

Integrity Management of Risers from Floating Production Systems

API RECOMMENDED PRACTICE 2RIM
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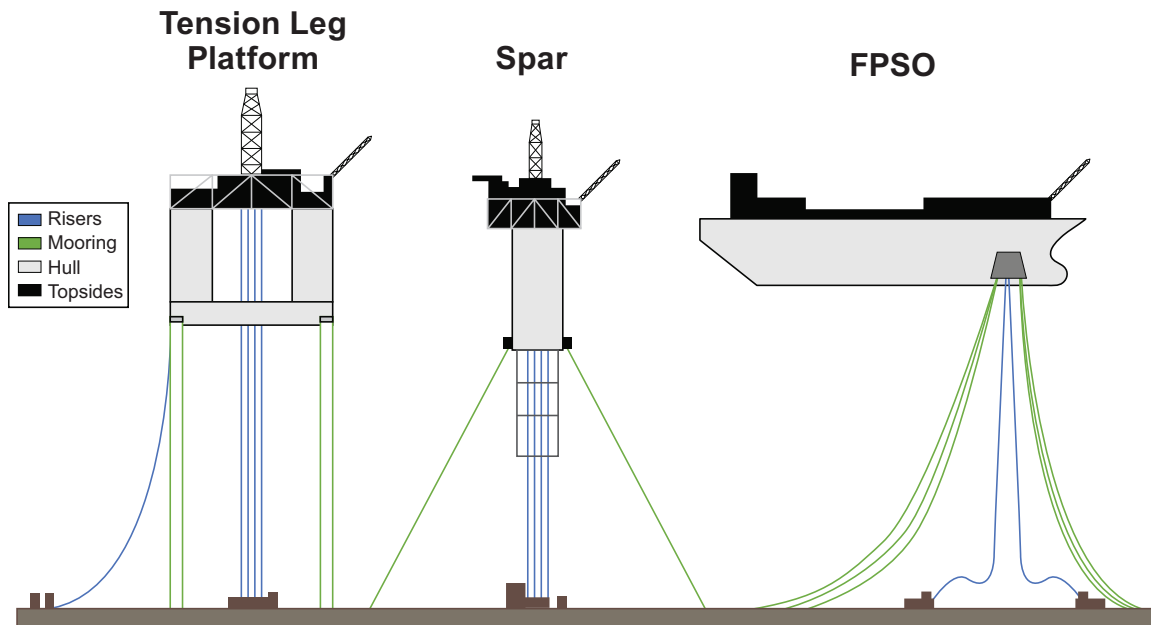
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Introduction

This recommended practice (RP) is one of three additions to API's portfolio of offshore floating structures standards that address integrity management (IM) of floating systems (API 2FSIM), mooring systems (API 2MIM), and riser systems (API 2RIM).

This RP is intended to be used by owners and engineers in the development, implementation, and delivery of a process to maintain system integrity of floating production systems (FPSs), including tension leg platforms (TLPs). The specifications, procedures, and guidance provided herein are based on internationally recognized industry standards and on global industry best practices.

API's existing suite of RPs such as API 2FPS, API 2T, API 2SK, API 2RD, and API 2SIM address several aspects of life cycle integrity management expectations, and the three new standards add to that suite by capturing experiences from owners, operators, integrity management specialists, recognized classification societies (RCSs), and regulators, establishing a common framework for IM for FPSs. Figure Intro 1 pictorially depicts the interfaces between the hull and mooring and risers for various types of FPSs and the IM standard that addresses the specific systems.



Physical Interfaces between API IM Standards

Implementation of effective integrity management for floating systems requires an understanding of the interfaces between the hull, mooring, and risers and how they translate to stewardship of IM activities in the field. The new standards have been developed with the objective of recognizing and identifying key interfaces, and they emphasize the criticality of a systems level approach.

By having a consistent systems level approach and by pursuing a risk-based framework to develop, evaluate, plan, and implement an integrity management program for a floating system, the user can tailor the IM program around the unique design drivers, in-service and operating conditions while conforming to the owner's organizational safety, health and environment risk management policies and regulatory requirements.

