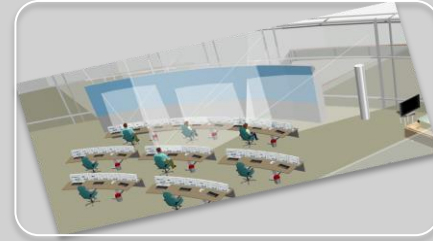


Human and organisational safety barriers in the oil & gas industry

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IFE – Institute for Energy Technology



Nuclear

Petroleum

Others

Human performance, human reliability and organisational factors

Control room design & evaluation – Control room systems

Human System Interfaces

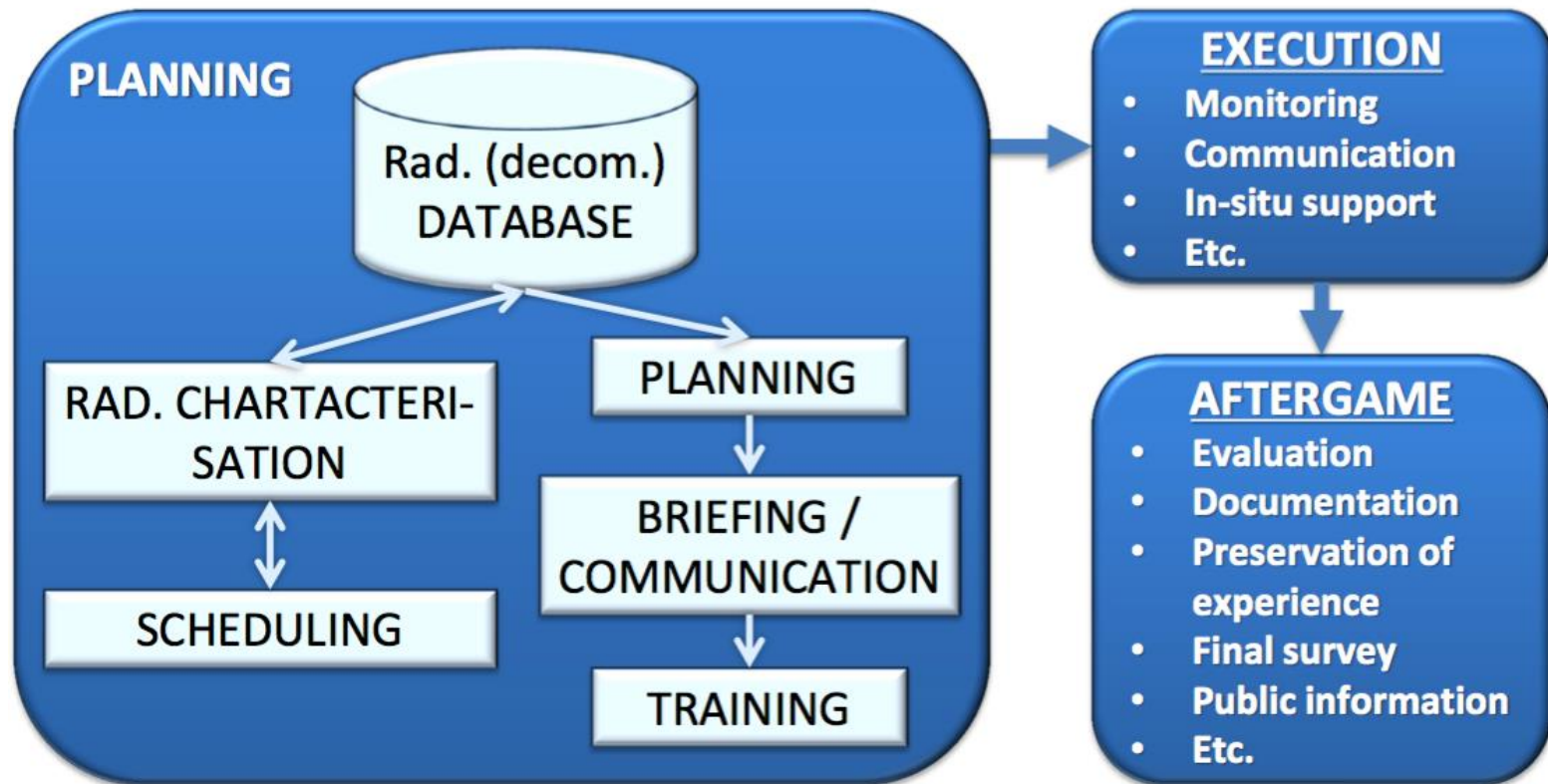
Future operational concepts & Integrated Operations

