features of the design that serve to minimize the severity of the potential Major Hazard. The list should contain generic information.

Examples might include: emergency shutdown on gas detection, area classification to minimize ignition potential or dropped object protection

2. Field 15 provides a high-level description of the methodology or action which controls the severity of the hazard case. The descriptions can be generic or specific. Where possible the level of detail should default to Facility specific information.

   Examples might include: Initiation of emergency shutdown and blowdown on fire detection for 2ooN detectors, area classification to minimize ignition potential, or dropped object protection provided on the production deck level for 1 MJ energy impacts

g. **Escalation controls** are documented in fields 18 through 21 of the Major Hazard and Risk Register scenario sheet. In the context of the Major Hazard and Risk Register, escalation controls are those that prevent escalation of the initial event limit and / or limit the potentially more serious consequences associated with escalation of the initiating event.

   1. Field 18 lists the features of the design that serve to minimize escalation of the initiating event, or the seriousness of the escalated event. The list should contain generic information.

      Examples might include: redundancy in structural supports, fire walls on occupied buildings, active fire protection minimizing escalation potentials or deck box providing residual buoyancy.

   2. Field 19 provides a high-level description of the escalation controls. The descriptions can be generic or specific. Where possible the level of detail should default to Facility specific information.

      Examples might include: natural ventilation to minimize smoke accumulation, redundancy in the production module structural design prevents collapse on the loss of supports, active fire protection systems with dedicated fire monitors on critical vessels minimizes escalation potentials, or fire walls providing protection to personnel in the Temporary Refuge for 60 minutes allowing a coordinated evacuation in 45 minutes.

h. **Emergency response components** are documented in fields 22 through 25 of the Major Hazard Scenario Sheet.

   1. Field 22 identifies the components of the emergency response, evacuation and rescue operations. The list should contain generic information

      Examples might include: escape routes, muster areas, and primary evacuation systems

   2. Field 23 provides a high-level description of the emergency response, command & control, escape and evacuation components. The descriptions should address all aspects of the emergency.

      Examples might include: provisions for lifejackets, egress from hazardous areas, or muster areas provide a place where personnel can muster safely in an emergency and from which monitoring, control and command functions can be safely undertaken

i. **References, Performance Standards, and Comments** are documented in Fields (8, 9), (12, 13), (16, 17), (20, 21), (24, 25), and 26 of the Major Hazard Scenario Sheet.

   1. Fields 8, 12, 16, 20, and 24 contain references to hazard management or engineering studies or reviews that substantiate the hazard management controls described and identify where additional information may be found. In cases where studies were not performed, such as the application of a general hazard management philosophy, this should be stated.

An example might be reference document S 7.43

2. Fields 9, 13, 17, 21, and 25 contain links or references to performance standards that outline specifications for system functionality, reliability, availability, and survivability. More information is included in DWGOM-GP 48-0001 Guidance on Practice for Protective System Identification.

3. Field 26 contains any additional comments that are relevant to Operations regarding the management of hazards

Annex C
Workshop Terms of Reference

C.1. Introduction

The workshop Terms of Reference (ToR) provides key information pertaining to the Major Hazard and Risk Register workshop. The Major Hazard and Risk Register workshop ToR is endorsed by a member of *Management* who is sponsor, and the individual with line responsibility for the management of hazards on the Facility.

BP GULF OF MEXICO
DEEPWATER PRODUCTION

Facility Name
Major Hazard and Risk Register Workshop

Terms of Reference

Document No.

REVISION HISTORY

Rev.	Date	Description	Originator	Checked	Endorsed

Document Control Number	Job Number	Area/Unit Designations	Discipline Code	Document Type	Sequence Number	Document Revision

Introduction

The GoM SPU Major Hazard Risk Management Policy states that a Major Hazards and Risk Register shall be developed that provides documented demonstration of the controls responsible for managing Major Hazards.

A Major Hazard and Risk Register provides a summary of the controls responsible for managing major accident hazards and helps readers locate further relevant information. The Major Hazard and Risk Register is an easily read document supported by other hazard management studies, and is a day-to-day reference for the operation of the Facility.