Integrity Management of Risers from Floating Production Systems

1 Scope

This recommended practice (RP) provides guidance for the integrity management (IM) of risers connected to a permanent floating production system (FPS) used for the drilling, development, production, and storage of hydrocarbons in offshore areas.

A riser is typically part of a larger subsea system extending from a wellhead, tree, manifold, template, or other structure on the seabed, to a boarding valve or pig trap on the host platform's topsides. This RP addresses the integrity management of the dynamic portion of the riser system.

For the purposes of this RP, a riser has a top boundary that is somewhere at or above the point where it transfers load to the platform structure, and it has a lower boundary where it transfers load into a foundation, which could be a wellhead, pipeline, or subsea structure.

For a top-tensioned riser (TTR), the top boundary would typically be the tensioner system hang-off point, and the bottom boundary would be the wellhead. For a steel catenary riser (SCR), the top boundary would typically be the stress joint or flexible joint. Some unusual configurations such as pull-tube SCRs merit special consideration. The top boundaries of a flexible or hybrid riser are typically a flanged connection to the riser end fitting at the top of an I-tube or J-tube, and a bend stiffener at the bottom of a I-tube or J-tube.

The IM of the structural support for a riser on the host platform is in the scope of API 2FSIM, although some hybrid configurations, such as pull tubes, can require overlapping riser and structural IM.

For risers structurally connected to the platform below the topsides, hull piping can be structurally clamped to the hull up to a boarding valve or pig launcher at the topsides. This is intended to be considered as part of the riser in terms of IM, although it also has structural elements addressed in API 2FSIM.

The scope of this RP includes:

- structural components of the riser;
- riser top hang-off assembly (i.e. stress joint, flexible joint, tensioner system/air can, bend stiffener);
- appurtenances attached to the riser that are critical to its integrity, including VIV suppression devices and buoyancy modules used to support the riser in any capacity;
- corrosion protection systems;
- insulation;
- other components in the load path or supporting the riser.

The scope of this RP specifically does not include:

- structural support for the riser on the host platform (i.e. riser porch, pull tube, tensioner support structure);
- wellhead or subsea structure at the lower end of the riser;
- valves (other than the mechanical design if they are in the dynamic load path);
- risers connected to mobile offshore drilling units (MODUs) or fixed platforms.

NOTE However, the interface of the riser with these components is important to the IM of the riser system.

Specific recommendations are provided for the inspection, monitoring, evaluation of damage, fitness-for-service assessment, risk reduction, mitigation planning, and decommissioning of risers. This RP incorporates and expands on the integrity management recommendations found in API 2RD, API 17B, and API 17L2.

2 Normative References

This document contains no normative references. For a list of documents and other publications associated with API 2RIM, see the Bibliography.

3 Terms, Definitions, and Abbreviations

For the purposes of this document, the following terms and definitions apply.

3.1 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1

anomaly

An observation or finding indicating the possibility that a certain parameter could be outside an acceptable design or performance threshold.

3.1.2

assessment

A technical review process triggered by an assessment initiator (as identified during an evaluation) to demonstrate that a system or structure is fit-for-service or to determine the need for risk reduction.

3.1.3

assessment initiators

Changes in riser condition or operating experience, such as storms, which require an existing riser to undergo an assessment to demonstrate fitness-for-service.

3.1.4

buoyancy module

A buoyant device secured to a riser to provide supplemental buoyancy.

NOTE Such devices are most commonly constructed from syntactic foam but can also have other structural forms.

3.1.5

catenary riser

A riser that is suspended in a catenary shape from near-vertical at the host platform to horizontal on the seabed after the touch-down point, typically constructed from steel line pipe or flexible pipe.

NOTE Supplemental buoyancy can be attached to portions of its length in some instances, forming a “wave” in the riser shape.

3.1.6

condition assessment

The process of gathering information on a riser’s present condition to perform a fitness-for-service assessment.

3.1.7

defect

An imperfection or flaw in a component of an existing riser.

NOTE As used in this RP, the term “defect” does not necessarily denote that the riser is not fit-for-service.

3.1.8**degradation**

The reduction in the ability of a component to provide its intended service.

3.1.9**design life**

The time period assumed for defining various design parameters such as corrosion allowance and fatigue life.