Virtual and augmented reality applications

Safety critical software

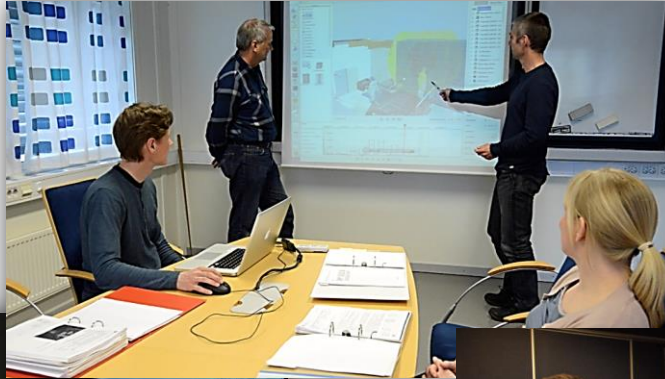


Promoting safety focus in decommissioning



Decom

Planning



Execution



Characterization

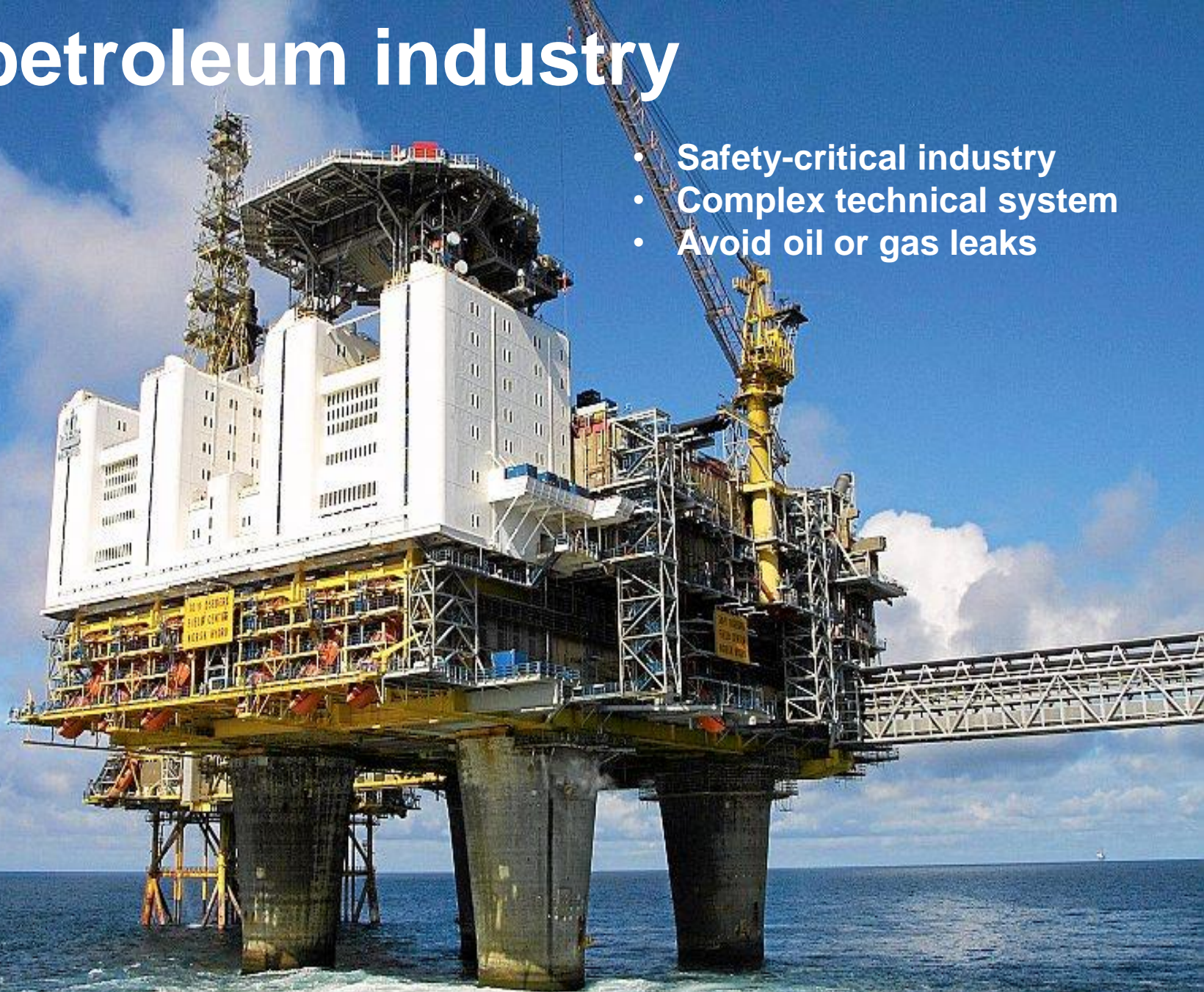


Preparation /
Briefing

Same data and models used throughout all phases

The petroleum industry

- Safety-critical industry
- Complex technical system
- Avoid oil or gas leaks



Major accidents

Definition of major accidents:

"A **sudden event**, such as a large release of hydrocarbons, a fire or explosion that immediately or later leads to several serious **injuries** and / or **loss of human lives**, grave damage to **environment** and / or a large **economic loss**."

