Guideline to Subsea Integrity Management

PTIL webinar
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Industry challenges

Ageing subsea assets and tie-in of new fields to existing infrastructure

Information and knowledge transfer to new generations of NCS Engineers

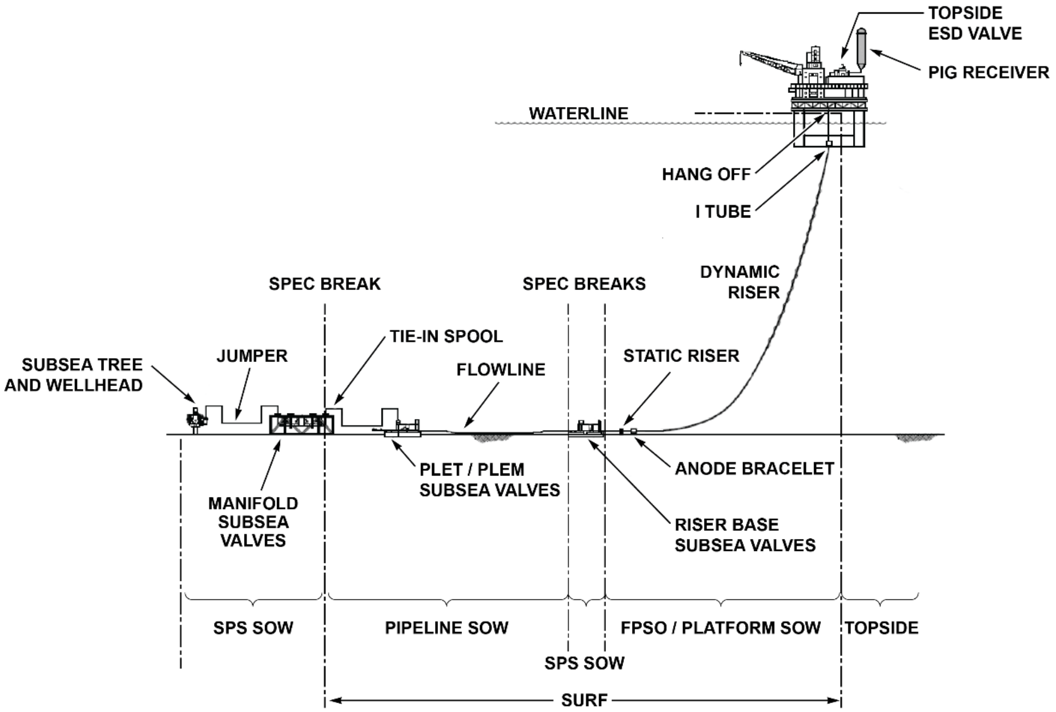
COVID-19 constraint on operations and the supply chain