3.1.10**evaluation**

An engineering review of integrity data, using engineering judgment, risk assessment, calculations, analysis, or other methods to identify anomalous conditions (i.e. assessment initiator) and determine whether additional detailed assessment or risk reduction is required to demonstrate fitness-for-service.

NOTE An evaluation can also consist of an engineering review of proposed changes to the riser to determine their significance on fitness-for-service.

3.1.11**extreme event**

A design metocean, seismic, and/or ice condition, with a low probability of exceedance, that a riser can be subjected to during its operational life.

3.1.12**failure**

Insufficient strength or inadequate serviceability of a system or component to fulfill its performance requirements.

3.1.13**fitness-for-service**

A demonstration that a riser has adequate integrity for the intended operating conditions while maintaining design functionality.

3.1.14**flexible riser**

A catenary riser constructed from flexible pipe.

3.1.15**floating production system**

A permanently moored floating platform that serves as the host for the risers under consideration (same as "host platform").

3.1.16**host platform**

Same as floating production system.

3.1.17**hybrid riser**

A riser that consists of two or more types of risers combined, typically with some sort of buoyancy supporting part of the riser and the remainder connecting to the host platform.

3.1.18**in-service**

The condition that characterizes a riser that has been commissioned and placed in operation.

3.1.19**inspection**

A specific visual or nondestructive examination performed for collecting data required in evaluation of a riser's integrity.

3.1.20**insulation**

An external coating that provides insulation to the riser, which can also be buoyant in sea water and hence have the same effect as buoyancy modules.

3.1.21**integrity data**

Information on the design, condition, and operation of a riser system.

3.1.22**life extension**

The procedure of demonstrating the extension of the operational life of a riser beyond the life specified during the original design and/or as originally permitted.

3.1.23**management of change**

A system for review and approval of changes in processes, procedures, or physical components prior to implementation of the change.

NOTE This usually includes assessment of risk, economic, and schedule implications.

3.1.24**mechanical damage**

A defect type that includes physical damage such as dents, gouges, wear, or other unanticipated plastic deformation.

3.1.25**mitigation**

Actions taken to limit negative consequences or to reduce the likelihood of occurrence of an event or condition.

3.1.26**operator**

The person, firm, corporation, or other organization employed by the owners to operate a floating production system.

3.1.27**original design criteria**

Design basis and design codes used in the original riser design.

NOTE The design criteria include reference codes, metocean conditions, analysis methods, safety factors, and original design assumptions.

3.1.28**owner**

A party who owns physical infrastructure assets (risers) and/or a party who owns capacity rights in those physical assets but does not own the asset itself.

3.1.29**performance criteria**

Criteria used in a fitness-for-service assessment of a riser system.

3.1.30**prior exposure**

The historical exposure of a riser to the design conditions.

3.1.31**repair**

The work necessary to restore a deteriorated structure or system to a condition deemed fit-for-service.

3.1.32**retrievable riser**

A riser that is designed to be deployed and retrieved multiple times as part of its intended service, such as a drilling riser (i.e. a riser for which dry inspection could be considered in the IM plan).

3.1.33**riser**

A pipe or system of pipes that spans from the seabed to the host platform and conveys fluids to or from the host platform.

NOTE Riser service includes production, drilling, well completion, water injection, gas injection, gas lift, oil export/import, and gas export/import.

3.1.34**service life**

The time period between a riser's installation date and the anticipated end of service.

3.1.35**splash zone**

The area of the riser that is intermittently wet or dry due to wave and tidal actions or change in operating draft.

3.1.36**steel catenary riser**

A catenary riser constructed from rigid steel pipe.

3.1.37**survey**

A general view, examination, or other activities performed for collecting data required in evaluation of system integrity.

3.1.38**vortex-induced motion**

Inline and transverse oscillation of a floating production system in a current induced by the periodic shedding of vortices about the hull of the platform.

3.1.39**vortex-induced vibration**

Inline and transverse oscillation of a riser in a current induced by the periodic shedding of vortices.

