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## SCOPE

This Project Standard and Specification defines general principles for assessing an extension of the service life beyond the original service life of risers and pipeline transportation systems, see Figure 1.

**Figure 1 - Overview of transportation systems**

## REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

1. API RP 2RD — Design of Risers for Floating Production Systems (FPSs) and Tension Leg Platforms (TLPs)
2. API 17J — Unbonded Flexible Pipe
3. ASME 31.4 — Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids
4. ASME 31.8 — Gas Transmission and Distribution Piping Systems
5. ISO 13623:2009 — Petroleum and natural gas industries – Pipeline transportation systems
6. OCIMF — Guidelines for the handling, storage, inspection and testing of hoses in the field, Rev. 2 1995
7. UKOOA — Flexible Hose Management Guidelines. 2003

## DEFINITIONS AND TERMINOLOGY

**Acceptance level -** maximum level of risk that is acceptable for the system at any time during its operation.
Note: A defined acceptance level is based on governmental regulations, design code or company requirements.

**Degradation -** gradual breakdown of components or of a material, as a result of being exposed, i.e. to time and environment.

Note: Sections and components degrade as a function of time and exposure, and the rate of degradation will vary. The components in the system have been qualified as a minimum to the design life. A system may also consist of components that are not intended to be in service for the design life. These components are planned to be replaced throughout the operational life based on specific intervals or condition based intervals. They are then a part of a maintenance plan.

**Degradation model -** model which shall describe how the integrity level of the system evolves over time and exposure.

Note: The degradation model can also be called “risk evolution model”. Typically the integrity will decrease, in other words the risk inherent in the system will increase. The degradation model is typically centered on the structural integrity of the system. Important factors are corrosion, fatigue, stress levels, temperature, pressure, erosion, operational environment etc. The degradation model is usually defined by the design standard, known technology and industry practice. This model can change over time, due to new technology and research, as well as changes in industry practice and updated design standards. In cases where the risk to/integrity of the system is defined more broadly (i.e. not only structural integrity, but also operational integrity, economic performance etc), other factors may play an important role in the degradation model.

**Design life -** specified period for which the integrity of the system is documented in the original design with anticipated maintenance, but without requiring substantial repair.

**Integrity assessment -** documents the present system integrity level, and forms a basis for further life extension work.

**Integrity life -** period during which the system or component may be operated without infringing the integrity acceptance level.

Note: The integrity life is longer than the design life, and in most cases the integrity life can not be documented. Conservatism in design and material data is the background for much of the difference between integrity life and design life. In the design process the focus is on documenting an acceptable integrity level for the specified design life. The design process is often conservative when choosing parameters for calculations and qualifications. The integrity life is the upper theoretical limit for the design life.

**Integrity level -** expression of the absence of risk inherent in the system.

Note: The risk can be of various natures; human, environmental, economic or political. Different systems have different failure modes or critical situations, and the risk associated with each of these can vary from system to system.

**Life extension -** documented justification for operating a system beyond its original service life.

**Modification -** changes, improvements or repairs of a system.

**Re-qualification -** re-assessment of design due to modified design premises and/or sustained damage.

Note: Life extension is a design premise modification.

**Service life -** time length the system is intended to operate.

Note: The service life is a part of the application toward authorities.

## SYMBOLS AND ABBREVIATIONS

| SYMBOL/ABBREVIATION | DESCRIPTION |
|---|---|
| API | The American Petroleum Institute |
| ASME | American Society of Mechanical Engineers |
| CP | cathodic protection |
| HSE | health, safety and working environment |
| ID | identification |
| IMS | integrity management system |
| ISO | International Organization for Standardization |
| OCIMF | Oil Companies International Marine Forum |
| PoF | probability of failure |
| PSA | Petroleum Safety Authority |
| UKOOA | United Kingdom Offshore Operators Association |

## ASSESSMENT METHODOLOGY

### Objective

This clause describes the general methodology to be applied to a life extension process. The remaining sections of this Project Standard and Specification are built up according to this methodology.

### Integrity Management System (IMS)

The operators follow up the transportation systems through an IMS. The objective of the IMS is to ensure that the technical integrity of the transport system is continuously maintained at an acceptable level. The structure of an IMS is illustrated in Figure 2.

The activities and assessments carried out as a part of the IMS is not part of the life extension process. A continuous integrity assessment is an inherent part of the integrity management process, where data from inspection, monitoring and testing are evaluated against the need for mitigation, intervention or repair. The integrity management process is carried out within the constraints of the original design, and is not necessarily sufficient to document and justify a life extension. However, the data provided by the IMS is beneficial in order to perform a life extension process.

**Figure 2 - The structure of an IMS and process**

**Life Extension Process**

The life extension process can also be called a re-qualification. It is triggered by the decision that the operation of the system will be continued beyond the original service life. The process that may be followed in a life extension is outlined in Figure 3.

The purpose of the life extension process is to document an acceptable system integrity to the end of the extended service life.

The overall life extension process is as follows:
- define the premise for the extended operation, and identify new threats to the system;
- assess the integrity of the system, in other words as far as possible quantify the current condition;
- carry out a reassessment of the system based on the available information from integrity assessment and established life extension premises, current industry practice and available technology;
- the reassessment can conclude that the integrity of the system is acceptable up to the end of the extended life, in which case the process moves on to documentation and implementation. If the integrity is not acceptable, modifications shall be considered together with the feasibility of the entire life extension.

**Figure 3 - Life extension process**

The following subclauses in this Project Standard and Specification are based on this work process, and references are included in the relevant boxes.

**Degradation**

The life extension process shall take into account the degradation that has taken place since the installation of the system.
Figure 4 is an example of degradation and integrity assessment. A life extension evaluation is initiated well ahead of the end of the original service life. Figure 4 illustrates that the original service life is not limited by the original design life, but the operator requested service life shorter than design life. In the original design, a given degradation model was used, which does not provide sufficient design life for the desired extended service life.
At the time of the life extension evaluation, an integrity assessment is performed. In this example it was found that the degradation model was conservative, and

the current condition of the system is actually better than anticipated. In the reassessment, a new degradation model is introduced based on new technology and/or industry practice. Based on this new degradation model, the new extended design life is established, which exceeds the desired extended service life. Subsequently a life extension application for the system can be submitted to the authorities, and service life for this system may be extended toward the extended design life without requirements to repair or modifications.
Note that in this example the first degradation model limited the original design life. Without the integrity assessment and the new degradation model, the life extension would not have been possible, since the extended service life was beyond the original design life.

**Figure 4 - A schematically sketch of the identified integrity level vs. time**

## LIFE EXTENSION PREMISES

### Objective

The original design premises shall be reviewed to assess whether they are still applicable for the life extension period. Revisions may be required, e.g. authority regulations. Changes or updates to the premises can lead to solutions that are more reliable and more cost-effective.

### Authority Regulations

The latest authority regulations apply to the transportation system.
Implementation of a life extension for a transportation system requires consent from the authorities.

### Design Standards

The transportation system is designed according to applicable standards that were selected at time of design. The same design standards may be used throughout operation of the system, also when changes to this system are introduced. This includes life extension.
When initiating a life extension process other standards may be commonly used for design of new transportation systems. Gaps between the original design standard (original revision shall be used) and applicable other standards at time of life extension shall be identified. Such gaps can indicate changes in the integrity acceptance level, and the transportation system operator shall assess the risk associated with these gaps.