



Risk and safety assessment - Good practices for risk assessment for major projects

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.... First briefly about DNV

Integrity at the core



- Independent self-owned foundation established in 1864
- The purpose is to Safeguard Life, Property, and the Environment
- 8500 competent professionals

Core competence

Industry:

- Energy sector – oil & gas, **renewables, CCS**
- Maritime sector – ships, mobile offshore units
- Identify, assess and manage risks during the complete life cycle of assets

Society:

- Technology development and knowledge sharing increase innovation and safety
- Joint industry projects are key to developing reliable guidelines and standards
- Joint industry projects allow industry players and authorities to join forces
- DNV's in-depth knowledge and independent role facilitate this process
- 30-40 such joint industry projects launched each year



DNV's core competence

identify
assess
manage

risk



Outline

- Risk management in the energy sector
 - Performance targets
 - Performance based regulations
 - Standards for HSE management
- How to transfer methodologies for risk and safety assessment to CCS
 - The development of CCS guidelines
 - CO2Qualstore guideline for qualification of CO2 storage sites
- DNV's recommended approach for risk and safety assessment for CCS
 - Performance based regulations in combination with a risk based assessment process
 - Site-specific and risk-based approach for managing geological storage of CO2
 - Assess the risks for each candidate site following the ISO31000 standard

Risk management in the energy sector

- Performance targets
- Performance based regulations
- Standards for HSE management

Risk management in the energy sector

- Risk management enables industry to realise the benefits of new technology in a safe and reliable manner.
- The energy industry has a long history of risk management - they control risks and perform risk assessments on a continual basis
- Methods for risk management differ between industries and types of risk; general financial decisions or environmental, ecological, or public health risk



Project Risk Management Types

Different risk management analysis techniques are applied for different purposes

"Set targets"

Develop project

- Explore
- Appraise
- Choose solution
- Budgets & schedule

"Meet targets"

Execute project

- Manage against cost, time and quality
- Manage interfaces
- Decision gate reviews

"Realise benefits"

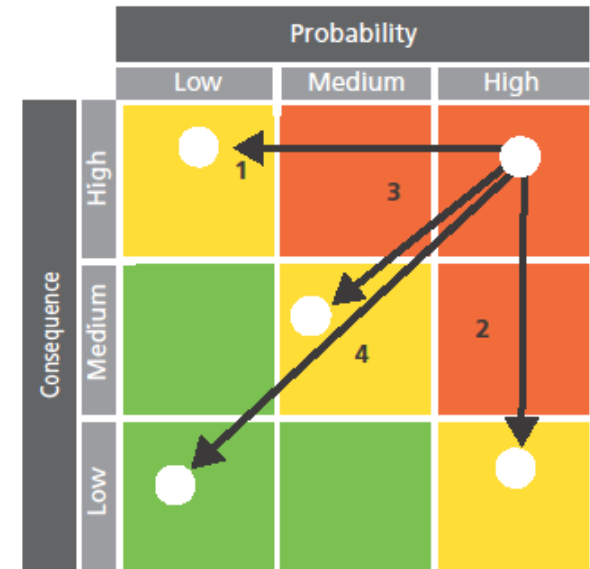
Operate

- **Day-to-day Risk Management.** Risk management activities related to the day-to-day identification, assessment and control of risks. Reporting of HSE, exploration activities, well activities, operations.
- **Stage Gate Reviews.** Risk management activities related to the passing of stage gate reviews and permit applications

