

Structural Integrity Management of Fixed Offshore Structures

API RECOMMENDED PRACTICE 2SIM
FIRST EDITION, NOVEMBER 2014

REAFFIRMED, SEPTEMBER 2020



Special Notes

API publications necessarily address problems of a general nature. With respect to particular circumstances, local, state, and federal laws and regulations should be reviewed.

Neither API nor any of API's employees, subcontractors, consultants, committees, or other assignees make any warranty or representation, either express or implied, with respect to the accuracy, completeness, or usefulness of the information contained herein, or assume any liability or responsibility for any use, or the results of such use, of any information or process disclosed in this publication. Neither API nor any of API's employees, subcontractors, consultants, or other assignees represent that use of this publication would not infringe upon privately owned rights.

API publications may be used by anyone desiring to do so. Every effort has been made by the Institute to assure the accuracy and reliability of the data contained in them; however, the Institute makes no representation, warranty, or guarantee in connection with this publication and hereby expressly disclaims any liability or responsibility for loss or damage resulting from its use or for the violation of any authorities having jurisdiction with which this publication may conflict.

API publications are published to facilitate the broad availability of proven, sound engineering and operating practices. These publications are not intended to obviate the need for applying sound engineering judgment regarding when and where these publications should be utilized. The formulation and publication of API publications is not intended in any way to inhibit anyone from using any other practices.

Any manufacturer marking equipment or materials in conformance with the marking requirements of an API standard is solely responsible for complying with all the applicable requirements of that standard. API does not represent, warrant, or guarantee that such products do in fact conform to the applicable API standard.

All rights reserved. No part of this work may be reproduced, translated, stored in a retrieval system, or transmitted by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission from the publisher. Contact the Publisher, API Publishing Services, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001.

Copyright © 2014 American Petroleum Institute

Foreword

Nothing contained in any API publication is to be construed as granting any right, by implication or otherwise, for the manufacture, sale, or use of any method, apparatus, or product covered by letters patent. Neither should anything contained in the publication be construed as insuring anyone against liability for infringement of letters patent.

The verbal forms used to express the provisions in this specification are as follows:

- the term “shall” denotes a minimum requirement in order to conform to the specification,
- the term “should” denotes a recommendation or that which is advised but not required in order to conform to the specification,
- the term “may” is used to express permission or a provision that is optional,
- the term “can” is used to express possibility or capability.

This document was produced under API standardization procedures that ensure appropriate notification and participation in the developmental process and is designated as an API standard. Questions concerning the interpretation of the content of this publication or comments and questions concerning the procedures under which this publication was developed should be directed in writing to the Director of Standards, American Petroleum Institute, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001. Requests for permission to reproduce or translate all or any part of the material published herein should also be addressed to the director.

Generally, API standards are reviewed and revised, reaffirmed, or withdrawn at least every five years. A one-time extension of up to two years may be added to this review cycle. Status of the publication can be ascertained from the API Standards Department, telephone (202) 682-8000. A catalog of API publications and materials is published annually by API, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001.

Suggested revisions are invited and should be submitted to the Standards Department, API, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001, standards@api.org.

Contents

	Page
1 Scope	1
2 Normative References	1
3 Terms, Definitions, Acronyms, and Abbreviations	1
3.1 Terms and Definitions	1
3.2 Acronyms and Abbreviations	5
4 Structural Integrity Management Overview	6
4.1 General	6
4.2 Competency	7
4.3 Risk	7
4.4 Limitations	7
5 Structural Integrity Management Process	8
5.1 General	8
5.2 Data	8
5.3 Evaluation	10
5.4 Strategy	16
5.5 Program	17
5.6 Decommissioning	17
6 Surveys	18
6.1 Inspection Strategy	18
6.2 Personnel Qualifications	18
6.3 Level I Surveys—Routine Above-water Inspection	18
6.4 Baseline Underwater Inspection	20
6.5 Level II, III, and IV Surveys—Routine Underwater Inspection	21
6.6 Special Inspections	24
6.7 Survey Work Scope	26
6.8 Inspection Specification	26
6.9 Data Records	27
7 Damage Evaluation	27
7.1 General	27
7.2 Degradation Mechanisms	27
7.3 Component Evaluation	29
7.4 System Evaluation	30
8 Structural Assessment Process	30
8.1 General	30
8.2 Assessment Category	31
8.3 Assessment Initiators	31
8.4 Assessment Information	33
8.5 Assessment Method	34
8.6 Performance Criteria	38
8.7 Risk Reduction	38