3.2 Abbreviations

BOP	blowout preventer
CP	cathodic protection
CRA	corrosion resistant alloy
FAT	factory acceptance test
FEA	finite element analysis
FM	fracture mechanics
FPS	floating production system
FPSO	floating production, storage, and offloading
ILI	in-line inspection

IM	integrity management
KPI	key performance indicators
LTA	local thin area
NDE	nondestructive examination
OEM	original equipment manufacturer
PLET	pipeline end termination
PQR	procedure qualification record
RBI	risk-based inspection
ROV	remotely operated vehicle
RSF	remaining strength factor
SAF	stress amplification factor
SCF	stress concentration factor
SCR	steel catenary riser
SIT	system integration test
SLWR	steel lazy wave riser
SMR	strengthening, modification and/or repair
SMTS	specified minimum tensile strength
SMYS	specified minimum yield strength
TTR	top-tensioned riser
VIM	vortex-induced motion (of a host platform)
VIV	vortex-induced vibration (of a riser)
WPS	weld procedure specification

4 Integrity Management Overview

4.1 General

The purpose of integrity management (IM) is to provide a proactive process for demonstrating the integrity of a riser throughout its life on a fitness-for-service basis. The IM process relies on gathering and collating information on the riser, periodically evaluating the data, and using the evaluation to set a strategy for subsequent inspection and monitoring.

IM of risers consists of the continuous process as illustrated in Figure 1.

IM process for a riser should be used from design through decommissioning to:

- understand, communicate, and manage the in-service structural risk;
- manage the effects of deterioration, damage, changes in service conditions, and accidental overloading;
- establish the framework for inspection planning, maintenance, and/or repair;
- demonstrate that the riser is fit-for-service (or prepare for decommissioning).

Implementing an IM process for risers provides an orderly way of maintaining an appropriate level of inspection and monitoring, ensuring that the riser is operating within its intended ranges, and managing the effects of deterioration and damage. The IM process is founded on risk principles and provides owners a framework for inspection, maintenance, monitoring, and remediation activities to validate the fitness-for-service of a riser for its intended application throughout its service life.