Performance based targets

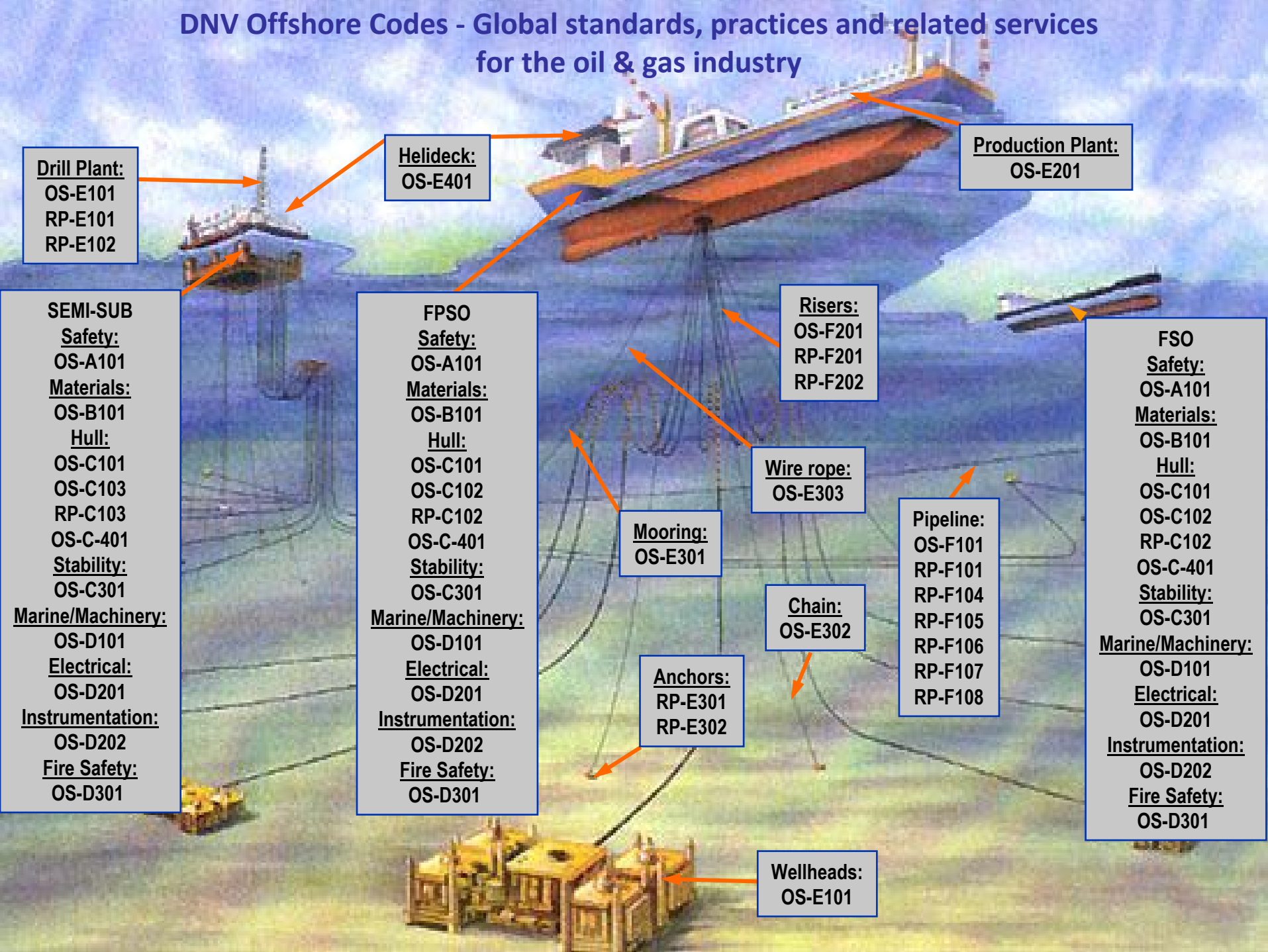
- Performance based vs. prescriptive regimes

- Offshore operations in the North Sea (UK & Norway) are governed by a risk based regime focus on the prevention of major accidents AND the deployment of new, best available technology
- Such a regime relies on setting performance based targets
- These goals provide a more accurate and better framework than would be achieved by industry simply meeting a pre-determined set of detailed legislative requirements
- Offshore risk management relies on an extensive framework of standards and recommended practices...



Performance targets: “A targeted level of risk/uncertainty reduction achieved through implementation of a defined risk/uncertainty reducing measure, or range of such measures, i.e. = required terminal risk level + measures to prevent significant irregularities”

DNV Offshore Codes - Global standards, practices and related services for the oil & gas industry



How to transfer methodologies for risk and safety assessment to CCS

- The development of CCS guidelines
- CO2Qualstore guideline for qualification of CO2 storage sites

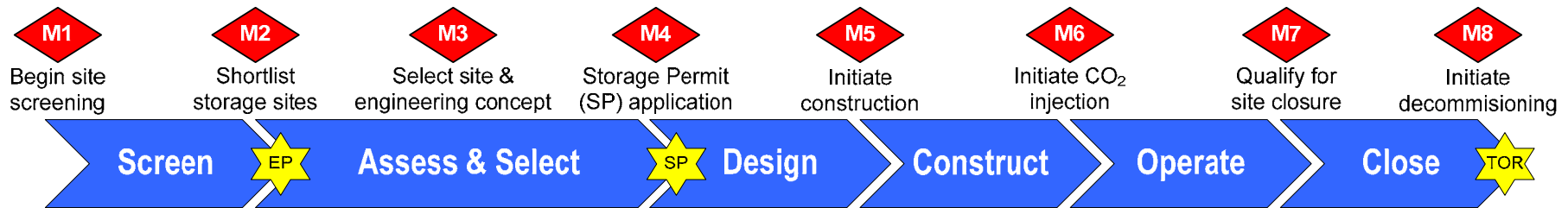
CO2QUALSTORE: a key element in the CCS value chain

- DNV led Joint Industry Projects (JIPs):
 - CO2CAPTURE: Recommended Practice (RP) for Technology Qualification of CO2 Capture Technology;
 - CO2PIPETRANS (I): RP for design and operation of CO₂ pipelines;
 - CO2QUALSTORE: guideline for selection and qualification of CO₂ storage sites;
 - CO2WELLS: guideline for risk management of existing wells and re-qualification for CO₂ injection;
 - CO2PIPETRANS (II): close the knowledge gaps that were identified in phase (I),
- JIPs carried out in collaboration with industry, regulators, international institutions and public enterprises assigned with responsibility for managing CCS



