SPE Wells Decomissioning conference
WELL DECOMISSIONING 2025

Norwegian regulatory requirements to development, testing and use of new technology, new methodologies and new well barrier materials for P&A

NINA RINGØEN
Drilling & Well technology

Havtil Norwegian Ocean Industry Authority

Norwegian Ocean Industry Authority
HAVTIL or Havindustritilsynet
(in Norwegian)

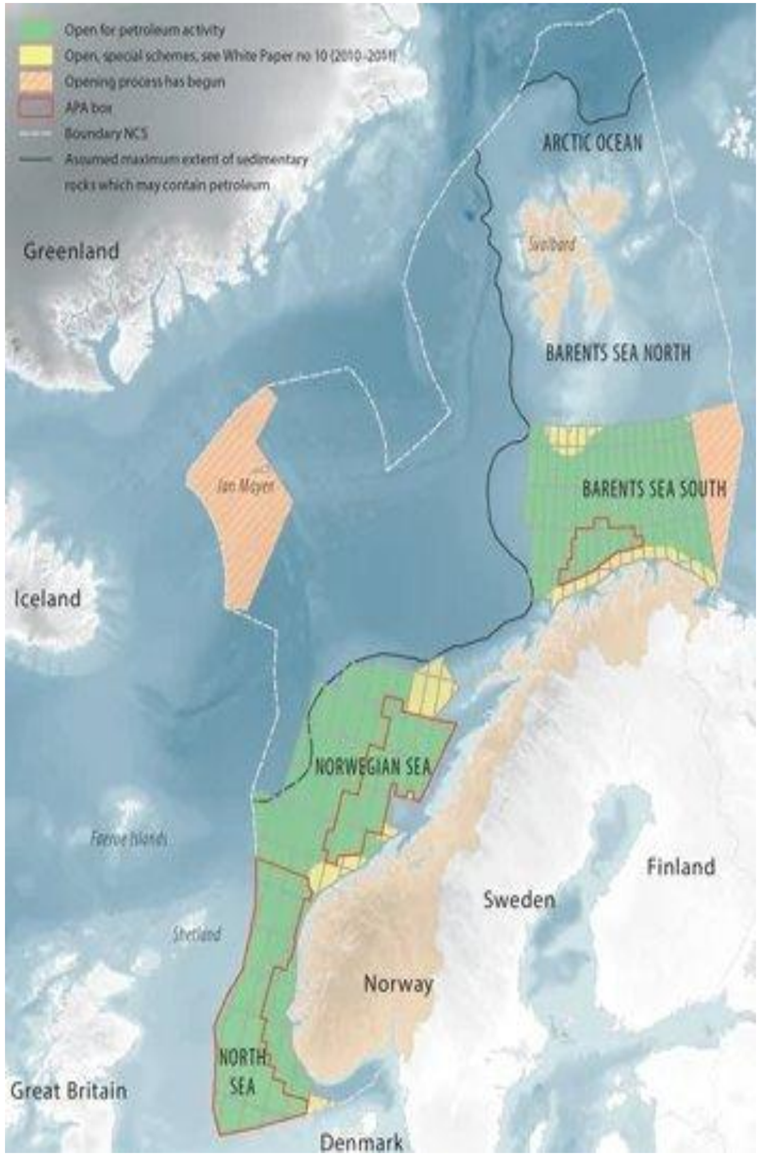
Regulatory responsibility for

- safety,
- working environment,
- emergency preparedness and
- security

in Norway's ocean industry.

Reports to the Ministry of Energy

Areas of responsibility



Petroleum operations – offshore and onshore

- 2218 wells

- 94 fields in production
- 61 fixed facilities
- 42 mobile facilities with AoCs
- 382 subsea facilities
- 25,000 employees offshore
- 18,310 km of pipelines
- 7 land plants

Updated 1 January 2025

New areas of responsibility
Supporting the Parliaments ambitious climate goals and the Energy transition

- **Transport and storage of CO2** (2018)
- **Renewable energy production offshore** (2020)
- **Seabed minerals** (2022)

Havtil Norwegian Ocean Industry Authority

Are we ready?
Outlook from 2025 - 2050

Several fields in production will have a decline in production rate from 2030…

More than 2000 wells expected to be permanent plugged between 2025 – 2050-2070.