Contents

	Page
9 Assessment for Metocean Loading	38
9.1 General	38
9.2 Assessment Criteria	39
9.3 Assessment Loading	40
9.4 Design Level Method	43
9.5 Ultimate Strength Method	44
9.6 Risk Reduction	46
10 Assessment for Fatigue Loading	46
11 Assessment for Seismic Loading	46
11.1 General	46
11.2 Simplified Analysis	47
11.3 Design Basis Check	47
11.4 Extreme Level Earthquake	47
11.5 Abnormal Level Earthquake	47
11.6 Risk Reduction	47
12 Assessment for Ice Loading	48
12.1 General	48
12.2 Design Basis Check	48
12.3 Simplified Analysis	48
12.4 Design Level Method	48
12.5 Ultimate Strength Method	48
12.6 Risk Reduction	48
13 Risk Reduction	49
13.1 General	49
13.2 Exposure Reduction	49
13.3 Likelihood Reduction	50
14 Platform Decommissioning	56
14.1 General	56
14.2 Decommissioning Process	57
Annex A (informative) Commentary on Structural Integrity Management	59
Bibliography	95
 Figures	
1 SIM Process	6
2 SIM Process and Document Organization	9
3 Risk Categorization Matrix Example	12
4 Assessment Within the SIM Process	15
5 Fitness-for-Purpose Assessment Process	32
6 Deck Silhouette Definition	42
7 Wave Heading and Direction Convention	43
8 SMR Techniques	51

Contents

Page

A.1 Schematic Load vs Deformation Diagram of an X-braced Platform	67
A.2 Schematic Load vs Deformation Diagram of a Diagonally Braced Platform	68

Tables

1 Exposure Category Matrix	13
2 Risk-based Inspection Program Intervals	21
3 Default Inspection Program	23
4 Drag Coefficient, C_d , for Wave/Current Platform Deck Forces	43
5 Design Level Metocean Criteria, U.S. Gulf of Mexico	44
6 Ultimate Strength Metocean Criteria, U.S. Gulf of Mexico	45
A.1 Decommissioning Activities	89

Introduction

The purpose of this recommended practice is to provide guidance to owner/operators and engineers in the implementation and delivery of a process to manage the structural integrity of existing fixed offshore platforms. This process is called structural integrity management (SIM).

The SIM process described in this recommended practice is based on internationally recognized industry standards, including API 2A-WSD, 22nd Edition and ISO 19902:2007, and on global industry best practices. This recommended practice details engineering practices for the evaluation, assessment, and inspection of existing fixed offshore structures to demonstrate their fitness-for-purpose. This recommended practice incorporates and expands on the recommendations of Section 14, "Surveys" and Section 17, "Assessment of Existing Platforms" as previously provided in API 2A, 21st Edition.

The principal section describing the recommended SIM process is Section 5. It contains details of each aspect of the SIM process and provides a roadmap for using the recommended practice. Each of the remaining sections provides self-contained detailed guidance on performing the relevant SIM task.

Section 6 contains guidance on underwater surveys of fixed platforms. Two approaches are provided: a risk-based underwater survey (6.5.2) and an exposure-based underwater survey (6.5.3). When the owner/operator has not adopted a risk-based SIM strategy, an exposure-based (default) inspection program should be used.

In particular, Section 9 contains guidance on the selection of calibrated metocean criteria used for the fitness-for-purpose assessment of platforms designed and constructed to API 2A-WSD, 19th Edition and earlier editions that are located in the U.S. waters of the Gulf of Mexico or West Coast. In addition, Section 9 contains guidance on the selection of appropriate metocean criteria used for the fitness-for-purpose assessment of platforms designed and constructed to API 2A-WSD, 20th Edition and later for platforms located in the waters of the U.S. Gulf of Mexico or U.S. West Coast.