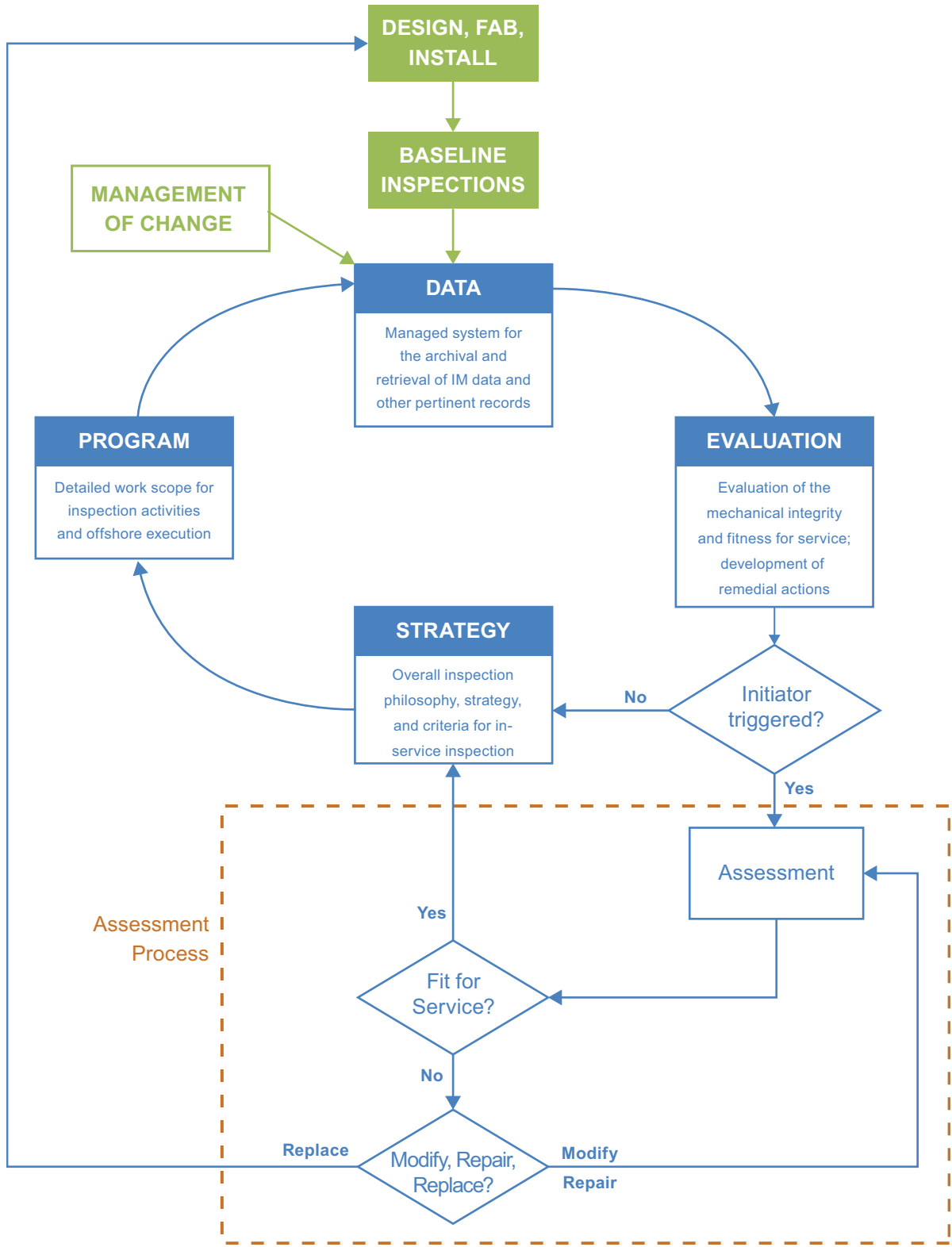


Figure 1—IM Process

Approaches to IM vary depending upon field life, type of riser, type of host platform, service conditions (e.g. internal pressure, temperature, fluid properties), and sophistication of regional infrastructure in which the riser is located. These factors influence the philosophical approach to IM that can vary from a riser involving emphasis on the use of monitoring equipment, to another riser with a preference for the extensive use of inspections. Regardless of the chosen IM approach, the purpose of the IM is to manage the integrity of the riser throughout its service life. The IM process can be used to demonstrate that the risks to riser operations are understood and to prevent and/or mitigate incidents that could result in safety, environmental, or economic consequences to the owner.

Choices are made in the design (e.g. selection of materials, design margins, operating procedures, condition monitoring systems, new or proven technology, robustness of design, redundancy, and fabrication/installation methods) that will influence IM activities during the operations. Implementation of an IM process can benefit from design decisions, such as providing access for inspection and maintenance. Initial IM development begins as part of the riser's design or reuse, ideally during the riser's concept and select stages.

The IM process is used to develop an inspection and monitoring program, including scope and frequency that can provide additional information on the condition of the riser. The collected information can be used to understand present and emerging risk from operating the riser and can provide information for determining the ongoing strategy for mitigating the emerging risk. A well-implemented IM process can provide evidence that the riser remains fit-for-service for the operational life of the riser and through to decommissioning.

Throughout the service life of the riser, new data are collected through monitoring activities, scheduled maintenance, scheduled inspections, results of accidental events, or planned changes (e.g. modifications or additions) to the riser. As new data are obtained, the data are subject to engineering evaluation to validate fitness-for-service. Based on the evaluation, adjustments to the strategy plans and program work scopes can be required to confirm fitness-for-service and maintain the riser's integrity. More detail on each of the elements is provided in Section 5.

4.2 Risk

The owner/operator should adopt risk-based principles for developing IM strategies that consider the present condition of a riser, the likelihood of damage or degradation of the riser, and the potential consequences. The consequences of failure should include the potential for loss of life, as well as undesired environmental and/or economic impacts (e.g. repairs, clean up, replacement, and deferred production).

A risk-based approach recognizes that risers with higher risks could warrant more frequent and more focused inspections than lower risk risers. During the development of an inspection strategy, a risk category can be used for setting inspection intervals and work scopes as part of a risk-based IM strategy.

4.3 Interfaces

This RP is a companion to three other RPs within API that address integrity management:

- API 2SIM, *Structural Integrity Management of Fixed Offshore Structures*
- API 2FSIM, *Floating Systems Integrity Management*
- API 2MIM, *Mooring Integrity Management*

The owner/operator is responsible for understanding and managing the interfaces between the integrity management for each of these interrelated RPs.