Wild Well Control reports an increase in well control incidents related to “suspended wells” globally

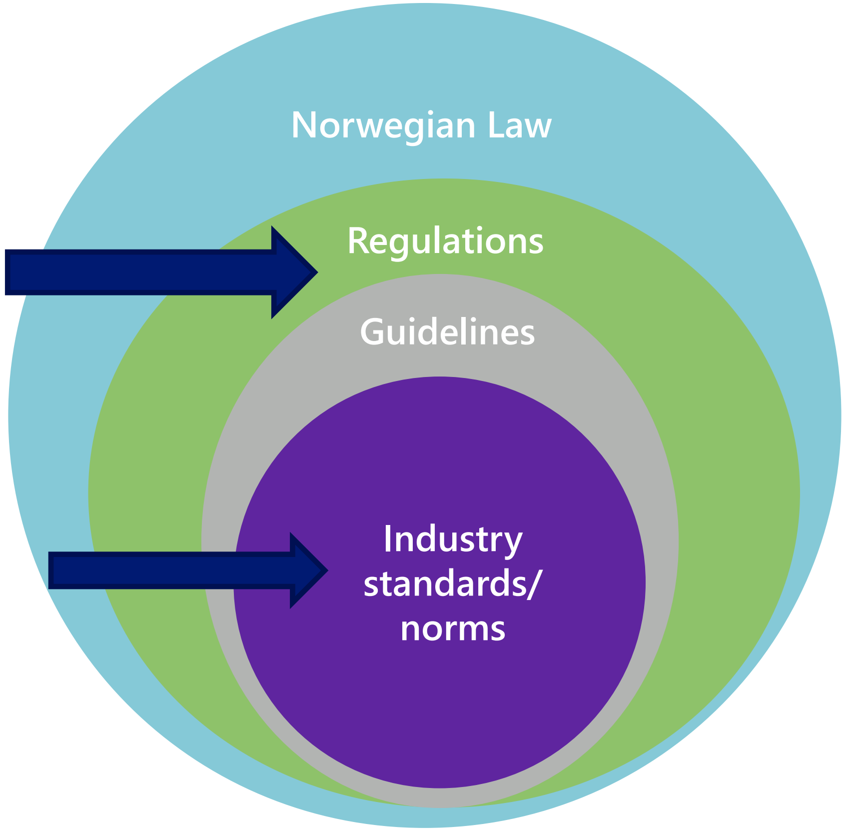
Are WE prepared ?

Innovation, Collaboration and use of new technology

- ❑ Development, testing and use of new technology for permanent plugging is crucial for continuous improvements.
- ❑ Collaboration and sharing of lessons learned can accelerate new innovative solutions and increase continuous improvements.
- ❑ Continuous improvement is one of the key principle in the norwegian HSE-regulations

Norwegian regulations underline the allocation of responsibility

- ❑ Our regulations are mainly **Functional Requirements (Goal setting)**
- ❑ Each company (Operator) is responsible for the safety of its own operations
- ❑ HAVTIL have been given the Authority to develop regulations and thereby contributing through our **Guidance level** to implement approved policies, norms or standards, e.g. NORSOK D-010 Rev. 5/2021



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Facility Regulations § 9

Qualification of new technology and new materials

TRL-process
API 17N

Criteria's shall be drawn up for
- **Development,**
- **Testing and**
- **Use**

Includes investigation and obtaining objective proof that the needs for a specific intended use are covered.