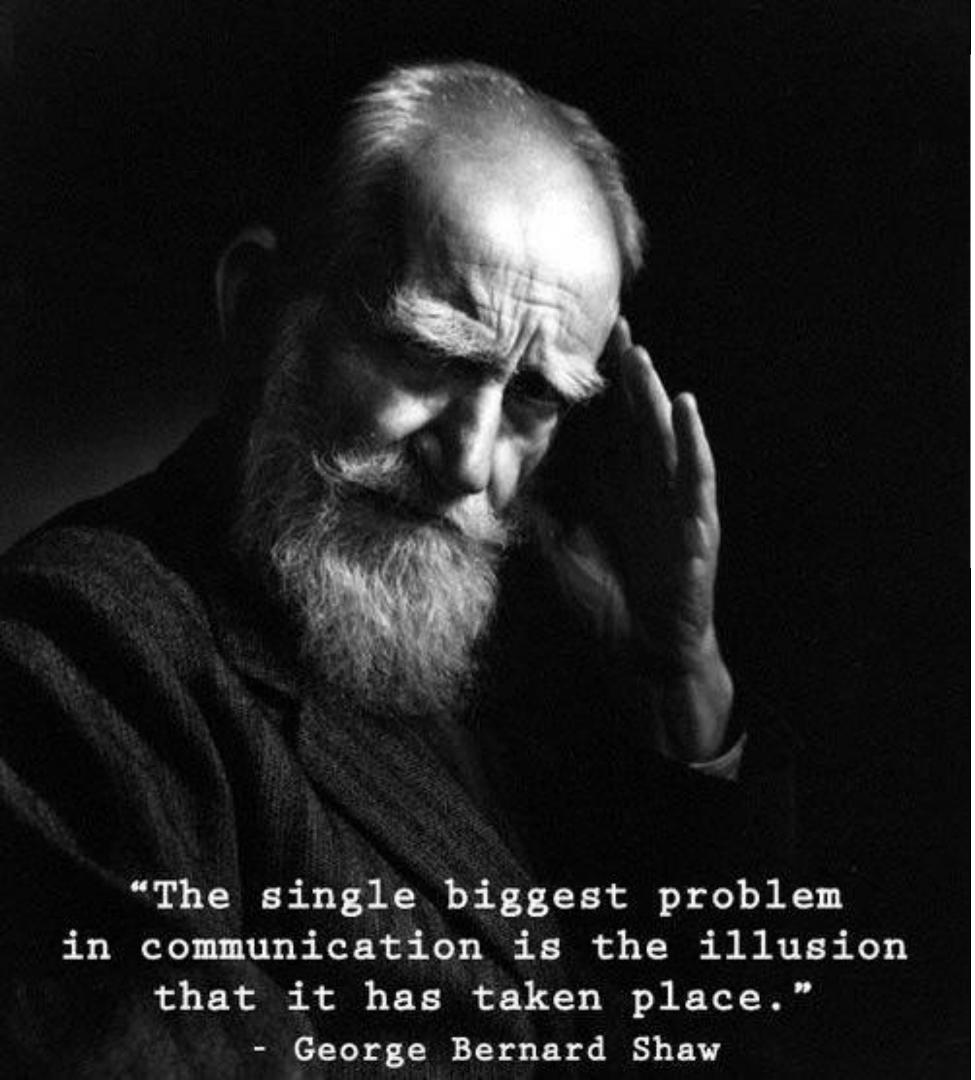
Quality in deliverables and operations through volatile oil price

Subsea System Scope Overview (figure 1-1)

Wellhead to Topside ESDV

- HC Pressure Containing Components
- Subsea Pipelines, Rigid Risers and Connection Systems
- Flexible Pipe Risers and Flowlines
- Valves
- XMTs and Wellheads





communication

/kəmjuːnɪˈkeɪʃ(ə)n/

noun

1. the imparting or exchanging of information by speaking, writing, or using some other medium.
   "television is an effective means of communication"
   Lignende: transmission imparting conveying reporting presenting
2. means of sending or receiving information, such as phone lines or computers.
   "satellite communications"

Oversett communication til Norsk

noun

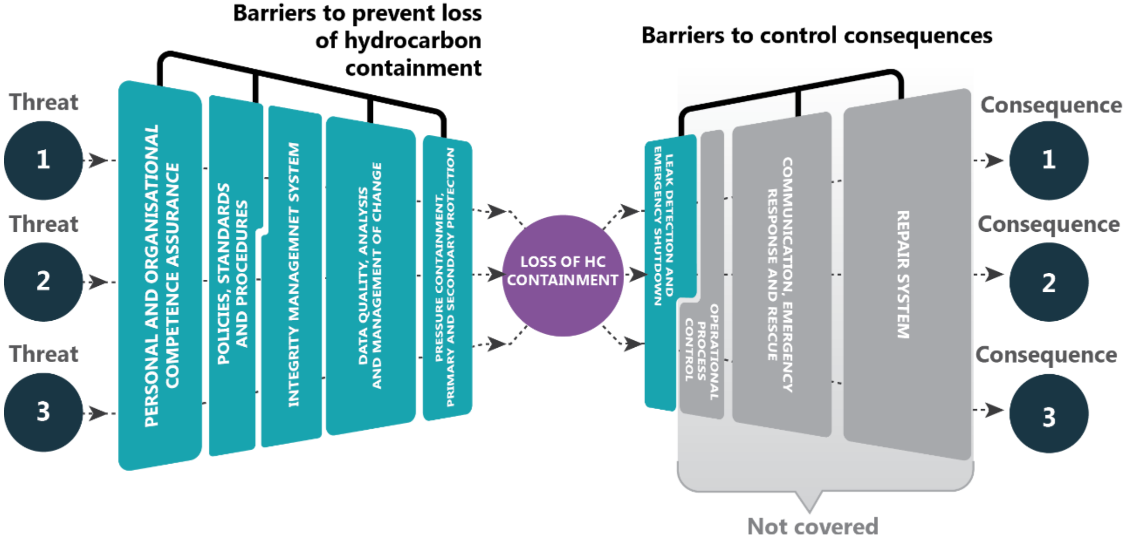
1. kommunikasjon

Definisjoner fra Oxford Languages

Tilbakemelding

Barriers to Prevent Loss of containment (figure 3-1)

