HOW DOES SHELL ASSESS AND MANAGE RISK?

OESI Risk Management Forum

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VP HSE Deepwater Operations
Shell’s Risk Management Efforts Are Based on Our Hazards and Effects Management Process

HEMP

**Identify**
- What are the Hazards?
- What if it happens?
- How to recover?

**Assess**
- What could happen?
- How serious will it be?
- How likely is it?

**Control**
- Is there a better way?
- How likely is it?

**Recover**
- How to prevent it?
- How to recover?
- What if it happens?

<table>
<thead>
<tr>
<th>Identify</th>
<th>What hazards are present? Are people, the environment, Shell’s reputation, or assets exposed to these hazards?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assess</td>
<td>Can the hazard be eliminated or minimized? What are the threats that can release the hazard? What are the credible scenarios and how likely are they? What are the potential consequences? What is the potential likelihood of the hazardous event? What is the risk?</td>
</tr>
<tr>
<td>Control</td>
<td>How are the hazards and their risks managed? What are the controls and barriers? How effective are the barriers and controls?</td>
</tr>
<tr>
<td>Recover</td>
<td>When a hazard is released, what are the recovery measures in place? How can the consequences be mitigated or minimized?</td>
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</tbody>
</table>
We Use “Bow-Ties” for Developing Control Barriers and Recovery Measures

**Risk Management Responses**

- **Prevention:**
  - keep within control limit
  - reduce likelihood

- **Mitigation:**
  - mitigate consequences
  - plan for recovery/re-instate
WE MAKE SURE WE HAVE THE RIGHT HARDWARE AND ACTIVITIES TO SUPPORT OUR BARRIERS

Examples of the Right Hardware
- Process Containment – Wellhead equipment, pressure vessels, relief systems, etc.
- Shutdown Systems – Emergency shutdown system, Pipeline isolation valves, etc.

Examples of the Right Activities
- Conducting emergency evacuation drills
- Testing pressure relief valves
- Develop a Job Safety Analysis (JSA)
- Lock Out/Tag Out on electrical equipment
Having the Right Safety Culture is Key ….

“Personal Commitment and Collective Care”

“Our House”

Golden Rules
Comply
Intervene
Respect

Commit
Act
Care

“Personal Responsibility”

Know my role
Know the barriers
Keep them healthy
Prove it

Goal Zero is a Mindset
MANAGING RISK IN SHELL

To sum it up...

MANAGING RISK

“Personal Commitment and Collective Care”

Goal Zero is a Mindset

Remedial Action Plan

Asset Integrity

Design Integrity

Technical Integrity

Operating Integrity

Hazard Identification & Assessment

Safety Critical Equipment

Safety Critical tasks

Identify Gaps / Improvement Opportunities

Risk Management Responses

Top Event

Prevention:
- keep within control limit
- reduce likelihood

Mitigation:
- mitigate consequences
- plan for recovery/re-instate

Control Measures

Recovery Measures

Consequence

Hardware

Software

Process

Safety Critical Elements:

- Integrity
- Design
- Management

“Goal Zero is a Mindset”