The technology or methods shall be adapted to already accepted solutions
(Verification /best practice)

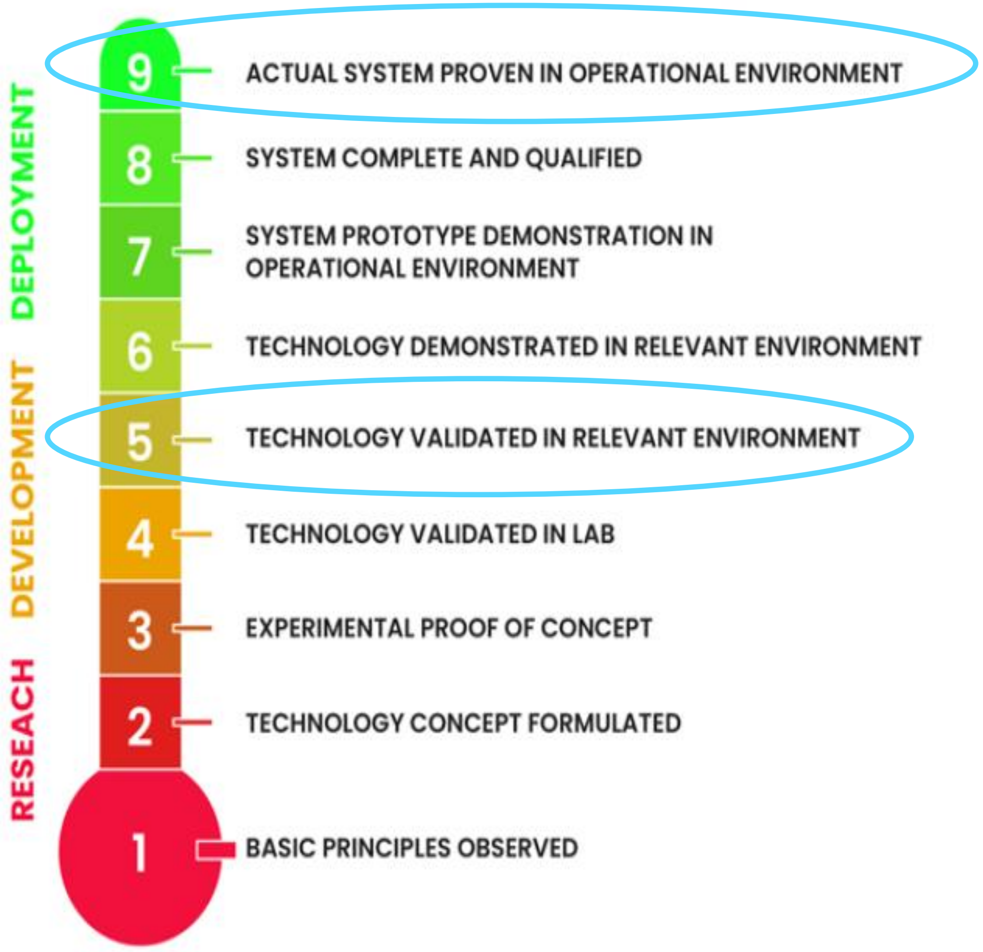
Guidance Level:
DNVGL RP-A203 and Oil & Gas UK Guidelines Use of Barrier Materials in Well Decomissioning Guidelines

New technology as mentioned in the first subsection, may be new products, new materials, analysis tools or known products used in a new way.

The qualification or testing shall demonstrate that applicable requirements can be fulfilled.

Technology Readiness Levels

Technology Readiness Levels (TRL) are a type of measurement system used to assess the maturity level of a particular technology.



