CANADA-NEWFOUNDLAND & LABRADOR
C-NLOPB
OFFSHORE PETROLEUM BOARD

Risk Assessments

David Randell, Risk Management Lead
Spill Response and Lessons Learned Forum
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Presentation Overview

1. Opening Remarks
2. A More Risk Based Approach
3. Severity Rankings
4. Case Study: Shell Glider Field Subsea Jumper Leak
5. Closing Remarks

Opening Remarks

The following items were included in the October 2019 letter from the C-NLOPB CEO to Operators (current and new entrants) in response to the recent multiple significant incidents that have occurred:

1. Ensure appropriate attention is also being given to addressing weak signals and alarms, fugitive emissions, and medium to low risks; and

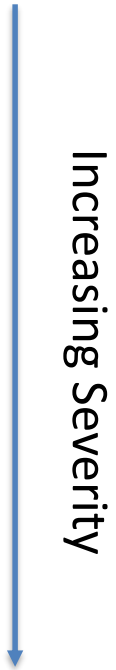
2. Ensure appropriate quality and thoroughness of risk assessments that inform planning and operational decision making.

A More Risk-Based Approach

- Additional analysis and trending of incident data.
- Assessing our current approach to audits and inspections to ensure we are targeting risks to the highest degree possible.
- Incorporating Synergi Life into many of our processes.

Severity Rankings

Environment	Facility Damage/Threat
Spill < 1 L Pollution <100 L	Minor damage or loss of function requiring repair but transient impact on operations.
Tier 1 Oil Spill Response 1 L < Volume < 159 L Pollution >100 L No Impact on VCs	Minor damage or loss of function requiring repair or replacement of equipment. Disruption to production/drilling (< 1 shift).
Tier 2 Oil Spill Response 159L < Vol < 159,000 L Pollution >100 L Impact on VCs	Significant damage or loss of function requiring repair or replacement of major equipment. Temporary suspension of production/drilling (1 shift to 5 days).
Tier 2→3 Spill Volume > 159,000 L [Maximum Volume Limited by Facility] Pollution >100 L Serious impact on VCs	Significant damage or loss of function requiring repair or replacement of multiple systems. Suspension of production/drilling for significant period (5 days to 30 days).
Tier 3 Spill Volume >159,000 L [Maximum Volume Limited by Reservoir] Pollution >100 L Significant Impact on VCs	Loss of facility function > 30 days.



Severity Rankings – Husky Spill

Environment	Facility Damage/Threat
Spill < 1 L Pollution <100 L	Minor damage or loss of function requiring repair but transient impact on operations.
Tier 1 Oil Spill Response 1 L < Volume < 159 L Pollution >100 L No Impact on VCs	Minor damage or loss of function requiring repair or replacement of equipment. Disruption to production/drilling (< 1 shift).
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Increasing Severity

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Severity Rankings – Hibernia Spill 1

Environment	Facility Damage/Threat
Spill < 1 L Pollution <100 L	Minor damage or loss of function requiring repair but transient impact on operations.
Tier 1 Oil Spill Response 1 L < Volume < 159 L Pollution >100 L No Impact on VCs	Minor damage or loss of function requiring repair or replacement of equipment. Disruption to production/drilling (< 1 shift).
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Tier 3 Spill Volume >159,000 L [Maximum Volume Limited by Reservoir] Pollution >100 L Significant Impact on VCs	Loss of facility function > 30 days.

Increasing Severity

Severity Rankings – Hibernia Spill 2

Environment	Facility Damage/Threat
Spill < 1 L Pollution <100 L	Minor damage or loss of function requiring repair but transient impact on operations.
Tier 1 Oil Spill Response 1 L < Volume < 159 L Pollution >100 L No Impact on VCs	Minor damage or loss of function requiring repair or replacement of equipment. Disruption to production/drilling (< 1 shift).
Tier 2 Oil Spill Response 159L < Vol < 159,000 L Pollution >100 L Impact on VCs	Significant damage or loss of function requiring repair or replacement of major equipment. Temporary suspension of production/drilling (1 shift to 5 days).
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Tier 3 Spill Volume >159,000 L [Maximum Volume Limited by Reservoir] Pollution >100 L Significant Impact on VCs	Loss of facility function > 30 days.