The register lists and describes each of the Major Hazards on the Facility. Major accident hazards are those with the potential for one, or more, of the following:

- Multiple injuries or fatalities
- Catastrophic loss of the Facility
- Irreparable damage to the environment, and,
- Damage to corporate reputation

This document outlines the process for developing the Major Hazard and Risk Register in accordance with the Major Hazard and Risk Register Development STP DWGOM-GP 76-0099.

Objectives

The objectives of the workshop are to:

- Produce a Major Hazard and Risk Register in compliance with the GoM SPU Major Hazard Risk Management Policy
- Create / validate a living, easily understood Major Hazard and Risk Register tat describes the causes, severity, consequences and management of each major hazard
- Identify actions required to validate the accuracy of statements made in the Major Hazard and Risk Register
- Capture actions identified during the workshop that serve to reduce risks.

Location

Define the workshop location

Timing

Provide the workshop date(s)

Scope

Clearly define the scope of the workshop. This should identify the boundaries of the Facility and the operational modes under consideration.

Methodology

Pre-Workshop Preparations

- Define the workshop sponsor.
- Prepare and endorse the Terms of Reference.
- Review previous hazard management studies.
- Review pending open action items from previous hazard studies.
- Identify and seek agreement of the major accident hazards.
- Pre-populate the Major Hazard and Risk Register scenario sheets.
- Collate and distribute pre-read material.
- Identify and invite workshop participants.

Workshop Session

- Review the process to be used.
- Agree the major accident hazards with workshop participants.
- Review the pre-populated Major Hazard and Risk Register information utilizing the Bow-Tie framework (see Figure 3 in DWGOM-GP 76-0099) to guide the discussion.
- Document changes to the pre-populated Major Hazard and Risk Register and generate action items where additional information is required.
- Validate / assign risk ratings for each major hazard scenario.

Post-Workshop

- The facilitator will review and edit the Major Hazard and Risk Register sheets, and distribute to workshop participants for review within one (1) week of the workshop.
- Action items will be assigned to personnel by the Major Hazard and Risk Register workshop sponsor.
- Comments from participants and action closures will be provided to the facilitator for incorporation into the Major Hazard and Risk Register sheets within three (3) weeks.
- The facilitator shall update the Major Hazard and Risk Register reflecting received comments and closure of action items.
- The Major Hazard and Risk Register shall be reviewed by Legal where high risk major hazards are identified.

Major Hazard Scenarios

Figure C.1 : Major Hazard and Risk Scenario Sheet

1. Area and Generic Hazard Category:			Rev. xx
2. HAZARD SCENARIO	3. STRATEGY	4. INITIAL INCIDENT	5. ESCALATION/ TR EXPOSURE
6. INHERENT SAFETY FEATURE FOR HAZARD ELIMINATION	7. CONTRIBUTION TO HAZARD ELIMINATION / IMPLICATION	8. REF.	9. PERF. STD.
10. HAZARD CAUSE	11. PREVENTION MEASURE	12. REF.	13. PERF. STD.
14. SEVERITY CONTROL	15. SEVERITY REDUCTION DESCRIPTION	16. REF.	17. PERF. STD.

1. Area and Generic Hazard Category:			Rev. xx
18. MITIGATION DAMAGE / EXPOSURE / ESCALATION	19. EXPOSURE/VULNERABILITY AND ESCALATION LIMITATION	20. REF.	21. PERF. STD.
22. EMERGENCY RESPONSE, COMMAND & CONTROL, ESCAPE & EVACUATION	23. INJURY/FATALITY LIMITATION AND ESCAPE/EVACUATION	24. REF	25. PERF. STD.
26. COMMENTS:			

Hazard Scenario sheets will be validated / developed for the following major accident hazards:

- *Major Hazard 1*
- *Major Hazard 2*
- *Major Hazard 3*
- *Major Hazard 4*
- *Major Hazard 5*

Pre-Read Information

Pre-read material to support the workshop comprises:

- *HAZID study(s)*
- *Pre-populated Major Hazard and Risk Register*
- *Facility layout drawings*
- *P & IDs*
- *Pre-read item 1*
- *Pre-read item 2*
- *Pre-read item 3*

List of Participants

The quality of the Major Hazard and Risk Register is highly dependant on the experience and technical knowledge of the workshop participants. The participants required to attend the Major Hazard and Risk Register workshop are listed below.