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Goal Zero
<table>
<thead>
<tr>
<th>Safety Critical Elements</th>
<th>Detection System</th>
<th>Pressure Containment</th>
<th>Shutdown Systems</th>
<th>Structural Integrity</th>
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</thead>
<tbody>
<tr>
<td>DS001 Fire and Gas Detection</td>
<td>PC001 Pressure Vessels</td>
<td>SD001 Emergency Shutdown System</td>
<td>Subsea/Vessel Hull/GBS/Foundation Structures</td>
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<tr>
<td>DS002 Security Systems</td>
<td>PC002 Heat Exchangers</td>
<td>SD002 Depressurisation System</td>
<td>Topsides/Surface Structures</td>
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<tr>
<td>DS003 Measurement</td>
<td>PC003 Rotating Equipment</td>
<td>SD003 High Integrity Protection Systems (HIPPS)</td>
<td>Heavy Lift Cranes &amp; Mechanical Handling equipment</td>
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<tr>
<td><strong>Emergency Response</strong></td>
<td><strong>PC004 Tanks</strong></td>
<td><strong>SD004 Operational Well Isolation Valves</strong></td>
<td><strong>Ballast and Cargo Management Systems</strong></td>
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<tr>
<td>ER001 Temporary Refuge / Primary Muster Areas</td>
<td>PC005 Piping Systems</td>
<td>SD005 Pipe Line Isolation Valves</td>
<td><strong>Road vehicles</strong></td>
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<tr>
<td>ER002 Escape and Evacuation Routes</td>
<td>PC006 Pipelines</td>
<td>SD006 Process Emergency Shutdown Valves (ESDVs)</td>
<td><strong>Mooring Systems</strong></td>
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<tr>
<td>ER003 Emergency / Escape Lighting</td>
<td>PC007 Relief System</td>
<td>SD007 Subsea Isolation Valves (SSIVs)</td>
<td><strong>Drilling Systems</strong></td>
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<td>ER004 Communication Systems</td>
<td>PC008 Operational Well Containment</td>
<td>SD008 Drilling and well intervention Well Control Equipment</td>
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<td>ER005 Uninterruptible Power Supply (UPS)</td>
<td>PC009 Fired Heaters</td>
<td><strong>Structural Integrity</strong></td>
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<td>ER006 Helicopter Facilities</td>
<td>PC10 Gas Tight Floor/Walls</td>
<td>S1001 Subsea/Vessel Hull/GBS/Foundation Structures</td>
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<td>ER007 Emergency Power</td>
<td>PC11 Tanker Loading Systems</td>
<td>S1002 Topsides/Surface Structures</td>
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<td>ER010 Open Hazardous Drains System</td>
<td>PC12 Helicopter Refuelling Equipment</td>
<td>S1003 Heavy Lift Cranes &amp; Mechanical Handling equipment</td>
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<td>ER011 Open Non-Hazardous Drains System</td>
<td>PC13 Wellhead and tree equipment</td>
<td>S1004 Ballast and Cargo Management Systems</td>
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<td><strong>Ignition Control</strong></td>
<td><strong>PS001 Deluge Systems</strong></td>
<td><strong>S1005 Road vehicles</strong></td>
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<td>IC001 Hazardous Area Ventilation</td>
<td>PS002 Fire &amp; Explosion Protection</td>
<td>S1006 Mooring Systems</td>
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<td>IC002 Non-Hazardous Area Ventilation</td>
<td>PS004 Fireater Pumps</td>
<td>S1008 Drilling Systems</td>
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<td>IC003 Certified Electrical Equipment</td>
<td>PS005 Fireater Ring Main</td>
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<td>IC004 Cargo Tanks Inert Gas System</td>
<td>PS006 Passive Fire Protection</td>
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<td>IC005 Earth Bonding</td>
<td>PS007 Gaseous Fire Protection System</td>
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<td>IC006 Fuel Gas Purge System</td>
<td>PS008 Fine Water Spray System</td>
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<td>IC007 Chemical Tanks Inert Gas Blanket System</td>
<td>PS009 Sprinkler System</td>
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<td>IC008 Miscellaneous Ignition Control Components</td>
<td>PS010 Power Management System</td>
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<td>IC009 Flare Tip Ignition System</td>
<td>PS011 Fixed Foam System</td>
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<td><strong>Life Saving</strong></td>
<td><strong>PS012 Sand Filters</strong></td>
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<td>LS001 Personal Survival Equipment (PSE)</td>
<td>PS013 Chemical Injection Systems</td>
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<td>LS002 Rescue Facilities</td>
<td>PS014 Navigation Aids</td>
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<td>LS003 Lifeboats / TEMSPSCs</td>
<td>PS015 Collision Avoidance Systems</td>
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<td>LS004 Tertiary Means of Escape</td>
<td>PS016 Metocean Data Gathering Systems</td>
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RESTRICTED
Barrier

A Risk Control or a Recovery Measure. Barriers provide the means of preventing an Event or Incident, or of mitigating the Consequences. A Barrier can be an item of equipment or a human intervention, and can also be a Control on an Escalation Factor.

Control

In the context of Managing Risk, a type of Barrier that is a means of preventing an Incident, and therefore is located on the left hand side of a Bow-Tie. Controls can be engineering, procedural or behavioural. (see also Recovery Measure)

Recovery Measure

A Barrier that reduces the Consequences of the release of a Hazard as a result of an Incident, and therefore is located on the right hand side of a Bow-Tie. Recovery Measures can be engineering, procedural or behavioural measures.

Escalation Factor

A situation, condition or circumstance that may lead to the partial or full failure of a Barrier.
HSSE Critical Equipment

An item of equipment or structure, or a system (including software logic), that acts as a barrier to prevent the uncontrolled release of a Hazardous Substance or release of energy leading to worst case credible scenario with RAM red, yellow 5A or yellow 5B Risk, or acts as a barrier to control or mitigate the effects of such a release. HSSE critical equipment is also known as Safety Critical Equipment or SCE.

HSSE Critical Activity

An activity necessary for the development, implementation or maintenance of a Barrier established for managing Hazards with RAM red Risks (and yellow 5A and 5B Risks for AIPSM Management Application Manual. HSSE Critical Activities comprise (in the context of Competence) Front Line Operational HSSE Critical Activities and Planning/Supervisory HSSE Critical Activities.