- Major Accident Hazard Prevention - main objective
- Focus on <u>preventive barriers</u> – left side of bow tie
- Personal and organisational <u>competence assurance</u> - defined as the first barrier from the left



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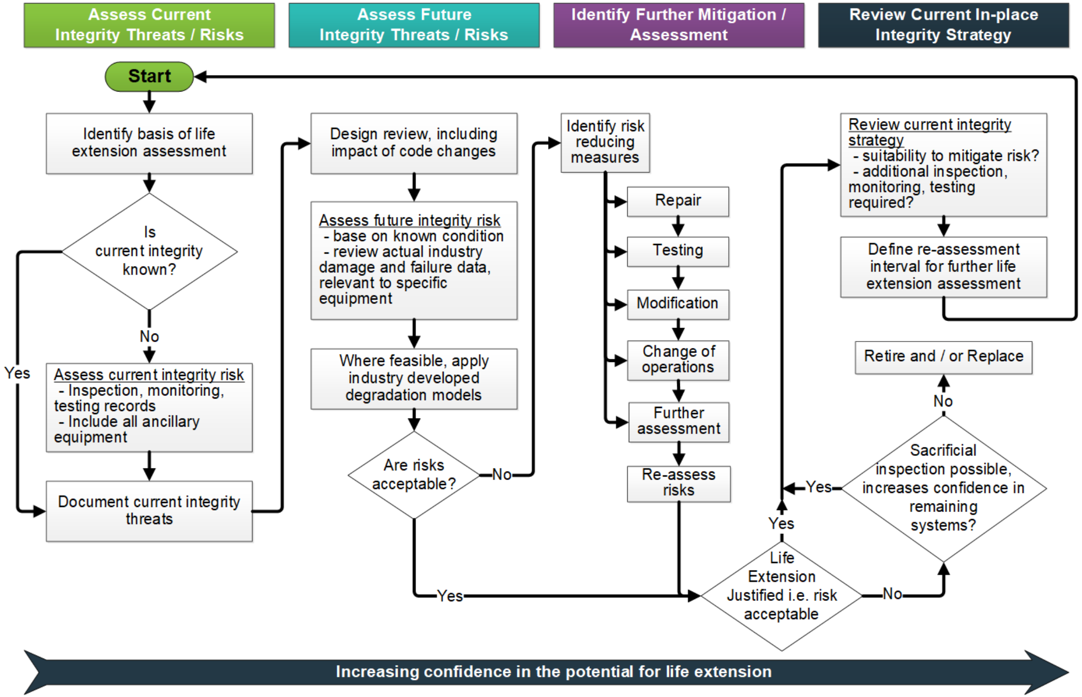
Section 9



Ref. Energy Institute, Guidance for Life Extension of Unbonded Flexible Pipe Systems, First edition (draft), January 2021

Lack of Data / Quality of Data

Lack of Data

Data acquired but lost during operating lifecycle

- Change of operatorship and incomplete handovers
- Deficient transfer from project to operational team
- Change of IT system
- Confidential data not known of everyone
- Data not properly recorded or documented

Data not acquired since the start of operating lifecycle

- Design data required now but not at design period
- Data difficult to record / not recordable
- Monitoring / data acquisition not planned in design
- Unprecedented / emergent failure modes
- Monitoring only initiated after a failure occurred

Quality of Data

DFI data quality issues

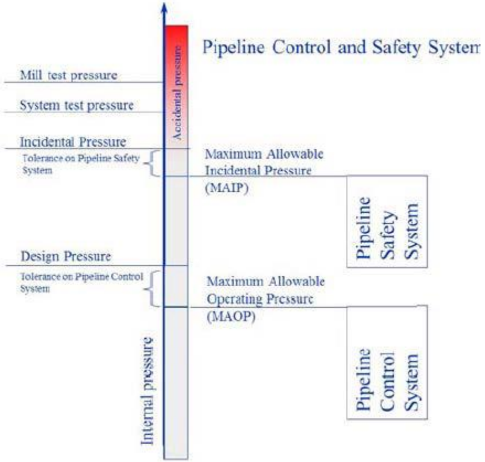
- Lack of detailed knowledge from design
- Changes not properly documented in project delivery
- Inconsistent design data