No.	Individual	Position / Skill Set
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Agenda

Time & Date

Time	Topic	Lead / Facilitator
8:00 am	Welcome and Safety Moment	
8:15 am	Risk Management Policy: Major Hazard and Risk Register	
8:30 am	*Facility* Major hazards	
9:00 am	Description of the process	
9:30 am	Break	
9:45 am	*Major Hazard 1*	
11:00 am	Lunch	
11:30 am	*Major Hazard 2*	
12:00 am	*Major Hazard 3*	
1:30 pm	*Major Hazard 4*	
3:00 pm	Break	
3:15 pm	*Major Hazard 5*	
5:00 pm	Close	

Annex D
Hazard Categories and Reference Numbers

D.1. Introduction

A unique identification number and description are used to categorize the hazards to provide consistency when referencing hazards. The reference numbers and descriptions are presented in Table D.1 and are used to populate Field 1 of the Major Hazard and Risk Register.

Ref.	Hazard Description
H-01	**Hydrocarbons**
H-01.01	Crude oil under pressure
H-01.02	Hydrocarbons in formation
H-01.03	LPGs
H-01.04	LNGs
H-01.05	Condensate, NGL
H-01.06	Hydrocarbon gas
H-01.07	Crude oil at low pressures
H-01.08	Wax
H-01.09	Coal
H-02	**Refined Hydrocarbons**
H-02.01	Lube and seal oil
H-02.02	Hydraulic oil
H-02.03	Diesel fuel
H-02.04	Petroleum spirit/gasoline
H-03	**Other flammable materials**
H-03.01	Cellulosic materials
H-03.02	Pyrophoric materials
H-04	**Explosives**
H-04.01	Detonators
H-04.02	Conventional explosive material
H-04.03	Perforating gun charges
H-05	**Pressure Hazards**
H-05.01	Bottled gases under pressure
H-05.02	Water under pressure in pipeworks
H-05.03	Non-hydrocarbon gas under pressure in pipeworks
H-05.04	Air under high pressure
H-05.05	Hyperbaric Operations
H-05.06	Decompression
H-06	**Hazards associated with differences in height**
H-06.01	Personnel at height >2m
H-06.02	Personnel at height <2m
H-06.03	Overhead equipment
H-06.04	Personnel under water
H-06.05	Personnel below grade
H-07	**Objects under induced stress**
H-07.01	Objects under tension
H-07.02	Objects under compression
H-08	**Dynamic situation hazards**
H-08.01	On land transport
H-08.02	On water transport
H-08.03	In air transport
H-08.04	Boat collision hazard to other vessels and offshore structures
H-08.05	Equipment with moving or rotating parts
H-08.06	Use of hazardous hand tools
H-08.07	Use of knives, machetes and other sharp objects
H-08.08	Transfer from boat to offshore platform
H-09	**Environmental Hazards**
H-09.01	Weather
H-09.02	Sea state/river currents
H-09.03	Tectonic
H-10	**Hot surfaces**
H-10.01	Process piping and equipment between 140 and 300 deg. F
H-10.02	Process piping and equipment over 300 deg. F
H-10.03	Engine and turbine exhaust systems
H-10.04	Steam piping
H-11	**Hot fluids**
H-11.01	Temperatures between 200 and 300 deg. F
H-11.02	Temperatures greater than 300 deg. C
H-12	**Cold surfaces**
H-12.01	Process piping between -10 deg. F and -110 deg. F
H-12.02	Process piping less than -110 deg. F

