Using Risk Analysis Tools for Early Project Decision Support

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Risk Management
Lloyd’s Register Celerity3

Mary Kay O’Connor Process Safety Center Symposium
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Introduction

• What is HSE Decision Support for?

• Why use HSE Decision Support?
Introduction

• What is HSE Decision Support for?
  ➢ Location of facility or working conditions
  ➢ Proximity to what else?
  ➢ process facility/equipment layout
  ➢ protection mechanism
  ➢ Reliability in varied conditions

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  ➢ Proximity to what else?
  ➢ process facility/equipment layout
  ➢ protection mechanism
  ➢ Reliability in varied conditions

• Why use HSE Decision Support?
  ➢ Corporate framework
  ➢ Justification of investment
  ➢ Regulators or third party demonstration and justification
  ➢ Legal liability, Insurance
## Design Life Cycle

### DESIGN LIFE CYCLE

<table>
<thead>
<tr>
<th></th>
<th>Feasibility</th>
<th>Concept</th>
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# Design Life Cycle

The Design Life Cycle involves various stages and activities that are crucial for the development of a project. Here is a breakdown of the key activities and responsibilities:

## Design Life Cycle Stages

<table>
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Quantifying critical elements
## Design Life Cycle

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- Quantitative tools for specific critical elements
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### Quantifying critical elements

- **Concept**
  - Quantitative tools for specific critical elements

### Confirming HSE Decisions and validation

- **Detailed**
  - Confirming HSE Decisions and validation

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Lloyd’s Register Celerity3
Feasibility Stage HSE Decision Support Tools

Information Gathering

- What information did you have available to you?
- What did you do with this information?
- Did you have some process to make your decisions?
- Did you document your information and decisions?
- Did the decisions seem reasonable given the information available when put through the process?

“Test of reasonableness” – Do you pass this?
Feasibility Stage HSE Decision Support Tools

**Document Information**
- Document the information
- Identifies uncertainties with information
- Follows a “Best Practice” process
- The process includes interaction and iterations with the project personnel or clients and/or regulators
- Not to demand decisions of the client but ensure issues, uncertainties and regulations are known and understood

The project (or client) can choose to outright comply or risk manage with full knowledge of the implications.
Feasibility Stage HSE Decision Support Tools

Risk Assessment Process

*No standardized process or approved approach, there remains wide latitude for how risk assessments can be approached and conducted.*

- Project Risk Criteria (defined in terms of safety, environmental and operational risk)
- Hazard Register or Log
- Ranking and Prioritization of Critical Elements
- Performance Standards matched to each critical element
## Feasibility Stage HSE Decision Support Tools

### Project Risk Criteria

#### Primary Drivers (Example)
- Community / Society / Third Party Impacts
- Financial or Business Impacts
- Environmental Impacts
- Technical Impacts
- Political or Government

#### Objectives (Example)
- Operability
- Reliability
- Project Schedule
- Compliance
- Construction/Transit
- External Factors

Consequences based on objectives
## Feasibility Stage HSE Decision Support Tools

### Project Risk Criteria (with measurable goals) - EXAMPLE

<table>
<thead>
<tr>
<th>Objective</th>
<th>Description</th>
<th>Goal</th>
<th>Consequences Criteria</th>
</tr>
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<tr>
<td>Operability</td>
<td>Lifecycle, or annual production goals</td>
<td>Short, medium or long term operating times</td>
<td>Define a criteria for High, Med, Low Consequences goals for each objective</td>
</tr>
<tr>
<td>Schedule</td>
<td>Project milestones, or first oil or first production</td>
<td>Date-based goals</td>
<td></td>
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<tr>
<td>Compliance</td>
<td>Regulations, Permitting, HSE</td>
<td>Specific regulations goals</td>
<td></td>
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<tr>
<td>Construction / Transit</td>
<td>Specifications based on equipment or parts, delivery</td>
<td>Delivery dates, or performance goals</td>
<td></td>
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<tr>
<td>Performance</td>
<td>Capabilities or Reliability, or Availability, Maintainability</td>
<td>% Production rates, RAM requirements goals</td>
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Feasibility Stage HSE Decision Support Tools

- Likelihood Criteria (example)

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<th>Description</th>
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<tr>
<td>High (H)</td>
<td>Once in 10 or more in industry projects</td>
</tr>
<tr>
<td>Medium (M)</td>
<td>Once in 100 or more in the industry projects or has happened in Company history</td>
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<tr>
<td>Low (L)</td>
<td>Once in 1000 or more in the industry projects</td>
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- A “risk matrix” customized for your project drivers
Feasibility Stage HSE Decision Support Tools

Hazards Gathering / Brainstorming

- A preliminary list of identified issues or events was compiled into an event register based on available project expertise.
- The events were further developed into a potential risk or hazard scenario if deemed necessary.
- Recorded in a Hazards Event Log

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<thead>
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<th>HAZID Source</th>
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<th>Primary Driver</th>
<th>Description of risk</th>
<th>Mitigation</th>
<th>Risk Ranking</th>
<th>Owner</th>
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Feasibility Stage HSE Decision Support Tools

Ranking of Critical Elements

- Risk or hazard scenarios were categorized by identified critical design elements.
- For each of the design elements a listing was made of hazards that may affect this element due primary drivers

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Examples
- Riser System, TR, F&G
- Detection system, Control Room
Feasibility Stage HSE Decision Support Tools

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- Compile all risk scenarios per critical elements