Norwegian petroleum safety authority (NPSA)



Piper Alpha, 1988

Events with the largest major accident risk :

- Hydro-carbon leakages (oil, gas, condensate)
- Serious well incidents
- Damage to carrying construction and maritime systems
- Ships on collision course



Aleksander L. Kielland, 1980

Safety barriers

In oil and gas industry:

Safety barriers: technical, operational or organisational elements that individually or collectively are intended to reduce the possibility for a specific error, hazard or accident, or that prevent or reduce negative consequences

In nuclear industry:

*"All safety activities, whether organizational, behavioural or equipment related, are subject to layers of overlapping provisions, so that if a failure should occur it would be compensated for or corrected without causing harm to individuals or the public at large. This idea of multiple levels of protection is the central feature of **defence in depth**..."*

Basic Safety Principles for Nuclear Power Plants (INSAG-3)

Safety barriers: Concepts

- *Barrier function* – the barrier's purpose
- *Barrier elements* – technical or organisational elements that fulfil the barrier function
- *A barrier's performance requirements* – requirements to ensure the barrier's effectiveness, directed towards e.g. the element's capacity, integrity or reliability
- *Performance-influencing factors* – factors that may influence the ability of a barrier to function as intended

The Deepwater Horizon accident



- Mexican Gulf, 2010
- Blowout – entry of high pressure gas into the well
- 11 killed
- 4,9 million barrels of oil leaked to environment

Breach of safety barriers in the build-up to the accident:

- Poor quality of cement plug at the bottom of the well
- Integrity test of the well was misinterpreted
- Inflow of gas into the well not detected
- Safety culture was a performance-influencing factor:
 - "At the time of the Macondo blowout, BP's corporate culture remained one that was embedded in risk-taking and cost-cutting " (DHSG 2011)

Research projects related to human and organisational barriers

- Use of mindful safety practices (Skjerve, 2006)
- Defining requirements for and monitoring organisational safety barriers (Næss et al., 2016)

Use of mindful safety-practices

Humans as safety barriers:

- humans play a role in detecting unwanted events or their precursors, in responding to them and in mitigating their consequences
- Humans have the possibility to detect an incident building up, via alarms or other indicators, and to take actions such as activating safety systems.

Use of mindful safety-practices

Mindful safety practices are safety-promoting work practices intended to prevent or interrupt unwanted events

Mindful safety practices aim to:

- increase employees' sensitivity to potentially dangerous situations related to something other employees are doing, or to potentially dangerous factors in the environment.
- identify the dangers and to warn against those dangers.

Examples of mindful safety practices are:

- warning somebody when you see that a person is in an unsafe situation
- to "take two", i.e. take a break to think through the situation when you are facing a potentially safety-critical condition

Use of mindful safety-practices

- A study using questionnaire data to investigate the use of mindful safety practices at petroleum installations and factors that may impact employees' willingness to use these practices
- The study categorised factors that may influence the employees' willingness to use mindful safety practices into three levels:
 1. the individual level (age, experience, health, perceived ability to deal with safety-related issues)
 2. the group level (managers' safety attitudes, colleagues' use of mindful safety practices, psychological work environment and task performance environment)
 3. organisational level (e.g. perceived risk level, overall work environment, physical work environment)

Use of mindful safety-practices

- Employees' willingness to use mindful safety practices was correlated more strongly with factors on the group level than on the individual or organisational level
 - This suggests that use of the practices is influenced by group norms - having a common view in the group of how things should be done, getting feedback from the group and observing others
- Implications:
 - initiatives to increase employees' willingness to use mindful safety practices should be directed at working groups in their local environment
 - The willingness to use mindful safety practices may change if an employee is transferred to a new work environment, or if changes are introduced in a work environment

Monitoring organisational safety barriers

Identify potential hazard and risk situations

Define barrier functions, barrier elements, and performance requirements

Monitor and follow up the status and performance of barriers

- Safety barriers may deteriorate over time. Important to know their status.
- The performance of barriers should be monitored across the lifetime of the installation

Monitoring organisational safety barriers

- How to monitor the status of organisational barriers?
- Research project:
 - Defined performance requirements for organisational barrier elements to ensure their effectiveness
 - Requirements to competence, criteria for action, response time, manning level, availability
 - Developed method to monitor organisational barriers
 - Defined indicators to measure status of the performance requirements on a strategic, process and operational level.

Monitoring organisational safety barriers

Use of the method:

- A way to proactively monitor parameters that can influence the risk for major accidents in an organisation, by identifying developing weaknesses in the barriers
- May be used to communicate the risk for major accident across organisations or companies
 - Regulators may trend major accident risk over time
- Provide support to management in understanding the status of organisational barriers and implement initiatives to restore barrier function

Summary

- Safety barriers are important tools for preventing or reducing consequences of major accidents in the petroleum industry
- Presented two project from the petroleum industry looking at the use and monitoring of organisational safety barriers
- Relevant for the nuclear industry?

Thank you!

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