For guidelines and recommended practices relating to planning, designing, and constructing risers, including reuse and change-in-use of existing risers, the recommendations in the following industry standards should be considered: API 2RD, API 17B, API 17J, API 17K, API 17L1, API 17L2. Other international standards such as DNV-OS-F201, DNV-RP-F203, DNV-RP-F206 can be considered as well.

5 Riser Integrity Management Process

5.1 General

The owner/operator shall have an IM plan for all risers. The IM plan shall include a process that incorporates the following elements:

- data;
- evaluation;
- assessment;
- strategy;
- program.

A conceptual map of the IM process is shown in Figure 1.

5.2 Data

5.2.1 General

An in-service data management system containing riser IM data shall be established and maintained for the service life of the riser. Data should include information from the original design of the structure, fabrication and installation data, inspection findings, effects of damage and deterioration, riser analyses, overloading, and changes in loading and/or use. In addition, data should include technology development projects or in-service experience of similar structures within industry.

Data fall into the following categories: characteristic, condition, or operating.

In many instances, not all these data might be available. Missing data can affect the evaluation, strategy, and program for the ongoing IM of a riser. Where data are not available or are out of date, surveys of the riser system should be completed to collect the necessary information. It can be more expedient to proceed with an appropriate premise, recognizing the inherent uncertainties and assumptions.

5.2.2 Characteristic Data

The characteristic data describe the as-installed, baseline condition of the riser, or the initial population of the IM data for a riser.

Characteristic data should be collated at the completion of the design, fabrication and installation phases of a project. However, it is recognized that for many older risers, data can be collated well into the operational phase of the riser.

5.2.2.1 The design data should include:

- riser design basis, including design criteria, codes and standards used, pressure, temperature, fluid properties, water depth, seabed topography, geotechnical data, metocean conditions, platform configuration, hang-off details, etc.;
- design calculations, drawings and installation or operating information that affects the design, including insulation and corrosion protection;
- hazard identification and risk assessment work relevant to the design and future IM.

5.2.2.2 The fabrication and installation data should include:

- as-built condition of riser components after factory acceptance test (FAT) and prior to installation, including all specifications, material testing reports, welding procedure qualifications, nondestructive examination (NDE) records, FAT and system integration test (SIT) records, repair and nonconformance records, coating records, as-built information, and vendor data books;
- record of how the riser was assembled and installed, including installation specifications, procedures, activity logs, welding and NDE procedures, coating information, repair and nonconformance records, material tracking (as required), appurtenance records (e.g. buoyancy, VIV suppression), and any other as-built information;
- as-installed data collected from the baseline inspection, documenting any deviations from the design or installation drawings, including appurtenances, as-laid surveys for catenary risers, joint tracking for top-tensioned risers.

5.2.3 Condition Data

The riser condition data represent the present condition of the riser, covering any changes to the characteristic data that occurs during the life of the riser. The following condition data should be collated within a data management system:

- in-service inspection;
- condition monitoring;
- damage evaluation;
- corrosion protection;
- operational incident;
- modifications to the riser;
- modifications to the host FPS that affect the risers.

5.2.4 Operating Data

The riser operating data are comprised of the record of how the riser has been operated, and may include the monitoring and collection of:

- pressure, temperature, flow rates, fluid composition;
- metocean data;
- host FPS motions, offsets, turret rotation (FPSO);
- TTR tensioner settings and annulus pressures;
- other operational monitoring or data recording.

5.2.5 Data Management

IM data collected throughout the life of a riser should be maintained in a data management system. The data should be compiled and updated periodically to provide a record of the riser's present condition. Data should be collected during inspections as defined by the IM strategy.

The owner/operator should retain detailed and up-to-date records for the service life of the riser. During change of ownership or operatorship, the owner/operator should transfer all riser data to the new operator.

5.3 Evaluation

5.3.1 General

An evaluation of the riser IM data shall be performed throughout the riser's service life and shall be used to confirm that the riser integrity, mitigation strategies, and established risk levels remain valid. As new information/data are collected, evaluation shall review the new information/data to identify anomalous conditions and determine whether a detailed assessment (i.e., assessment initiator observed) or risk mitigation is required to demonstrate fitness-for-service.