Source: https://www.nasa.gov/wp-content/uploads/2023/09/trl.png

Technology Readiness Level definition – API 17N

Technology Readiness Level	Description
TRL 0	Unproven idea/proposal Paper concept. No analysis or testing has been performed
TRL 1	Concept demonstrated. Basic functionality demonstrated by analysis, reference to features shared with existing technology or through testing on individual subcomponents/subsystems. Shall show that the technology is likely to meet specified objectives with additional testing
TRL 2	Concept validated. Concept design or novel features of design validated through model or small scale testing in laboratory environment. Shall show that the technology can meet specified acceptance criteria with additional testing
TRL 3	New technology tested. Prototype built and functionality demonstrated through testing over a limited range of operating conditions. These tests can be done on a scaled version if scalable
TRL 4	Technology qualified for first use. Full-scale prototype built and technology qualified through testing in intended environment, simulated or actual. The new hardware is now ready for first use
TRL 5	Technology integration tested. Full-scale prototype built and integrated into intended operating system with full interface and functionality tests
TRL 6	Technology installed. Full-scale prototype built and integrated into intended operating system with full interface and functionality test program in intended environment. The technology has shown acceptable performance and reliability over a period of time
TRL 7	Proven technology integrated into intended operating system. The technology has successfully operated with acceptable performance and reliability within the predefined criteria

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Roadmap to NORSOK D-010

The vision of NORSOK standards:

- ❑ Focus on establishing well barriers by use of Well Barrier Elements (WBEs),
  - ❑ their acceptance criteria,
  - ❑ their use,
  - ❑ monitoring of integrity during their life cycle.

- ❑ WBEAC tables shall be in place for all Well Barrier Elements used
  - ❑ includes preparing new EAC's for use of new technology.
    - ❑ EAC = Elements Acceptance Table

Table C.61 — EAC Table 61 – Perforate/wash/cement (PWC) cement plug

Features	Acceptance criteria	See
A. Description	This element consists of cement placed in the single annulus between the casing/liner and the borehole wall while also forming a cement plug inside the wellbore by using the Perforate, Wash & Cement technique (PWC). Note: this EAC table does not apply to dual casing PWC operations.	
B. Function	The purpose of the element is to provide a continuous, permanent seal across a perforated interval in the casing annulus and inside a wellbore, to prevent flow of formation fluids between formation zones and/or to surface/seabed.	
C. Design, construction, and selection	1) A programme shall be issued for each PWC operation, covering the following as a minimum: a) foundation requirements in casing and annulus; b) perforation hole size and density, relative to casing/hole sizes; c) parameters for washing perforations, and placement of spacer and cement; d) properties of mud and spacer, relative to formation and cement slurry design. 2) The cement plug shall a) be designed as per EAC Table 24 paragraph C; b) cover the perforations and the logged/verified interval in the annulus; c) extend 50m MD above the top perforation. 3) Planned perforation interval length shall be sufficient to obtain, as a minimum, 30m MD of cement bonding, verified by logging, for the element to act as a single barrier	
D. Initial verification	1) The annulus cement length shall be verified by one of the following: a) Bonding logs: Logging methods/tools shall be selected based on ability to provide data for verification of bonding. The measurements shall provide azimuthal/segmented data. The logs shall be verified by qualified personnel and documented. i) Actual cement length verified by bond logs shall be minimum 30m MD per barrier. b) If the element has previously been qualified for the same casing/borehole geometry, lithology, and fluid system, by drilling out cement and running cement bond logs, and a successful and auditable track record has been established, using a qualification matrix with a documented parameter set is considered sufficient for subsequent wells. i) In the event of losses, or the inability to perform the PWC operation according to the parameter set defined in the	DNV GL RP A203 [59]