Increasing Severity

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Rankings Based on Recent Incidents

- The purpose of the proceeding slides was not to try and establish any hard rule sets.
- There may be other influences.
- Risk should not be thought of as static but evolving.

Case Study: Shell Glider Field Subsea Jumper Leak Background (www.bsee.gov)

- Located in the US Gulf of Mexico.
- Glider Field is connect back to the Brutus TLP.
- Operator at the time was Shell Offshore Inc.
- On May 8th, 2016, Dayshift Control Room Operators (CROs) notified the Nightshift CROs of continued slugging issues.
- At 23:11 on May 11th, 2016, multiple Glider pressure sensing devices detected a pressure drop and a large acoustical abnormality. Multiple system alarms were triggered (for operator use only).

Case Study: Shell Glider Field Subsea Jumper Leak Background

- Based on recent experience, the CROs believed the issues to be caused by slugging.
- The CROs continued to trouble shooting based on slugging issues until approximately 05:00 on May 12th.
- At this time, the CROs began to suspect the possibility of a mechanical integrity failure within the Topsides equipment.
- No abnormal conditions were identified.
- Shift handover.

Case Study: Shell Glider Field Subsea Jumper Leak Background

- At 06:23, the CROs began verifying the integrity of the Glider subsea systems.
- Starting at 06:37 and continuing until 08:52, the CROs performed a controlled shut in of the Glider subsea field.
- At approximately 07:30, a crew change helicopter was diverted to search for signs of an oil sheen.
- At 07:46, the CROs suspected mechanical integrity issues subsea since they were unable to reduce the system pressure below hydrostatic pressure.

Case Study: Shell Glider Field Subsea Jumper Leak Background

- At 07:55, the helicopter confirmed the presence of an oil sheen.
- Glider field shutdown was completed at 08:52.
- At 11:00, the entire Brutus TLP and remaining subsea fields were shut in.
- At 11:35, the US Bureau of Safety and Environmental Enforcement (BSEE) was contacted.
- On the evening of May 12th, the Operator enacted their ROV inspection procedure.

Case Study: Shell Glider Field Subsea Jumper Leak Background

- Just after midnight, on May 13th, a crack was located on the Glider Subsea Well (SSW) #4 jumper.

- The estimated volume oil released associated with this leak was 1926 bbl (or approximately 306 m^3).

- On May 15th, the Glider #4 jumper was recovered.

Case Study: Shell Glider Field Subsea Jumper Leak Recovery

- The sheen was described as 2 miles x 13 miles (or approximately 67 km^2).
- Recovery commenced the evening of May 12th.
- On May 16th, no recoverable oil could be found.
- The decision was made to stand down the Unified Command.
- Skimming vessels recovered 842 bbl (or approximately 134 m^3) of oil/water emulsion.

Case Study: Shell Glider Field Subsea Jumper Leak Investigation

- The BSEE investigation report was issued on March 9th, 2018.
- Failure analysis concluded that the failure was due to a ductile tensile overload fracture of the Load Limiting Joint (LLJ).
- The LLJ is an engineered weak section in the jumper so that the it fails in a known way if overstressed. (e.g., MODU dragged anchor scenario).

Case Study: Shell Glider Field Subsea Jumper Leak Investigation

- Investigation concluded that the failure was caused by the partial burial of the jumper.
- Partial burial due to the deposit of drill cuttings and excess cement during the drilling of nearby wells.
- Introduced additional stress and restrained movement in the Glider #4 jumper were not accounted for in the jumper's design.
- Failure triggered by thermal expansion bringing the well back into service.

Case Study: Shell Glider Field Subsea Jumper Leak Investigation

- Operator was aware as early as February 2014.

- Investigation report indicated that the Operator's response to the spill was in compliance with their response plan.

