ALARP Demonstration
for existing offshore facilities- Case study of Panna Riser

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ATA-Process

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AGENDA

- What is ALARP?
- When the risk is ALARPed
- ALARP determining Process
- Barriers and ALARP
- How to demonstrate ALARP- Case study for Panna pipeline
- Conclusion
- Q &A
WHAT IS ALARP?

Can we eliminate all Hazards and risks in oil and gas industry?

NO

What we can do to Manage risks?

- Where reasonably practicable, eliminate hazards or substitute hazards that have lower risk.
- Identify and implement controls and recovery measures for hazards to reduce the risk to ALARP.

ALARP is short form of “As Low as Reasonably Practicable”

ALARP is in context of Risk, **Risk is reduced to As Law as Reasonably Practicable**

**OISD Rule-21; Risk Reduction: sub rule (1): Risk to human, assets and the environment should be reduced to as low as reasonably practical (ALARP) levels.**
WHAT IS ALARP? CONTINUE

- Concept of what is reasonably practicable was first considered by the court of appeal in the UK in the case of Edward vs National Coal Board in 1949.

- UK Health and Safety at Work act (1974) includes the general duties on all employers to reduce risk so far as is Reasonably Practicable.

- The concept of reasonably practicability recognises that absolute safety can not be guaranteed in some circumstances, and permits the duty holder a defense in law of choosing not to adopt certain risk reduction measures.

OISD Sub-rule (5): For risk acceptance criteria, established industry guidelines like those of HSE, UK should be followed.
An upper bound above which risks are deemed to be unacceptable and, save in exceptional circumstances, must either be reduced, whatever the cost.

A range between the upper and lower bounds which risks are regarded as being tolerable provided that they have been reduced to levels that are as low as reasonably practicable.

A lower bound below which risks are regarded as being broadly acceptable and therefore requiring no significant action to effect further reduction.
## Heat Map

<table>
<thead>
<tr>
<th>SEVERITY</th>
<th>CONSEQUENCES</th>
<th>INCREASING LIKELIHOOD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PEOPLE</td>
<td>ASSETS</td>
</tr>
<tr>
<td>0</td>
<td>No injury or health effect</td>
<td>No Damage</td>
</tr>
<tr>
<td>1</td>
<td>Slight injury or health effect</td>
<td>Slight Damage</td>
</tr>
<tr>
<td>2</td>
<td>Minor injury or health effect</td>
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</tr>
<tr>
<td>3</td>
<td>Major injury or health effect</td>
<td>Moderate Damage</td>
</tr>
<tr>
<td>4</td>
<td>PTD or upto 3 fatalities</td>
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WHEN THE RISK IS ALARP?

‘The point at which the cost (in time, money and effort) of further Risk reduction is grossly disproportionate to the Risk reduction achieved’.

Example: To spend $1 Mn to prevent five staff suffering bruised knee is obviously grossly disproportionate but

To spend $1 Mn to prevent major explosion capable of killing 150 people is obviously proportionate
HOW TO DEMONSTRATE ALARP

Pre- Requisites

• Compliance to local legal requirements to be met
• Good practices must have been applied
• Risk must be in Tolerable criteria (with in Company defined IRPA values)
HOW TO DEMONSTRATE ALARP

GUIDING STATEMENTS

➢ The decision making process to get to ALARP is not a mathematical one. At the end it depends on subject matter expertise and professional judgment.

➢ ALARP decision making should be defendable.

➢ Where implementation of ALARP is a legal requirement (e.g. in UK), it is not just about numbers and complicated risk models. It is about demonstrating that the cost and effort (time and trouble) of further risk reduction is grossly disproportionate to the risk reduction achieved.

➢ ALARP decision making is applicable through the whole life cycle of an asset from concept to operate phase

➢ ALARP solutions are dynamic, they change over time with changes in societal expectations; technology advances, availability and cost.

➢ ALARP requires documentation of identified risk reduction opportunities through various safety studies, and appropriate review and closure.