Structural Integrity Management of Fixed Offshore Structures

1 Scope

This recommended practice provides guidance for the structural integrity management (SIM) of existing fixed offshore structures used for the drilling, development, production, and storage of hydrocarbons in offshore areas. However, the general principles of SIM apply to any structure.

Specific guidance is provided for the evaluation of structural damage, above- and below-water structural inspection, fitness-for-purpose assessment, risk reduction, mitigation planning, and the process of decommissioning. This recommended practice incorporates and expands on the recommendations of Section 14, “Surveys” and Section 17, “Assessment of Existing Platforms” as previously provided in API 2A-WSD, 21st Edition. See Annex A for additional information and guidelines on the provisions stated in the numbered sections of this document.

The SIM process provided in this recommended practice is applicable to existing platforms installed at any location worldwide. However, the recommended practice provides specific metocean criteria, which are only applicable for use in fitness-for-purpose assessments of platforms located in the U.S. Gulf of Mexico and the U.S. West Coast.

For guidelines, recommended practices, and other requirements relating to planning, designing, and constructing new fixed offshore platforms, including reuse and change-in-use of existing platforms, reference should be made to the latest edition of API 2A-WSD.

For guidelines, recommended practices, and other requirements relating to planning, designing, and constructing new offshore floating production systems, including reuse and change-in-use of existing floating production systems, reference should be made to the latest edition of API 2FPS.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

API Recommended Practice 2A-WSD, *Planning, Designing, and Constructing Fixed Offshore Platforms—Working Stress Design*, 22nd Edition

API Recommended Practice 2EQ, *Recommended Practice for Seismic Design Procedures and Criteria for Offshore Structures*

API Recommended Practice 2MET, *Recommended Practice for Derivation of Metocean Design and Operation Conditions*

API Recommended Practice 2N, *Planning, Designing, and Constructing Structures and Pipelines for Arctic Conditions*

3 Terms, Definitions, Acronyms, and Abbreviations

3.1 Terms and Definitions

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

3.1.1

air gap

The clearance between the highest water surface that occurs during the extreme metocean conditions and the underside of the cellar deck.

3.1.2**anomaly**

An in-service survey measurement that is outside the threshold considered acceptable from the design or most recent fitness-for-purpose assessment.

3.1.3**assessment initiators**

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

3.1.4**collapse**

The ultimate load bearing capacity of the platform at which the jacket structure or deck columns are no longer able to support vertical loads.

3.1.5**condition assessment**

The process of gathering the information on the platform's present condition needed in order to perform a fitness-for-purpose assessment.

3.1.6**consequence**

The adverse effects of an extreme event, such as metocean, seismic, ice, or accidental, on personnel, the environment, or property.

3.1.7**consequence of failure category**

A system applied to categorize the consequences of failure of an existing offshore platform.

3.1.8**corrosion**

Degradation of a component or components due to corrosion. Corrosion may be categorized as either general or local and may cause pitting, holes, or crevices.

3.1.9**damage tolerance**

The quantity of deterioration or damage that a structure can withstand without failing.

3.1.10**deck elevation**

The measured distance from the underside (bottom-of-steel) of the support structure of a topside deck structure to a confirmed datum, such as the mean sea level (MSL).

3.1.11**decommissioning**

A process followed to plan, gain approval for, and implement the removal, disposal, or reuse of the platform structure, equipment, and associated pipelines and wells.

3.1.12**defect**

An imperfection, fault, or flaw in a component of an existing platform. As used in this recommended practice, the term "defect" does not necessarily denote that the platform is not fit-for-purpose.

3.1.13**design level analysis**

A fitness-for-purpose analysis of a platform using linear-elastic methods with an appropriate safety margin, similar to the analysis methods used for new platform designs

3.1.14**design life**

The planned time period from initial installation or reuse until permanent decommissioning, which may include extensions justified through the SIM process.

3.1.15**deterioration**

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

3.1.16**exposure category**

The classification used to categorize the platform consequence of failure based on the consideration of life safety, environmental pollution, and business disruption.