The evaluation can address the overall riser or components thereof where damage or adverse conditions have arisen or occurred.

Findings from the evaluation shall be used as a basis for supporting or adjusting the IM strategy (see 5.4) and IM program (see 5.5), and shall conclude either that:

- a) the riser is fit-for-service between inspections;
- b) the riser is fit-for-service between inspections and requires on-going scheduled maintenance/monitoring/inspection (with a specified scope); or
- c) remedial measures (immediate or longer term) are required to render the riser fit-for-service.

Evaluation should address risk evaluation, assessment initiators, assessment, and mitigation measures.

Evaluation does not automatically imply a detailed riser analysis and should be based on a qualitative analysis of the riser that incorporates engineering judgement, operational experience, research data, qualitative screening analysis, and/or predictive techniques to assess the effect that new information/data have on the IM strategy. Evaluation can include a review of results from a previous design or assessment analysis of the riser, without performing a detailed assessment. IM data and assessments for similar risers or components can be used in the evaluation as well.

The evaluation phase can result in no change, or it could indicate degradation or damage that requires assessment. The assessment could result in some combination of remediation, modification of operating procedures, additional monitoring, and additional or more frequent inspection. Attention should also be given to trends in inspection and monitoring data over time, as well as data from similar risers.

5.3.2 Factors to Consider

Evaluation should address all factors relevant to the integrity of the riser, including:

- riser age, condition, original design criteria;
- riser service—i.e. production, drilling, water injection, gas injection, gas lift, export;
- flow characteristics—i.e. flow rates, fluid properties, pressure, temperature, chemical injection, sand content, H₂S, water cut;
- TTR annulus conditions (vent rate monitoring, gas sampling, annulus vacuum, and/or positive pressure testing);
- outer sheath integrity and annulus conditions for flexible risers;
- polymer coupon sampling for flexible risers;

- host platform motions;
- analysis results and assumptions made in the original design or subsequent assessment;
- degree of uncertainty in metocean criteria that can lead to conservative assumptions;
- metocean hindcast data in lieu of, or supplemental to, measured data;
- occurrence of any damage during transportation or installation;
- extent of inspection during fabrication, transportation, and installation;
- in-service inspection findings;
- learning from other similar risers;
- riser modifications, additions, and repairs/strengthening;
- riser condition after an accidental loading, extreme metocean event (e.g. hurricane, high current event), or excursion beyond design limits (e.g. pressure, temperature, corrosive fluids);
- fatigue sensitivity and verification of fatigue performance;
- past performance of corrosion protection system;
- riser monitoring data.

Consideration should be made for how these factors change over time. For each riser or group of similar risers, potential threats specific to those risers should be evaluated in terms of risk of failure and that the plans required to mitigate likelihood of failure or the consequences of failure. This information should be used to help establish the assessment initiators described in Section 6.

5.3.3 Risk Evaluation

5.3.3.1 General

An owner/operator can choose to adopt a risk-based strategy that optimizes inspection resources and planning. If a risk-based IM strategy is adopted, risers should be assigned to the risk category based upon the combination of likelihood of failure and consequence of failure.

IM can be done on a risk-basis, on a prescriptive basis, or on some mix of the two. However, even if a prescriptive approach to inspection and monitoring is taken, a risk assessment for the riser system should still be conducted and the IM plan constructed to manage the risks accordingly.

Risk can be presented in a variety of ways to communicate the results of the analysis to decision-makers and inspection planners. One goal of the risk determination is to communicate the results in a common format that all parties can understand. A risk matrix can be helpful in accomplishing this goal.

An example of a simple risk matrix is shown in Figure 2. In this figure, the consequence of failure and likelihood of failure categories are arranged such that the highest risk ranking is toward the upper right-hand corner. Owner/operators can decide to adopt more detailed risk assessment techniques or more complex matrices to further subdivide the characterization of the consequence and/or likelihood of failure. Most operators have more comprehensive risk assessment matrices for general hazard assessment that can be adopted for riser IM. Examples are also available in industry standards, such as DNV-RP-F206.

Risk categories are typically assigned to the boxes in the risk matrix. For the example matrix, symmetrical risk categories have been assigned. They might also be asymmetrical where for instance the exposure category can be given higher weighting than the likelihood category.