Examples
- Riser System, TR, F&G Detection system, Control Room
Feasibility Stage HSE Decision Support Tools

Performance Standards

- Critical Element
- Role
- Scope
- Primary Driver & hazards description ("why")
- Regulatory Requirements
- Project Specific Requirements
- Dependencies – with other critical elements
- Document References
Feasibility Stage HSE Decision Support Tools

Performance Standards

- Critical Element
- Role
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Validation and continuous improvement is important as the project progresses.
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- **Quantifying critical elements**
- **Quantitative tools for specific critical elements**

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**Lloyd’s Register Celerity3**
Determine hazards

- Develop hazards log by brainstorming or hazards analysis with input from other project personnel to recognize and understand the hazards

Define hazards criteria

- Define quantitative criteria for hazards

Compare hazards

- Develop comparative tables based for

  Hazards vs. various decision options
Concept/Early FEED Stage HSE Decision Support Tools

Comparison tools – (examples)

• Consequence Analysis
  • Decision to have or not have Subsea Isolation on production offshore facilities?
  • Decision on Platform location A vs. B impacted by adjacent platform safety events?

• Risk quantification
  • Decision for location A vs. B distance from hazard based on escape impairment?

• Reliability modeling
  • Proposed “increased” capacity,
  • Proposed higher expected demand of the system.
  • Proposed “new” capacity
  • Comparison of types
Consequence Analysis – Jet fire

- Decision to have or not have Subsea Isolation on production offshore facilities?

For example, for an riser accidental release and ignition on an offshore gas facility forces personnel to shelter to alternate muster area.

The modeled jet fire impinges on primary evacuation route for more than 60 minutes if the SSIV is not there, but with an SSIV, you can reduce the jet fire duration to 10 minutes.

Jet Fire modeling of different possible consequences and durations can help determine if escalation and EER can be achieved.
Concept/Early FEED Stage HSE Decision Support Tools

Consequence Analysis - Dispersion

- Decision on Platform location A vs. B impacted by adjacent platform safety events

For example, sour gas release from adjacent platform HSE impacts based on:

- Dominant wind direction
- Distance between platforms for LFL or toxic distances
- Probit toxic dosage (% fatality per exposure)

*Dispersion and flash fire modeling followed by Probit analysis of sour gas can help determine if escalation to second platform is possible.*
Concept/Early FEED Stage HSE Decision Support Tools

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Final decision based on geo, marine, structural etc and HSE inputs!!!
Quantification of Risk

- Decision on length of bridge between platforms (or siting a building)

For example, if all other risks remain the same, except hydrocarbon release risks, you can add incremental risk based on

- Release scenario locations
- Location of interest
- Distance from scenarios and locations of interest

Assigning “industry best practice” % fatality or escape criteria to consequence analysis can help achieve higher or lower risk of various locations.
Concept/Early FEED Stage HSE Decision Support Tools

Quantification of Risk (contd)

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<tr>
<th>Consequences</th>
<th>Scenario 1 - Escape Impairment Criteria</th>
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<tbody>
<tr>
<td>Distance from Scenario</td>
<td>25 m</td>
</tr>
<tr>
<td>Location A</td>
<td></td>
</tr>
<tr>
<td>Explosion</td>
<td>50%</td>
</tr>
<tr>
<td>Flash Fire</td>
<td>100%</td>
</tr>
<tr>
<td>Jet Fire</td>
<td>100%</td>
</tr>
<tr>
<td>Toxic</td>
<td>100%</td>
</tr>
<tr>
<td>Location B</td>
<td></td>
</tr>
<tr>
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<td>50%</td>
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Less impairment

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## Quantification of Risk (contd)

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<td>25 m</td>
<td>50 m</td>
<td>75 m</td>
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<td>50%</td>
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75m distance from scenario for “A” is about the same as 100m for “B”.

Less impairment

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Concept/Early FEED Stage HSE Decision Support Tools

Reliability Modeling

- Collecting failure data MTBF and MTTR data
- Collecting possible scheduled data
- Inputs from Operations or experienced Project personnel
- Tools to use
  - Reliability Block Modeling
  - Simple – Excel for availability, scheduled downtime events
  - Complex but linear RBD tool software packages

- Typical Results - % Available capacity, % downtime, % reliability, tank storage or hold time
Concept/Early FEED Stage HSE Decision Support Tools

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Leave Monte Carlo RAM simulations for FEED Stage or when assumptions are more established!
HSE Decision Support Tools - Conclusions

Risk Assessment in Early Stage or Feasibility

- No standardized process or approved approach for how risk assessments can be approached and conducted.
- Use standardized Best Practices approach or *justifiable* method.
  -> Risk Criteria development
  -> “Real Time” HAZID Log
  -> Critical Elements
  -> Performance Standards
  -> Re-Evaluation & Confirmation
HSE Decision Support Tools - Conclusions

Risk Assessment in Concept or Early Stage FEED

• Determine Hazards

• Perform hazards analysis
  ➢ Basic Consequence modeling tools
  ➢ Basic Risk quantification tools
  ➢ Reliability tools

• Compare Hazards to different options
HSE Decision Support Tools - Conclusions

Risk Assessment in Concept or Early Stage FEED

- Determine Hazards
- Perform hazards analysis
  - Basic Consequence modeling tools
  - Basic Risk quantification tools
  - Reliability tools
- Compare Hazards to different options

These tools help support project decisions!!!
Ultimate goal of most projects is safe operations with highest quality and smallest cost/schedule.
Questions?