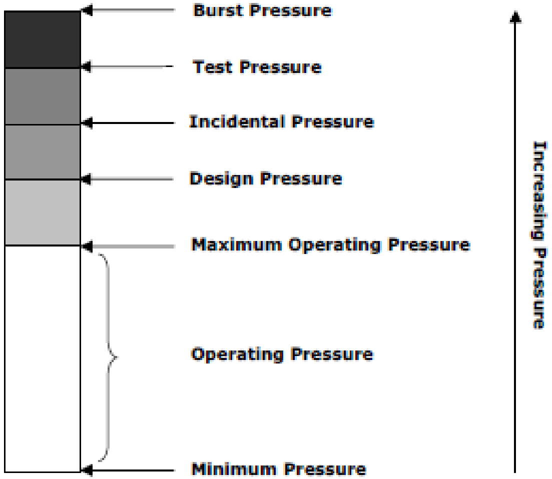
Operational data quality issues

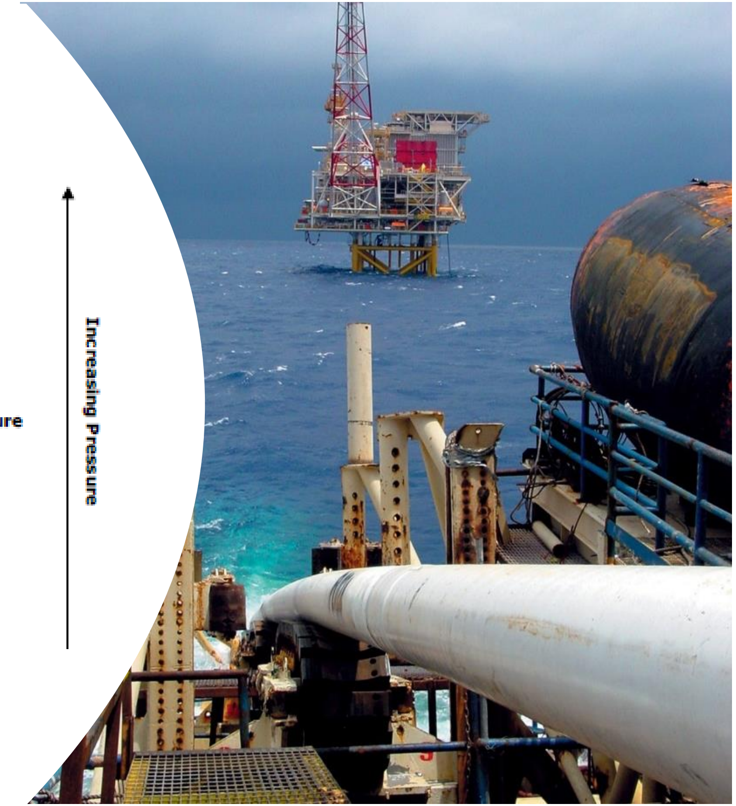
- Inconsistent data from subsequent inspections / tests
- Unrepresentative data
- Poorly recorded data
- Incomplete data
- Future data uncertainty