Consequence of Failure	High	Risk Level 2	Risk Level 1	Risk Level 1
	Medium	Risk Level 3	Risk Level 2	Risk Level 1
	Low	Risk Level 3	Risk Level 3	Risk Level 2
		Low	Medium	High
		Likelihood of Failure		

Figure 2—Risk Categorization Matrix Example

Risk categories can be used for setting inspection intervals and work scopes as part of a risk-based IM strategy. For example, a 3x3 risk matrix, as shown in Figure 2, can be used to categorize the risers as follows:

- Risk Level 1: Major focus of resources, which can include an increased inspection frequency and intensity of inspection and/or more detailed engineering;
- Risk Level 2: Moderate focus of resources;
- Risk Level 3: Less focus of resources, which can include a reduced inspection frequency and scope of inspection.

The example provided in Figure 2 is generic; however, the risk matrix does allow differentiation of the IM focus for various combinations of consequence and likelihood. It is up to the owner/operator to add rigor and calibration to the risk assessment process that makes sense for a riser or group of similar risers.

The results of risk assessments, including mitigations required to reach the final risk levels, should be documented.

5.3.3.2 Consequences of Failure

The consequences of failure for a riser can include life safety, environmental impact, social impact, economic loss, and damage to the reputation of the owner/operator.

Life safety should consider the maximum anticipated environmental event expected to occur while personnel are on the host platform.

The consequence of failure should include consideration of the anticipated impact to life safety, the environment, the possible economic impact through losses to the owner (riser and equipment repair or replacement, lost production, etc.), and the anticipated losses to other operators (e.g. lost production through trunk lines). Depending on the robustness of the component or system, the consequence of a specific failure may be acceptable within a period and mitigation measures employed.

5.3.3.3 Likelihood of Riser Failure

If the owner/operator chooses to adopt a risk-based riser IM strategy, the IM data should be evaluated to determine the likelihood of riser failure. The likelihood that a riser will fail because of loading is a function of the robustness of the riser.

Each riser has a likelihood of failure based on key characteristics. Damage or deterioration can indicate that the strength of a riser has reduced, potentially increasing the likelihood of failure.

5.3.4 Assessment Initiators

Evaluation should provide recommendations for performing an assessment for changes that can increase the riser's operational risk, including for changes in: condition, action, criteria, consequence, and use.

5.3.5 Mitigation Measures

Evaluation of risk mitigation options to reduce the likelihood and/or consequence of failure should be considered at all stages of the IM process. Recommendations for evaluating risk reduction measures are provided in Section 10.

5.4 Assessment

5.4.1 Assessment Process

If the engineering evaluation determines that the riser operational risk has significantly changed, some level of engineering assessment analyses should be performed to determine whether the riser achieves the required performance level or whether risk reduction or mitigation measures are required. The assessment is part of evaluation, as illustrated in Figure 1.

Assessment should demonstrate that the performance of risers or riser components achieves the required fitness-for-service acceptance criteria, or whether risk reduction or mitigation measures are required. The assessment process may involve gathering more information in the form of monitoring, materials testing, sampling, or more detailed inspection.

Assessment is step-wise with increasing complexity and is typically accomplished by performing an analysis of the system or component. Recommended methods of assessment and analyses are provided in the assessment requirements (see Sections 7 and 8).

5.4.2 Assessment Initiation

Motives for performing a riser assessment vary and should be established prior to performing the assessment. The selection of the assessment method is influenced by the assessment motive, which can include:

- a) Supporting an evaluation—For risers where the evaluation has determined that an assessment of the structural strength is required, an assessment should be performed to demonstrate that the riser achieves the performance level required by the IM strategy;
- b) Categorizing the riser likelihood of failure—For risk-based IM strategies, an assessment should be performed to determine the likelihood of failure and provide input into categorizing the riser's structural risk;
- c) Supporting an inspection program—An assessment should be performed to determine the locations required for inspection and for setting inspection anomaly threshold reporting requirements;
- d) Supporting a monitoring program—Risers that have included monitoring as part of their IM strategies should be assessed to provide information on the threshold that would indicate a change in the condition;