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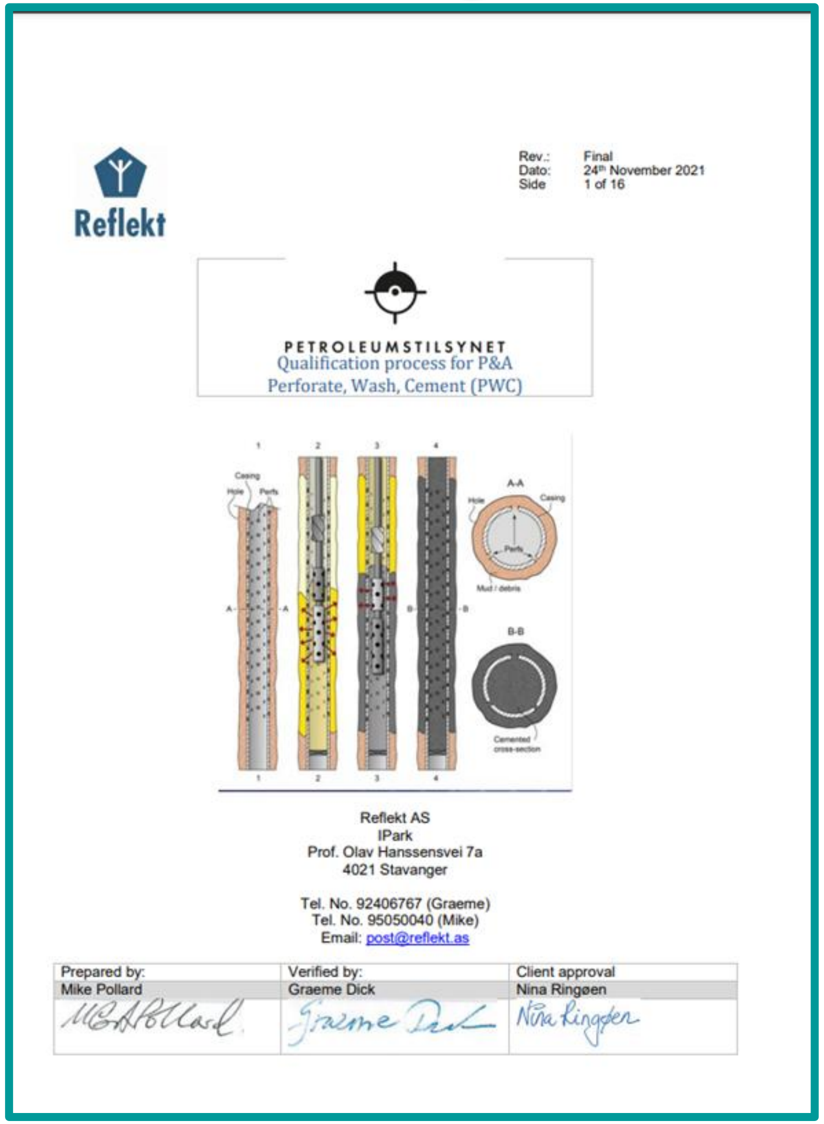
Knowledge Sharing 2021: Perf, Wash and Cement (PWC)



Reflekt

Rev.: Final
Dato: 24th November 2021
Side 1 of 16

PETROLEUMSTILSYNET
Qualification process for P&A
Perforate, Wash, Cement (PWC)