Impact of Code Changes

Section 5 – standards review







Generic Un-mitigated Barrier Threat Assessment

Appendix A

Barrier Threats Identification				Observability and Consequence of Failures for High Unmitigated Probabilities Threats					Unmitigated Probability Assessment				Interfaces		
Threats	Barrier Failure Mode	Barrier Failure Cause	Failure Mechanism	Record of Occurrence	Detection/ Observation (ref Table 7-1)	Highest Observation Accuracy	Consequence (seep, pinhole, leak, rupture)	Location (inside / outside 500m zone)	XMT/ Wellhead	Rigid Pipelines / Risers	Valves	Flexible Pipelines/Riser	Organisational Interface	Operational Interface	Technical Interface
Internal Corrosion	1.Internal fluid induced corrosion, leakage, collapse or rupture 2. Sour fluid induced corrosion collapse or rupture	Corrosion Inhibitor; 1.a. Inefficient corrosion inhibitor 1.b. Unavailable corrosion inhibitor 1.c. Inhibitor dosing pump failure 1.d. Topside corrosion inhibitor leak Internal coating/cladding, Operational Pigging, Flow management; 1.e. Ratio flow assurance steady / unsteady state - excursions exceeding allowable 1.f. Monitored operating parameter excursions exceeding BOD values (Temperature, pressure CO_2, H_2S, water cut, Chlorides, iron counts, sulphide / sulphur, SRB counts, sand levels, mercury) 1.g. Water chemistry threshold value excursions exceeding BOD values: pH, dissolved oxygen, minimal microbial activity planktonic (in fluid), and sessile (at wall), organic acids, residual inhibitor concentrations 1.h. Wettability less efficient than assumed in BOD 1.i. Slug flow, accelerated fluid velocities / cavitation 1.j. Damage to scale film 1.k. Process upset/ ineffective dehydration 1.l. Inappropriate materials design Fluid composition management; 2.a. Reservoir souring above BOD 2.b. SRBs inhibition system not efficient 2.c. Inappropriate materials design	1. Localized corrosion or pitting of steel / Reduction in wall thickness / material loss on gasket or flange seal surface / Seal pressure capacity reduced 2. Inappropriate materials/ localized corrosion or pitting of steel / reduction in wall thickness	Happened to Operators	ILI UT Radiography Tracerco Visual Pressure loss recorded during pressure test.	Requires analyses of data	Pinhole, Leak, Seep	Along the pressurized system typically at horizontal sections and at 6 o'clock position. Areas of low flow or dead legs where debris can build up can be areas of higher probability.	H	H	M	L	Discipline Engineers	Design Fabrication Installation Operation Beyond Design Life	Corrosion inhibitor injection system from topside to wells.

Data Strategy & Information Management (section 4)

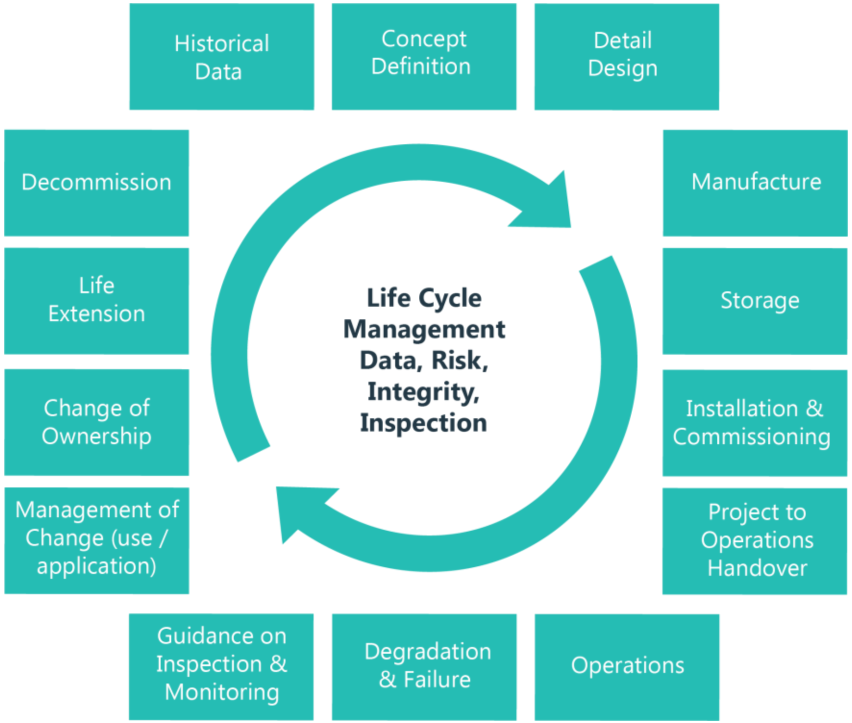
How to ensure a successful data collection for life cycle management?

Data collection starts at the concept design phase of the asset

Integrity Management Strategy (IMS) in place from start-up

Data Management Planning (data collection and preservation) to ensure through-life data management

Use the latest available technology



Web-based GIS Portal (Section 4)

A web-based GIS portal can include:

1. **Seabed survey data**
(bathymetry, slope, geohazards and locations of other nearby infrastructure)

2. **Asset information**
(pipelines, subsea equipment, jumpers, controls, mooring lines and other subsea infrastructure)

3. **Pipeline features**
(valves, anodes, buoyancy modules, strakes, crossings, spans and touchdown locations)