3.1.17**extreme event**

An extreme metocean, seismic, and/or ice condition that a structure may be subjected to during its operational life.

3.1.18**fitness-for-purpose**

A demonstration that an existing structure has adequate strength to resist the imposed assessment loads.

3.1.19**full population hurricane**

A population of hurricanes that includes all hurricanes that develop inside or outside of the Gulf of Mexico, used for statistical analysis.

3.1.20**in-service**

A platform that has been placed in operation.

3.1.21**inspection**

The visit to the platform and the associated survey activities for purposes of collecting data required in evaluating its structural integrity for continued operation.

3.1.22**life extension**

The process of extending the operational life of a structure beyond the life considered during the structure's design.

3.1.23**mechanical damage**

A defect type that includes dents, bows, gouges, holes, and separated or severed members.

3.1.24**mitigations**

Platform strengthening, modification, and/or repairs (SMRs) and/or operational procedures that reduce loads, increase capacities, or reduce the exposure category.

3.1.25**nonredundant platform**

A platform for which its global capacity is reached when one of its primary structural elements reaches its maximum capacity.

3.1.26**not normally manned**

A platform that does not have facilities to accommodate personnel for overnight or extended stays.

3.1.27**omnidirectional**

A criterion that is considered uniform in all directions.

3.1.28**operator**

The person, firm, corporation, or other organization employed by the owners to conduct operations.

3.1.29**owner**

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

3.1.30**performance criteria**

The criteria for which an existing platform should meet to be considered fit-for-purpose.

3.1.31**prior exposure**

The historical exposure of a platform to the design metocean, seismic, or ice loading.

3.1.32**redundant platform**

A platform for which its global capacity is maintained when one or more of its primary structural elements reaches its maximum capacity.

3.1.33**redundancy**

The availability of alternate load paths in a platform following the failure of one or more structural components.

3.1.34**repair**

The structural work necessary to restore a platform to a condition deemed fit-for-purpose.

3.1.35**reserve strength ratio****RSR**

A measure of the ultimate load carrying capacity of a platform, defined as the ratio of the base shear at ultimate capacity to the base shear from the 100-year reference criteria.

NOTE For the Gulf of Mexico this is the full population hurricane.

3.1.36**residual strength**

The ultimate strength of an offshore structure in a damaged condition is expressed as the structure's residual strength and is highly dependent on the inherent robustness of the structure.

3.1.37**risk-based inspection**

Inspection strategies developed from an evaluation of the risk associated with a platform or group of similar platforms with the intention of tailoring inspection level to risk magnitude and location.

3.1.38**robustness**

The ability of a structure to tolerate damage without failure.

3.1.39**sudden hurricane**

A hurricane that develops inside the Gulf of Mexico sufficiently close to the relevant platform such that personnel evacuation is not assured.

3.1.40**splash zone**

The area of the structure that is intermittently wet and dry due to wave and tidal action.

3.1.41**survey**

A specific visual or nondestructive examination of one or more platform components.

3.1.42**ultimate capacity**

The load or action at which a structure will collapse.

3.1.43**ultimate strength analysis**

The fitness-for-purpose analysis of a platform using nonlinear methods or equivalent linear methods to determine the platforms global ultimate capacity, often referred to as a "pushover."

3.2 Acronyms and Abbreviations

ALE	abnormal level earthquake
CP	cathodic protection
CFR	<i>Code of Federal Regulations</i>
CGF	conductor guide frame
CVI	close visual inspection
ELE	extreme level earthquake
FMD	flooded member detection
HEAT	Hurricane Evaluation and Assessment Team
HLV	heavy lift vessel
LRFD	load and resistance factor design
MLLW	mean lower low water

NDE	nondestructive examination, including visual examination
NDT	nondestructive testing
MSL	mean sea level
OCS	Outer Continental Shelf
ROV	remotely operated vehicle
RSR	reserve strength ratio
SIM	structural integrity management
SMR	strengthening, modification, and/or repair
SSSV	subsurface safety valve
UT	ultrasonic testing
WSD	working stress design

4 Structural Integrity Management Overview

4.1 General

SIM is a continuous process used for demonstrating the fitness-for-purpose of an offshore structure from installation through to decommissioning. SIM provides the process for understanding the effects of deterioration, damage, changes in loading, and accidental overloading. In addition, SIM provides a framework for inspection planning, maintenance, and repair of a platform or group of platforms. The SIM process, shown in Figure 1, consists of four primary elements: data, evaluation, strategy, and program.