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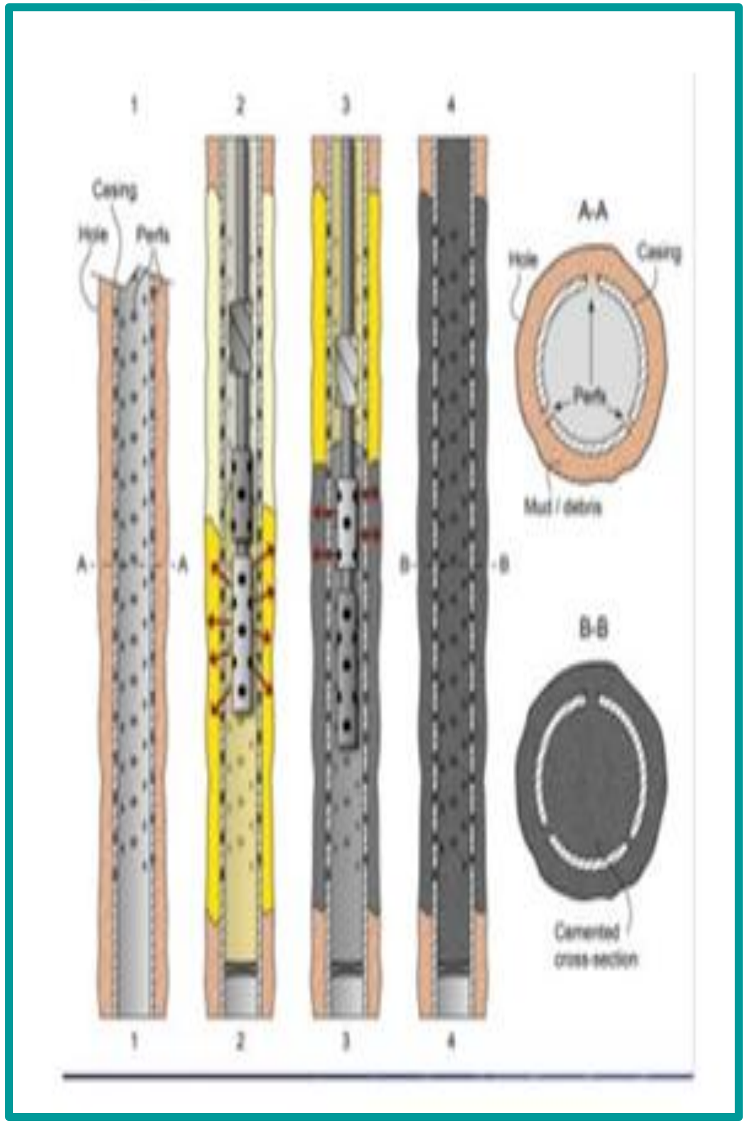

- Builds on experience with emphasis on establishing a **track record, best practice and qualification matrix**
- **Emphasis on limitations of application (risk based)**
  - operator have clearer guidelines as to when to PWC, and when not to PWC (revert to section milling).

Pubslished on www.havtil.no

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Knowledge Sharing 2023: Bismuth alloy

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Dato: 31st October 2023
Side 1 of 19

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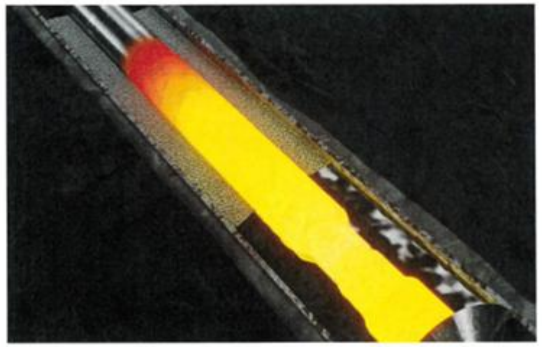
PETROLEUMSTILSYNET

Knowledge acquisition on Bismuth alloy for PP&A applications



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The following companies have provided knowledge and input to this report;

- Aker BP,
- Total Energies,
- BiSn,
- Interwell,
- ISOL8 and
- Wellstrøm.

SWIPA (Subsurface Well Integrity and Plug & Abandonment, a consortium of SINTEF)
NORCE & NTNU.

Publshed on www.havtil.no

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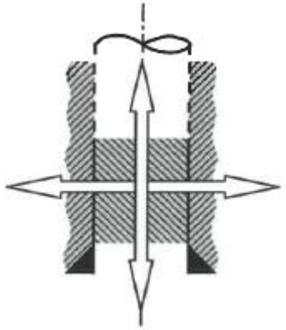
Technology threats Bismuth Alloy



The following threats were discussed as part of the review:

- Long term integrity
- Low Permeability
- Radial shrinkage
- Mechanical loads
- Chemical stability
- Bonding to tubulars
- Effect on tubular integrity