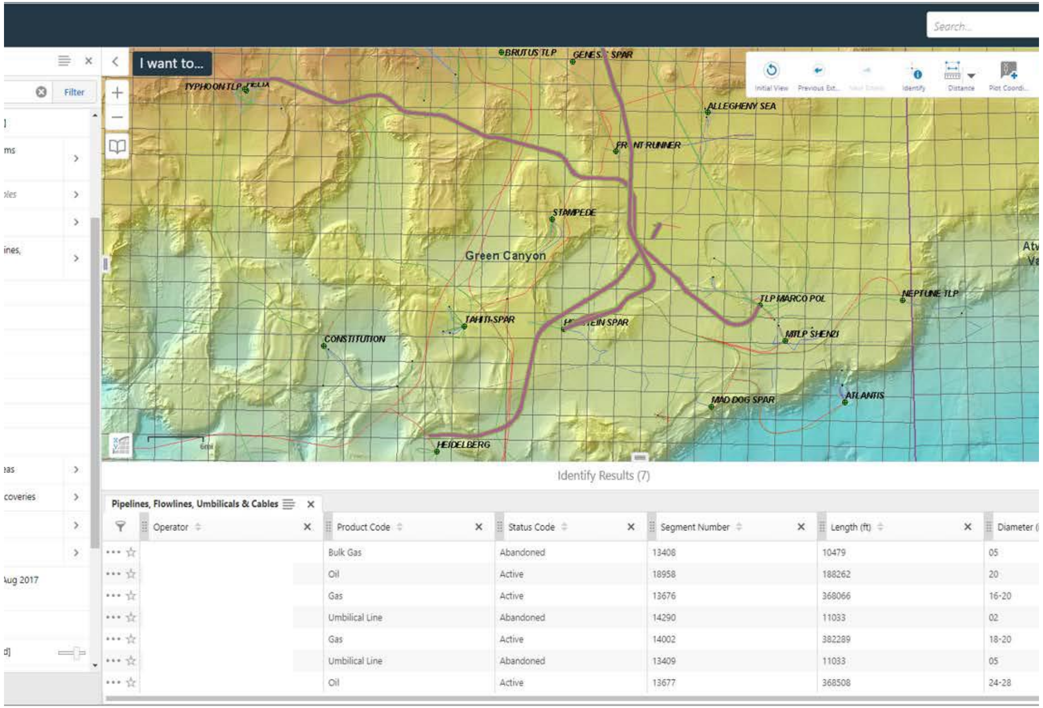
4. **Materials information**
(manufacturer, dimensions, grade, specification and heat numbers)

5. **Pipelay and fabrication information**
(including welding and coating records)

6. **Pressure testing and commissioning records**

7. **Longitudinal, transverse and out-of-straightness profiles**

8. **Inline and ROV inspections**
(anomalies and maintenance records)



Auditable Elements of a Subsea Integrity Management System

Table 2-1

Auditable Element	Section Ref.	Key Requirements	Recommendations
i. Subsea integrity management framework	3.2, 3.3, 4.15, 8.0	1. Satisfy legislative and regulatory requirements with respect to major accident risk prevention 2. Define organisational responsibility and interfaces	1. Organisational responsibility chart specific to subsea integrity management should be maintained and actively implemented
ii. System sub-division	4.0, 4.16, Table 4-2, 5.0	3. To define technical interfaces at subsea system boundaries 4. For pressurised hydrocarbon retaining components, the governing design standards and associated operational pressure definitions / regimes should be understood and clearly communicated	2. Identification of all safety critical equipment, i.e. not solely pressure retaining components 3. Ensure that any opportunities for holistic production monitoring across interfaces are understood and actioned
iii. Documentation management	4.2, 4.4.6	5. Demonstrate that design phase documentation is traceable & complete 6. Demonstrate that SIM documentation is maintained	4. Provision and maintenance of a centralised document management system for subsea equipment through asset life
iv. Accessibility of historic / live operational data	4.1, 4.10, 4.11	7. Demonstration of operational data availability 8. Operator has established operational trends and is actively monitoring for operational changes 9. Logging of subsea valve movements and all abnormal / shutdown events	5. Graphical presentation of long-term operational parameters 6. Comparison of operational parameters (e.g. pressure, temperature, flowrate, fluid composition) with design intent 7. Awareness that degradation mechanism may be more onerous for equipment that is non-operational
v. Threat assessment	4.5, 4.8, 4.12, 4.14, 6.0	10. Equipment failure mode risk assessments completed and maintained (Appendix A presents a generic unmitigated threat assessment for typical subsea equipment) 11. Demonstrate an awareness of relative subsea component risk, e.g. operator understands relative utilisation levels across technical interfaces	8. Perform peer review of risk assessments 9. Cross discipline risk reviews 10. Appreciate the implications of emergent threats 11. Engage and collaborate with wider industry to share operational experience / learnings
vi. Management of Change	4.1, 4.6, 4.14, 4.16, 5.0	12. Demonstrate MoC process is in place and share relevant MoC examples 13. Implications of the change are assessed on overall system sub components 14. Demonstrate awareness and understanding of any changes or evolution in codes and standards	12. MoC process should describe communication channels, ensuring interdisciplinary expertise is captured 13. Carefully appraise whether replacement equipment should be treated as 'like-for-like' or 'new' 14. Highlight where operational changes impact safe operating limits
vii. In service integrity management	4.4.7, 4.5, 4.9, 4.10, 4.11, 7.0, 8.2.4	15. Actively maintained and documented SIM reports through life cycle 16. Presentation / demonstration of instrumented safety system controls and barriers 17. Anomaly tracking process	15. Understand extent and implications of any operational changes made to instrumented safety systems, e.g. disabled or inhibited alarms, bypassing of barriers or controls, LP trips etc 16. Regular system wide risk re-assessment and SIM updates
viii. Lifetime extension	9.0	18. Availability of through life SIM records and operational data history 19. Reassessment of threats	17. Corporate knowledge management & communications 18. Succession planning