➢ When balancing cost, judgment should be on what is practicable and not what is affordable
ALARP DETERMINING PROCESS

Step 1: Identify hazard, threats and hazard release scenarios

Step 2: Assess risks of the scenarios

Step 3: Identify options to eliminate or substitute hazard

Step 4: Select decision type

Type A decision

Type B decision

Type C decision

Type A decision

Step 5: Select barriers to reduce risks to ALARP using authoritative Good Practice

Step 6: Review proposed solutions for cumulative risk

Step 7: Document as per Appendix 1

Step 8: Implement barriers, monitor and improve

Type B decision

Step 5: Select barriers to reduce risks to ALARP using Good Practice + analysis

Type C decision

Step 5: Select barriers to reduce risks to ALARP using Good Practice + consultation with stakeholders
ALARP DECISION PROCESS

Means of Calibration
- Codes and Standards
- Verification
- Peer Review
- Benchmarking
- Internal Stakeholder Consultation
- External Stakeholder Consultation

Significance to Decision Making Process

Decision Context Type
- Nothing new or unusual
  - Well understood risks
  - Established practice
  - No major stakeholder implications
- Lifecycle implications
  - Some risk trade-offs or transfers
  - Some uncertainty or deviation from standard or best practice
  - Significant economic implications
- Very novel or challenging
  - Strong stakeholder views and perceptions
  - Significant risk trade-offs or risk transfer
  - Large uncertainties
  - Perceived lowering of safety standards

Codes & Standards
- Good Practice
- Engineering Judgement
- Risk Based Analysis e.g. QRA, CBA
- Company Values
- Societal Values
 Barrier is a common term for threat control, recovery measures, and escalation factor control.

Barrier can be a hardware such as PSV or a procedure such as Lock out procedure.

**Diagram:**
- Hazard
  - Top Event
    - Threat 3
    - Threat 2
    - Threat 1
  - Barrier (Threat Control)
  - Barrier (Recovery Measure)
    - Consequence 1
    - Consequence 2
    - Consequence 3

**HSE Critical Tasks**
- Engineering
- Maintenance
- Operations
For barrier to be valid and considered in ALARP it should be:

- Effective
- Verifiable
- Independent

For well understood risks, risk is reduced to ALARP when all barriers are established by authoritative good practice are implemented and effective.

For novel or less understood risk, good practice is insufficient to establish number of barriers and detailed analysis and consultation with stakeholder is required.

Number of barrier needed to reduce the risk to ALARP depends upon level of risk.
ALARP DEMONSTRATION- CASE STUDY- PANNA WELLFLUID PIPELINE/RISER
CASE STUDY-
PANNA WELLFLUID PIPELINE/RISER

Phase: Operate phase- Existing facility

Problem: There is no Sub Sea Isolation Valve (SSIV) for incoming well fluid pipeline at Panna process facility PPA to isolate inventory in case of leak in riser (splash zone).

How do you demonstrate you’ve managed the risks to ALARP?.

Pre-requisites
Is it a Legal requirement?: NO

Are good practices applied?: YES (e.g. API standards followed, ESDV available on topside, Pipeline designed as per standards

Risk in tolerable region?: YES (based on Panna complex QRA study)
Identify the Hazard: Loss of containment from well fluid risers outboard of SDV (long inventory of pipeline)

Consequences:
- Toxic gas (H2S) exposure to people
- Radiation exposure to people due to fire
- Explosion impact to people VCE

Threats:
- Internal/External corrosion
- Dropped object
- Vessel impact to riser
- Flange leak
- External fire

Credible threats:
- Riser leak due to external corrosion- in splash zone
- Fire impingement from near-by risers
- Internal corrosion in subsea pipeline
- Vessel impact on riser guard

*Note: For operating facilities this is already available in safety case document*
CASE STUDY: STEP 2

Undertake an assessment of the risks to help you do option selection and choose the ALARP decision type.

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Risk is $5 \times B$
CASE STUDY: STEP 3

Apply Inherent Safety principles – eliminate the hazard, substitute a lower risk hazard for a higher one, minimize the magnitude of the hazard and/or its consequences.

Options-Example

1. Install SSIV in existing pipeline
2. Install additional SDV on top of riser.
3. Install Passive Fire Protection
4. Provide new Temporary refuge (TR) to manage consequence to people working in platform

*Note: Being an operating platform inherent safety options are limited*
CASE STUDY: STEP 3

Carry out cost benefit analysis of options;

- Cost of implementing the option is estimated (cost of SSIV/Shutdown cost etc.)

- Benefit of implementing the option is estimated by calculating the loss/damage from an escalated event in case the modification is not implemented.

  \[
  \text{Benefit} = \text{Remaining asset life} \times \text{Cost of escalation} \times \text{Escalation Frequency (per year)}
  \]

- Net cost of the risk reduction measure is calculated as the difference between the cost of the Option and the benefit from it.