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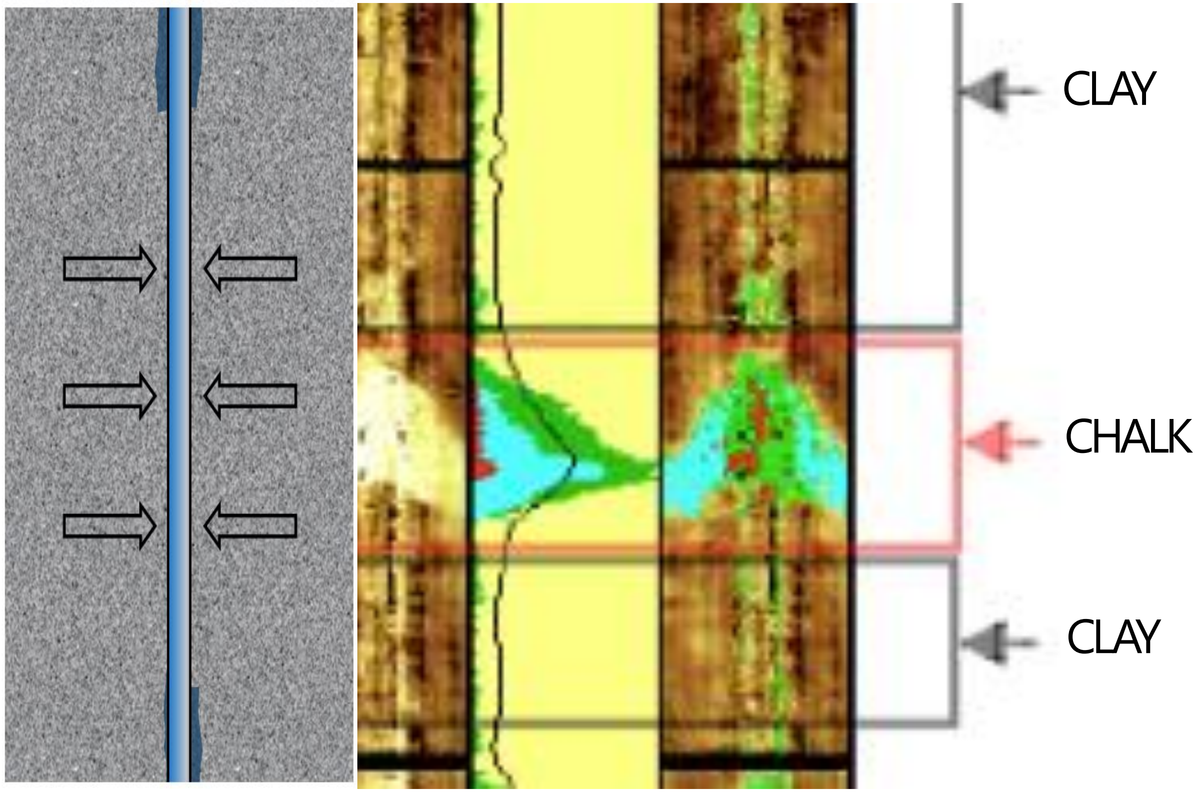
Knowledge sharing 2025: – Creeping Shale /Creeping formation

Our goal:

- ❑ Share knowledge and best practise between operators and also with the Global P&A community

- ❑ Input to the revision of Norsok D-010 EAC table 52 Creeping Formation (Creeping shale)

- ❑ Emphasis on establishing a track record and a qualification matrix for each field / geological layer with respect to qualification



Williams, Carlsen, Constable and Guldahl (2009)

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Collaboration with other authorities and industry partners is key