Technical risk and safety management

Critical for ongoing confidence in integrity management / technical assurance

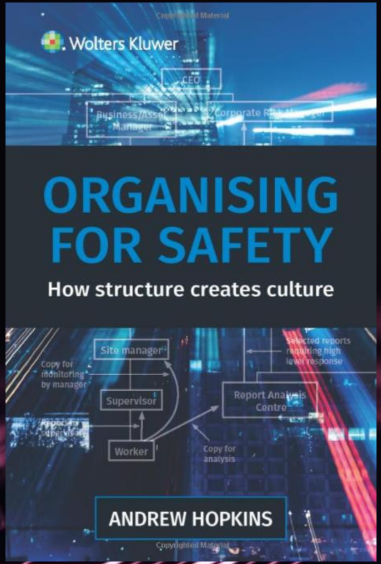
Some useful points / references by Andrew Hopkins (2019),
"Organising for Safety; How structure creates culture";

- Need for strong and independent technical engineering authority
- Ensure safety concerns are not over-ruled by other operational goals
- Is your goal to ensure regulatory approval, or to ensure operations are safe?

How do you ensure that in your operations?

What is our approach?

- Our GTEN (Global Technical Expert Network)
- Demonstrate technical strength of decisions
- Technical hierarchy to quickly reach the right experts
- Route to rapidly elevate technical issues to senior leadership



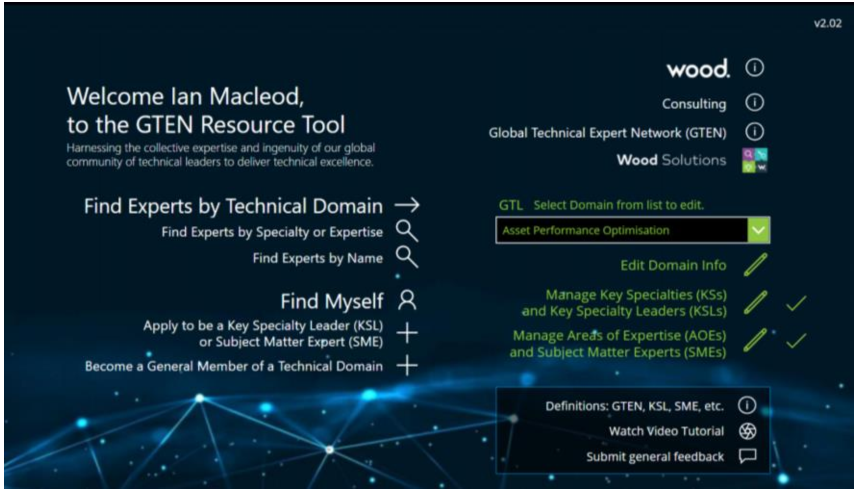
Assurance Framework & Expertise

What are the critical elements of your assurance frameworks?