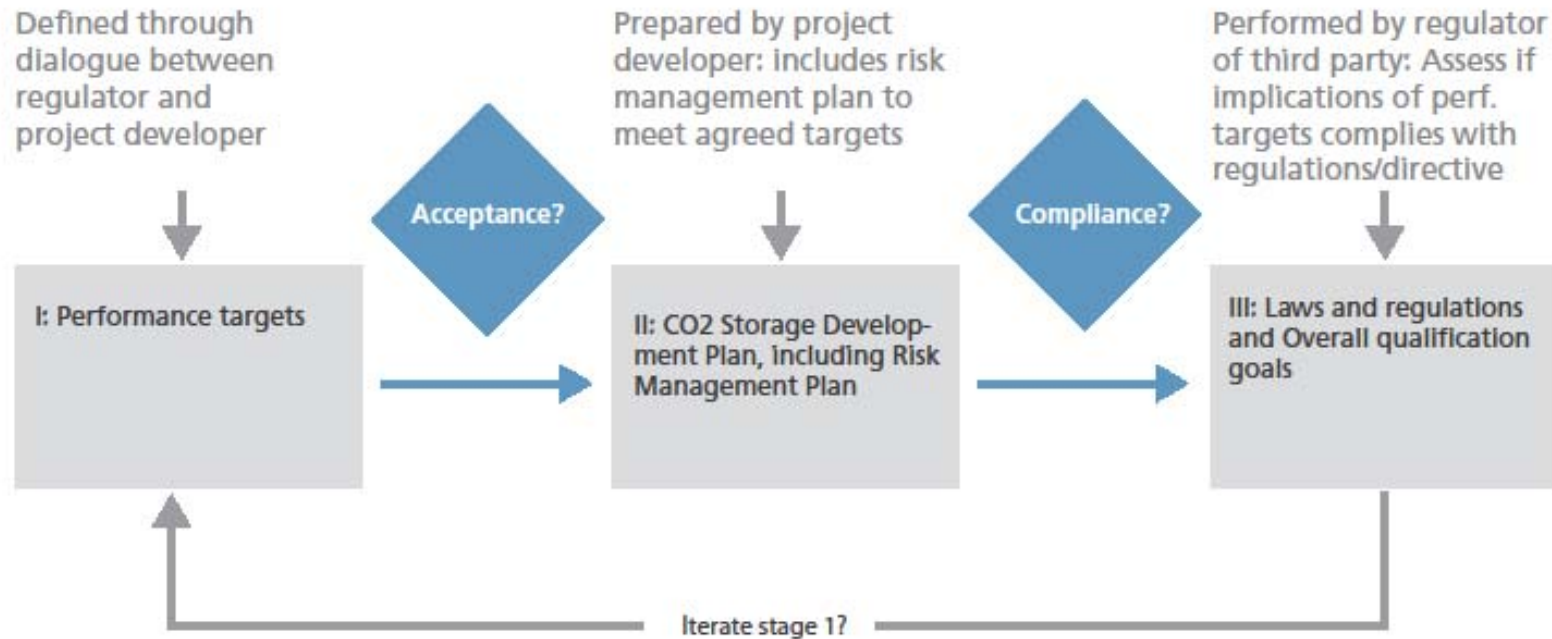
The CO2QUALSTORE guideline:

....mirrors best practices within the O&G industry, existing and emerging regulations, standards and directives relevant for geological storage of CO₂, and learnings from existing CCS projects



- Defines a structured approach for CO₂ storage site selection;
- Provides a tool for managing CCS project development in a responsible way;
- Facilitates definition of criteria and procedures for issuing permits.

A risk-based qualification and management approach facilitates a discussion between regulators and project developers



- The CO2 QUALSTORE guideline describes a methodology for regulators to determine what is acceptable and un-acceptable levels of risk for geological storage sites.
- Risk assessments should be further refined as the site selection process progresses
- The final risk assessment will form the basis of the monitoring and measurement program as well as shape the corrective measures strategy.

Applicability

Provides project developers with

- A transparent basis for decision-making to meet internal milestones and decision gates
- Guide to set performance targets that will enable the granting of relevant permits for individual sites
- Predictable operating conditions



Provides regulators/authorities with:


- Standardized guide to verify that sites have been selected and assessed as suitable for geological storage of CO₂
- Basis for development/implementation of national regulations aligned with industry best practice, directives and other national regulations



DNV's recommended approach for risk and safety assessment for CCS

- Performance based regulations in combination with a risk based assessment process
- Site-specific and risk-based approach for managing geological storage of CO₂
- Assess the risks for each candidate site following the ISO31000 standard

CCS in the CDM



DNV believes that the risks with CCS can be effectively managed within a CDM context by an adaptive risk-based approach

Guidelines and regulatory frameworks have been developed

Validation of geological storage is a feasible objective

Safeguarding life, property and the environment

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MANAGING RISK

ISO 31000 Framework for Risk Management