SPE International
Aberdeen Section

Net Zero Technology Centre

OFFSHORE NORGE

NORWEGIAN OFFSHORE DIRECTORATE

NORCE

Norwegian Environment Agency

Swipa Subsurface Well Integrity Plugging and Abandonment

Energistyrelsen

HSE

North Sea Transition Authority

otm networks
Delivered by sagentia innovation

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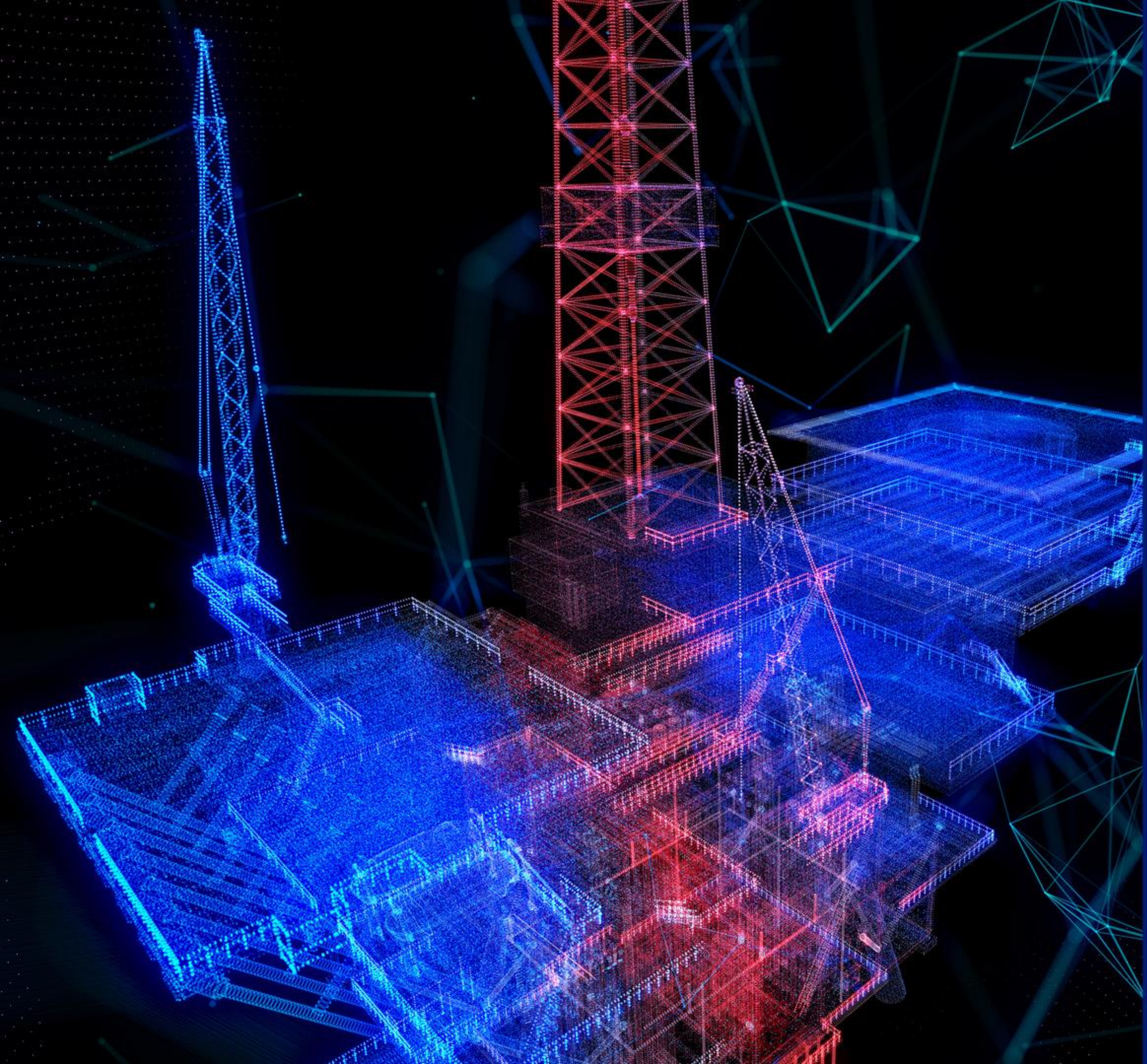

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