- Competence framework / assurance / audit
- Management systems (compliance vs safety?)

Who are your technical specialists, Key Speciality Leaders, Subject Matter Experts?...

- ..., and how do you find / engage them, and at the right time?
- Global Technical Expert Network, GTEN

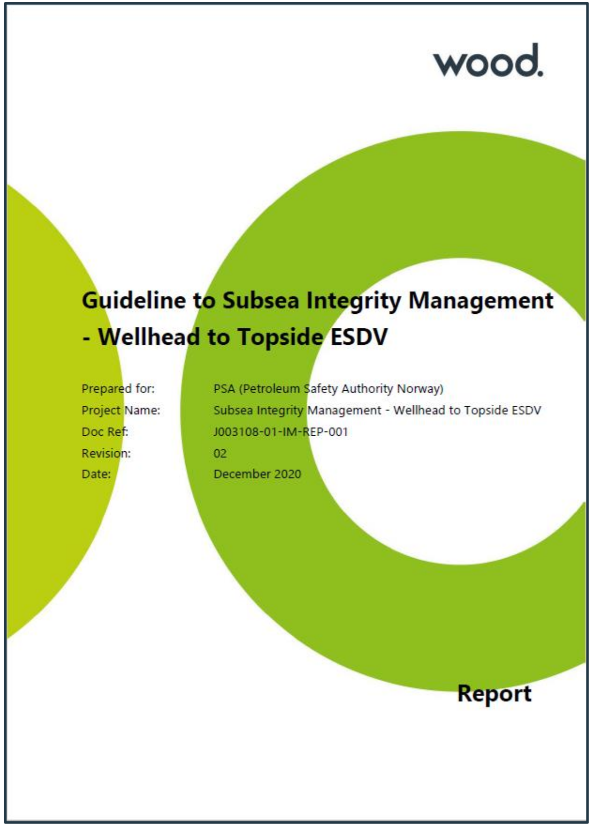


Contributions

- Thomas Garten – Study Lead
- Ian MacLeod – Study Sponsor & Peer Review
- Flexible Pipelines TA
- Rigid Pipelines TA
- Wellheads TA
- Valves TAs
- Lifetime Extension SME
- GIS SME
- Risk and Reliablity Team Lead
- Integrity Engineering SMEs

PSA / PTIL Site Link - https://www.ptil.no/en/technical-competence/explore-technical-subjects/reports-from-projects/2021/management-of-integrity-from-wellhead-to-facility/

PSA / PTIL Document Link - https://www.ptil.no/contentassets/1c056b61222a41b6ba5886987dc1de1e/guideline-to-subsea-integrity-management.pdf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Guideline to Subsea Integrity Management - Wellhead to Topside ESDV

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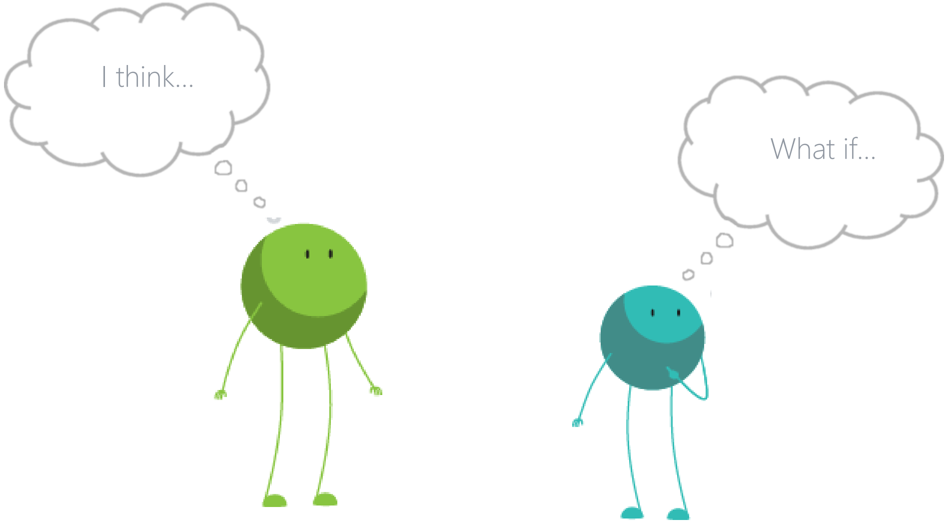
Report

Thoughts, comments or questions?



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