

GATE KEEPER

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Subsea Integrity Management – Inspectability & Maintainability Review

Subsea Integrity Management is defined as the management of a subsea system or asset to ensure that it delivers the design requirements while not adversely affecting life or the health of the environment throughout the required life of the field¹.

Periodic subsea inspections and routine maintenance are generally seen as a necessary evil by many Operators and not as an opportunity. This is because there are no regulatory requirements instructing Operators to conform to or to implement an Integrity Management Program.

There are various recommended practices which help guide Operators with the Inspection, Maintenance and Repair (IMR) operations for pipelines and subsea assets, but nothing mandates Operators to comply with the recommended practices. However, this is changing for a number of reasons:

1. Potential for new and enhanced regulations
2. Greater awareness of the benefits by the Operator
3. Increasing complexity of subsea systems
4. Subsea developments are contributing to a larger share of companies' bottom lines

Advantages of a comprehensive Subsea IMR campaign:

- Extend the life of existing facilities
- Increase operating time (reduced downtime due to normal inspection, maintenance and repair activities)
- Minimize unscheduled downtime
- Maximize inspection data while minimizing inspection costs

On a recent project, GATE performed an assessment of the subsea equipment and flowlines to provide a link between sand production and erosion risk. This link enables the Operator to evaluate production rates against the expected remaining life of the equipment, in particular the MPFMs (Multi-Phase Flow Meter), and to develop an intervention program schedule that depends on the prevailing production rates and the associated level of sand production. By assessing this risk early, threats, such as deferred production costs and well work-over costs following any serious sand control failure in a production well, are minimized. These intervention costs could have a huge impact on the life of field economics for subsea developments.

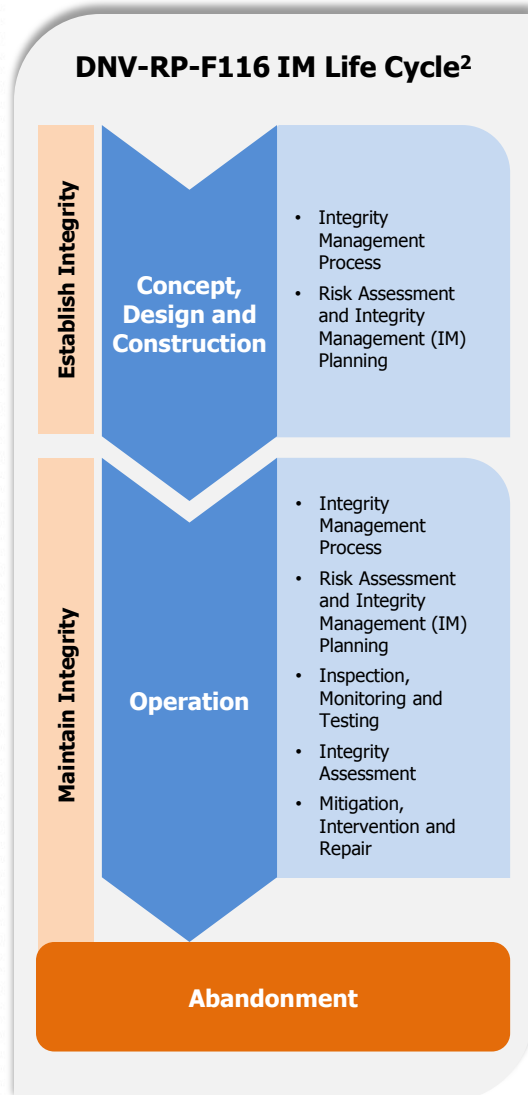
When is the Best Time to Start Focusing on IMR?

GATE recommends development of an IMR Philosophy during FEED, consequently completing an Installability & Maintainability (I&M) review during Detailed Design and that is continued and refined throughout the fabrication phase. All subsea facilities should be reliable, maintainable and cost-effective to operate and should retain their integrity throughout the life of the field. For this to be achieved, it is critical that those who will operate the subsea facility are able to contribute to the design and procurement. This is an example of why the Operations team should be involved early in the project phase.