Case Study: Shell Glider Field Subsea Jumper Leak Risk Assessment

- The Operator performed a “burial risk assessment”.
- However, they failed to consider issues associated with the LLJ.
- LLJ drawings were not shown on the drawings used in the risk assessment.
- The risk assessment did not consider structural integrity as a potential risk.
- This was noted in the BSEE investigation report conclusions.

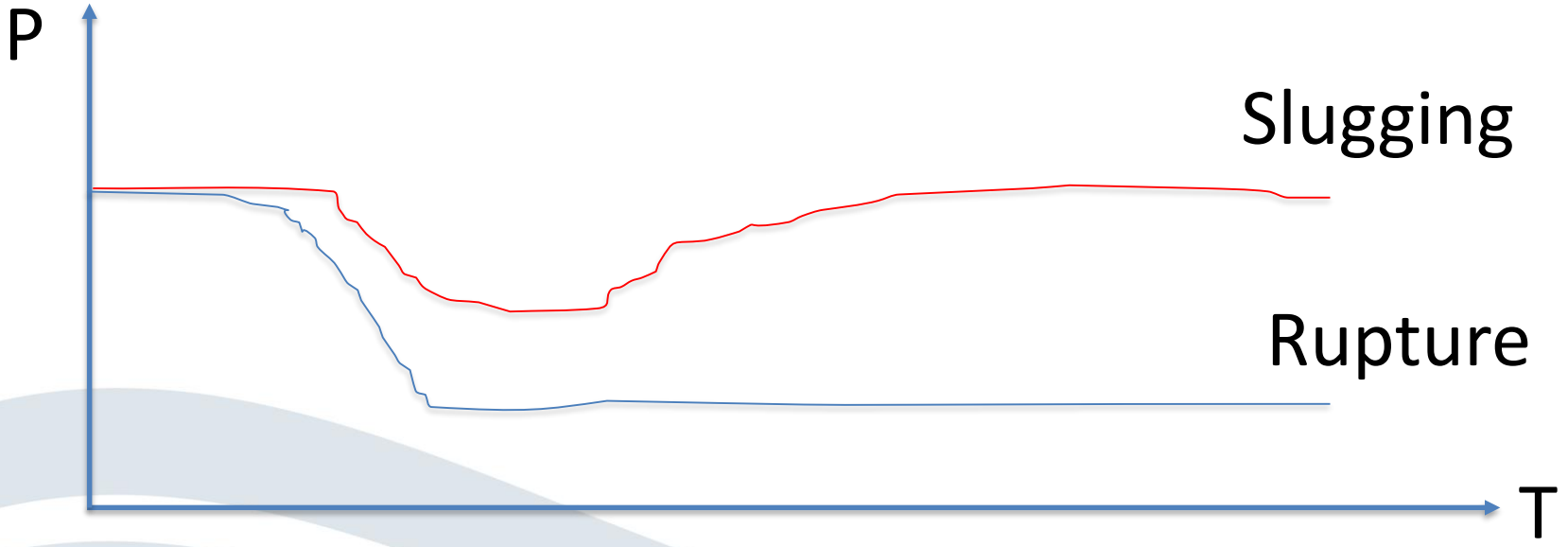
Case Study: Shell Glider Field Subsea Jumper Leak Discussion

- LLJ has a similar function to the weak links used in the White Rose and Terra Nova fields.

- Changing conditions.

Case Study: Shell Glider Field Subsea Jumper Leak Discussion

- Slugging vs. Line Rupture



Case Study: Shell Glider Field Subsea Jumper Leak Discussion

- The CROs assumption that they were experiencing slugging and not a system rupture was incorrect.
- Lack of training/awareness to abnormal conditions.
- Identified a need for improved simulator training.

Case Study: Shell Glider Field Subsea Jumper Leak Discussion

- Attention and focus from environment protection groups, as well as other interested parties (e.g., fishing).

Closing Remarks

- Hindsight is 20/20.
- Ensure appropriate attention is being given to addressing weak signals and alarms, and medium to low risks; and
- Ensure appropriate quality and thoroughness of risk assessments that inform planning and operational decision making.
- We all have a role to play in the journey towards industry continual improvement.

Questions