Ref.	Hazard Description
H-13	**Cold fluids**
H-13.01	Oceans, seas and lakes less than 50 deg. F
H-14	**Open flame**
H-14.01	Heaters with fire tube
H-14.02	Direct fired furnaces
H-14.03	Flares
H-15	**Electricity**
H-15.01	Voltage 50 to 440 V in cables
H-15.02	Voltage 50 to 440 V in equipment
H-15.03	Voltage >440 V
H-15.04	Lightning discharge
H-15.05	Electrostatic energy
H-16	**Electromagnetic radiation**
H-16.01	Ultraviolet radiation
H-16.02	Infra-red radiation
H-16.03	Microwaves
H-16.04	Lasers
H-16.05	E/M radiation ; high voltage ac cables
H-16.06	X-Ray
H-17	**Ionising radiation - open source**
H-17.01	Alpha, beta - open source
H-17.02	Gamma rays - open source
H-17.03	Neutron - open source
H-17.04	Naturally occurring ionising radiation
H-18	**Ionising radiation - closed source**
H-18.01	Alpha, beta - closed source
H-18.02	Gamma rays - closed source
H-18.03	Neutron - closed source
H-19	**Asphyxiates**
H-19.01	Insufficient oxygen atmospheres
H-19.02	Excessive CO_2
H-19.03	Drowning
H-19.04	Excessive N_2
H-19.05	Halon
H-19.06	Smoke
H-20	**Toxic gas**
H-20.01	H_2S
H-20.02	Exhaust fumes
H-20.03	SO_2
H-20.04	Benzene
H-20.05	Chlorine
H-20.06	Welding fumes
H-20.07	Tobacco smoke
H-20.08	CFCs
H-21	**Toxic liquid**
H-21.01	Mercury
H-21.02	PCBs
H-21.03	Biocide
H-21.04	Methanol
H-21.05	Brines
H-21.06	Glycols
H-21.07	Degreasers
H-21.08	Isocyanates
H-21.09	Sulphanol
H-21.10	Amines
H-21.11	Corrosion inhibitors
H-21.12	Scale inhibitors
H-21.13	Liquid mud additives
H-21.14	Odorant additives
H-21.15	Alcohol-containing beverages
H-21.16	Recreational drugs
H-21.17	Used engine oils
H-21.18	Carbon tetrachloride
H-21.19	Grey and/or Black Water

Ref.	Hazard Description
H-22	**Toxic solid**
H-22.01	Asbestos
H-22.02	Man-made mineral fibre
H-22.03	Cement dust
H-22.04	Sodium hypochlorite
H-22.05	Powdered mud additives
H-22.06	Sulphur dust
H-22.07	Pig trash
H-22.08	Oil-based muds
H-22.09	Pseudo-oil-based muds
H-22.10	Water-based muds
H-22.11	Cement slurries
H-22.12	Dusts
H-22.13	Cadmium compounds and other heavy metals
H-22.14	Oil based sludges
H-23	**Corrosive substances**
H-23.01	Hydrofluoric acid
H-23.02	Hydrochloric acid
H-23.03	Sulphuric acid
H-23.04	Caustic soda
H-24	**Biological Hazards**
H-24.01	Poisonous plants
H-24.02	Large animals
H-24.03	Small animals
H-24.04	Food-borne bacteria
H-24.05	Water-borne bacteria
H-24.06	Parasitic insects
H-24.07	Disease transmitting insects
H-24.08	Cold and Flu Virus
H-24.09	Human Immune deficiency Virus
H-24.10	Other Communicable Diseases
H-25	**Ergonomic hazards**
H-25.01	Manual materials handling
H-25.02	Damaging noise
H-25.03	Loud steady noise > 85 dBA
H-25.04	Heat stress
H-25.05	Cold stress
H-25.06	High humidity
H-25.07	Vibration
H-25.08	Workstations
H-25.09	Lighting
H-25.10	Incompatible hand controls
H-25.11	Awkward location of workplaces and machinery
H-25.12	Mismatch of work to physical abilities
H-25.13	Mismatch of work to cognitive abilities
H-25.14	Long and irregular working hours/shifts
H-25.15	Poor organisation and job design
H-25.16	Work planning issues
H-25.17	Indoor climate
H-26	**Psychological hazards**
H-26.01	Living on the job/away from family
H-26.02	Working and living on a live plant
H-26.03	Post traumatic stress
H-27	**Security related Hazards**
H-27.01	Piracy
H-27.02	Assault
H-27.03	Sabotage
H-27.04	Crisis
H-27.05	Theft, pilferage
H-28	**Use of Natural Resources**
H-28.01	Land
H-28.02	Water
H-28.03	Air
H-28.04	Trees, vegetation
H-28.05	Gravel
H-29	**Medical**
H-29.01	Medical unfitness
H-29.02	Motion sickness
H-30	**Structural Integrity**
H-30.01	Loss of Stability