- \textbf{Cost per averted fatality} = \frac{\text{Net cost}}{\text{Averted fatalities}}

- Cost per life criteria assumed to be \(\approx 23\) million GBP (as per UK HSE guideline)

Cost Benefit Analysis (CBA) may be used, with a factor that is appropriate to the burden of proof of disproportion. For example, if IRPA for a worker is near the threshold of 1x10-3, a risk reduction measure would have to cost more than \(10x\) the risk cost of accepting the consequences to be considered grossly disproportionate.
Since it's an operating facility, opportunity of applying inherent safety principles is lost unless huge cost, time and efforts are put. The option of SSIV is grossly disproportionate.

You now need to select the decision type to guide you on the work required to demonstrate that the barriers you put in place are suitable to manage the hazard.
**WORKED EXAMPLE:**

**STEP 4 (CONT…)**

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**In favour of SSIV?**

<table>
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<th>Codes and Standards</th>
<th>Yes/No</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Codes and Standards do not indicate a decision either way, but refer to engineering judgement and risk based analysis (BG standard).</td>
<td>Yes</td>
<td>A or B</td>
</tr>
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</table>

<table>
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<tr>
<th>Current Practice</th>
<th>No</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current offshore practice varies - it is not common to install SSIV on wellfluid pipelines. There are known examples in Indian Offshore where low pressure well fluid pipelines have NOT been provided SSIV</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Engineering Judgment</th>
<th>Yes/No</th>
<th>B</th>
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</thead>
<tbody>
<tr>
<td>The SSIV provide an additional barrier to the inventory in the pipeline/ Riser, the base case should be to install the SSIV based on the significant reduction in inventory they offer even though the event frequency and impact on consequence is not large. Issues with testing of SSIV and managing it.</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk Based Analysis</th>
<th>No</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>The installation of SSIV reduces the risk due to releases upstream of the riser ESDVs. The QRA work indicates that the benefit is small due both to the low frequency of these events, hence no change to the immediate effects of such a release.</td>
<td>No</td>
<td></td>
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</table>

<table>
<thead>
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<th>Company Values</th>
<th>No</th>
<th>B</th>
</tr>
</thead>
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<tr>
<td>The internal company guidelines - most notably the standard requires SSIV to be installed if the facility safety case requires this. For Panna this is not the case.</td>
<td>No</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Societal Values</th>
<th>N/A</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Society is unlikely to have or hold definite view unless aftermath of any escalation event</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>

**Decision type: Type B** as this is departure from standard good practices and lessons learned in industry.
WORKED EXAMPLE: STEP 6

Determine all the required barriers - Bow Tie analysis to be used along with other analysis such as consequence assessment - Dispersion, FERA, EMERA, QRA etc.

**Comparison IRPA & PLL (Without SSIV) Vs (With SSIV)**

<table>
<thead>
<tr>
<th>CASES</th>
<th>IRPA</th>
<th>PLL</th>
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</thead>
<tbody>
<tr>
<td>WITHOUT SSIV</td>
<td>1.17E-04</td>
<td>1.59E-02</td>
</tr>
<tr>
<td>WITH SSIV</td>
<td>1.14E-04</td>
<td>1.54E-02</td>
</tr>
<tr>
<td>RISK REDUCTION</td>
<td>3.00E-06</td>
<td>5.00E-04</td>
</tr>
</tbody>
</table>

**IRPA**

H2S disperses (40 ppm) after 16 m
Look at the overall hazard management strategy. Use **barrier model** to see other anomalies which can affect the barrier. E.g. any safety system bypassed, any thickness reductions?
To provide transparency on decision making, document the process followed including inputs and your final solution. In this case you complete an “ALARP Decision Sheet/or ALARP document” and place it in the Safety case.
CASE STUDY: STEP 8

- Monitor barriers in operate phase for its integrity. Carry out Annual barrier verification by third party

- Implement any additional risk reduction measure as part of ALARP
CONCLUSION

- ALARP demonstration is the key Technical Safety activity in offshore industry as hazard can not be removed

- ALARP decision making is applicable through the whole life cycle of an asset from concept to operate phase

- During design phase follow Inherent safety principles i.e. Eliminate or substitute hazard

- For well understood risks in standard situations, the application of applicable codes and standards together with Good Practice will normally be sufficient to demonstrate ALARP

- For operating facilities (late life assets) maintaining barrier is the key focus as implementing any major modification may be grossly disproportionate

- ALARP demonstration forms a central part of safety case
THANK YOU

Q & A