The Operations team can influence the design of the subsea components to simplify future inspections, maintenance and repair operations. Recommendations from the Operations team will allow the project team to make informed decisions relating to the design and arrangements of key pieces of the subsea hardware; this can be accomplished by hosting an Installability and Maintainability (I&M) review.

Installability & Maintainability Review

I&M reviews are carried out to highlight the potential issues which could impact either the operational response capacity, the HSE policies, the equipment Mean Time to Repair (MTR) or the OPEX allowance for the Inspection and Maintenance works on subsea structures.



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I&M reviews are also carried out to propose possible equipment design improvements to optimize subsea inspections and subsea maintenance tasks. These reviews will consist of checking design and construction aspects of the subsea equipment against the subsea inspection and module change-out interventions.

I&M review tasks consist of the following:

- Client and Contractor Documentation Review (focused on I&M work)
- 3D draft modeling
- Equipment Construction and ROV Interventions Review
- Presentation of I&M Review Results and Recommendations to Company

I&M reviews should be performed with a IMR vision during the design of the project. This review will ideally start as soon as enough required Contractor documents for the given equipment are available.

Typical required documents required for an I&M review are:

- Scope of Supply Drawings
- General Arrangement Drawings
- Marking Drawings
- Cathodic Protection Drawings (Anode General Arrangement)
- P&ID's
- Flow, Hydraulic and Electrical Schematics
- ROV Access Reports
- Cathodic Protection Reports
- Failure mode effects and criticality analysis (FMECA) and Reliability, Availability and Maintainability Analysis (RAM) Reports
- Installation Procedures
- Operating and Maintenance Manuals

Inspection Features

Typical I&M inspection review includes:

- Equipment identification marking (size, type & color) and Orientation markings (size, type & color)
- Specific marking for inspection works (CP point location, weight, etc.)
- ROV Visual Inspection
- CP potential measurement points
- Anode depletion evaluation works
- Access to :
 - Specific areas of visual inspection
 - Thickness measurement (if applicable)
 - Reference anodes for CP monitoring activities
 - Valves indicators when applicable
 - Specific inspection / monitoring activities

when applicable (sand detector, pig detector, local non-destructive testing, free span, subsidence and displacement monitoring, fluid sampling, etc.)

Maintenance Features

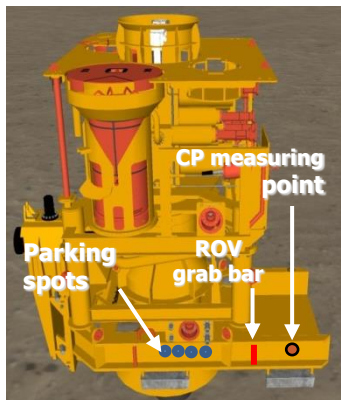
Typical I&M maintenance review includes:

- ROV access to recoverable elements (spools, jumpers, manifold and subsea tree modules, subsea pods and sensors)
- Size and weight of equipment
- Recovery rigging and attachment points (pad eyes, straps, quick connection devices or others...) and the capability for re-connecting this rigging on the abandoned structure by the means of ROV
- Structure landing, module engagement & locking system indicators / markings
- Specific Remote Operated Tools (ROT) or ROV tooling required for recovery works
- Parking skid/place for recoverable items (MQC parking slot, etc.)
- Deck space storage devices, and specific parking stand /sea-fastening required to carry out recovery works
- Required Lift capacity (Safe Working Load) and Preferred terminal lift device (Crane, H-Frame)
- Hang-off, load transfer, auxiliary winch and heave compensation device requirements.

Conclusion

The benefits of an I&M review during the early project phase substantially outweigh the cost which can be incurred during an unplanned or unnecessarily complex intervention operation. Such intervention costs far exceed the procurement cost of most components and so are a major target for operability assessment and optimization.

The combination of an I&M review leading to the development of a detailed IMR strategy is a highly effective means of reducing the operating risk associated with complex subsea production systems and can also result in substantial operational cost and deferred production savings over the life of a field.



FMC Subsea Tree: General I&M Review Comments*

I&M Review Process



References

1. Energy Institute – Guidelines for the management of integrity of subsea facilities
2. DNV-RP-F116 Integrity Management of Submarine Pipeline Systems
3. FMC Technologies Subsea Tree



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