Annex E
Risk Matrix

Figure E.1 : Risk Matrix

(Gulf of Mexico Major Hazards and Risk Policy, UPS-US-SW-GOM-HSE-DOC-00439-2)

				Continuous Activities		Possible, but not known to have occurred in the E&P industry	Has not occurred in the E&P industry	Has not occurred in the E&P industry in the last 10 years	Occurs once in 100 facility lifetimes	Occurs once in 10 facility lifetimes	Possibility of occurring in the facility lifetime	Possibility of repeated events in the facility lifetime	Common occurrence at this facility
				Project Activity of "short" duration		Possible, but not known to have occurred in the E&P industry	Has not occurred in the E&P industry	0.001% chance of occurring during a project	0.01% chance of occurring during a project	0.1% chance of occurring during a project	1% chance of occurring during project	10% chance of occurring during project	Occurs once, or more, during the project
						($<10^{-6}$ / yr)	(10^{-6} to 10^{-5} / yr)	(10^{-5} to 10^{-4} / yr)	(10^{-4} to 10^{-3} / yr)	(10^{-3} to 10^{-2} / yr)	(10^{-2} to 10^{-1} / yr)	(10^{-1} to 1 / yr)	> 1 / yr
Health and Safety	**Health and Safety - 3rd Parties**	**Environmental Impact**	**Financial Loss**	**Reputation**	**Severity Level**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
>200 acute or chronic (actual or alleged) fatalities	>50 acute or chronic (actual or alleged) fatalities	>100,000 bbls of oil in sensitive coastal waters; >1,000,000 bbls of oil in other coastal waters. Prolonged regional/global contamination	>$10 billion	Global outrage, global brand damage and/or affecting international legislation.	A	MEDIUM							
>50 acute or chronic (actual or alleged) fatalities)	>10 acute or chronic (actual or alleged) fatalities	>10,000 bbls of oil in sensitive coastal waters. >100,000 bbls of oil in other coastal waters. Short term damage at regional level. Prolonged contamination affecting extensive nature conservation	$1-10 billion	International media coverage. Regional outrage, for example North America, Europe. Regional brand damage. Likely to lead to change of regulations at regional level.	B	MEDIUM	MEDIUM						
>10 acute or chronic (actual or alleged) fatalities)	1 or more acute or chronic (actual or alleged) fatalities. Multiple permanent injuries or irreversible health effects	>10,000 bbls Oil, >1,000 bbls oil in sensitive area, >100 Te of classified material. Long Term damage affecting extensive area.	$100 million - $1 billion	Regional media coverage or severe national outrage. Threat of, or loss of license to operate for affected business/site. Likely to lead to change of regulations an National level.	C	CRR	MEDIUM	MEDIUM					
1 or more acute or chronic (actual or alleged) fatalities. Multiple permanent injuries or irreversible health effects.	Permanent injury or irreversible health effect affecting single person. Non permanent injuries or short term health effects affecting multiple people	Uncontained release of reportable quantity (e.g. >100 bbls oil, less if in sensitive location or >10 Te classified material). Extensive short term pollution/contamination. Prolonged pollution/contamination affecting limited area.	$10 to $100 million	National media attention or sever local outrage. Prosecution by regulator.	D	CRR	CRR	MEDIUM	MEDIUM				
One or more permanent / disabling injuries	One or more serious injuries requiring medical care beyond first response.	Release offsite with immediate remediation or onsite release with prolonged damage.	$1 to $10 million	State media coverage	E	CRR	CRR	CRR	MEDIUM	MEDIUM			
One or more loss time injuries	One or more minor injuries.	Onsite release that is remediated immediately	$100,000 to $1 million	Local media coverage	F	CRR	CRR	CRR	CRR	MEDIUM	MEDIUM		
One or more first aid injuries	No offsite impacts	Contained onsite release.	<$100,000	No community notification	G	CRR	CRR	CRR	CRR	CRR	MEDIUM	MEDIUM	