Data includes information from the original design of the structure, inspection findings throughout the life of a structure, effects of damage and deterioration found through inspection, overloading, and changes in loading and/or use. Data may also emanate from technology development projects or in-service experience of similar structures within industry. Throughout the life of the platform, new data is collected through periodic inspections, results of accidental events, from planned modifications, or from additions to the platform. This data is subject to qualified engineering evaluation to demonstrate fitness-for-purpose and adjust the SIM strategy, if necessary. The results from the evaluation are used to develop and subsequently implement a topside, above- and below-water inspection strategy. The program is the implementation of the detailed inspection, maintenance, and repair work scopes, as defined from the SIM strategy.

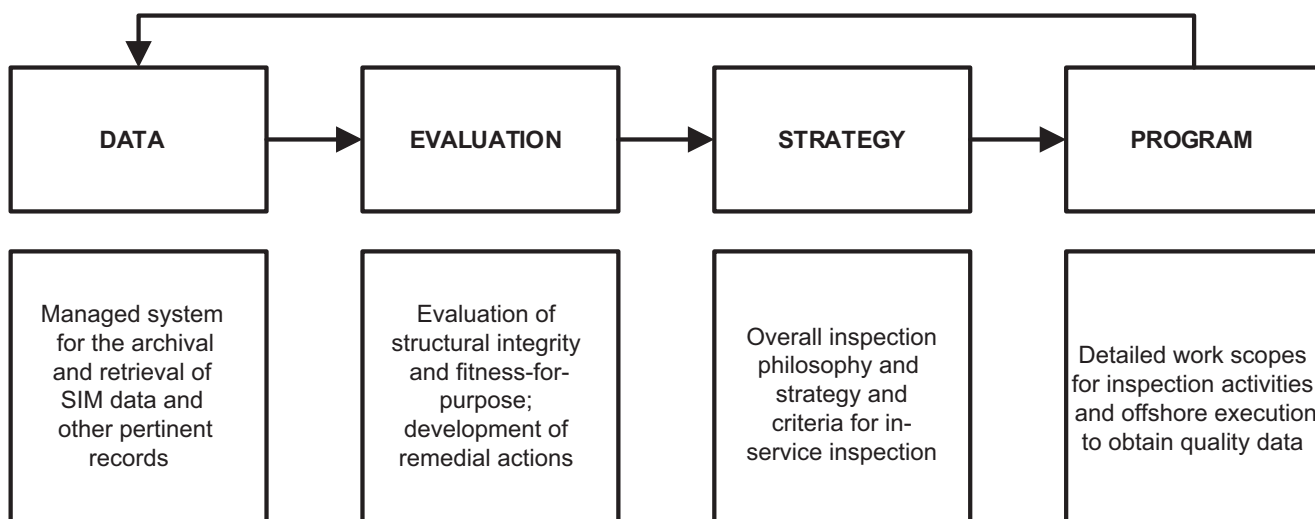


Figure 1—SIM Process

4.2 Competency

Broadly defined, competency is the experience gained through formal education and a combination of training, qualifications, understanding, and practicing skills. The engineer(s) involved in the SIM process should be knowledgeable of the following:

- a) offshore structural engineering and with the specific platform(s) under consideration;
- b) offshore construction, repair, and installation techniques and technologies;
- c) deterioration, damage evaluation, and mitigation;
- d) the differences between design and assessment engineering;
- e) risks to offshore structures;
- f) offshore inspection and construction planning, tools, and techniques;
- g) the general inspection findings in the offshore industry;
- h) anomalies that may trigger additional inspection or analysis.

Further description of competencies for each aspect of the SIM process is provided in the relevant section.

4.3 Risk

This recommended practice includes a risk-based approach to managing the structural integrity for existing offshore structures. Within this context, risk is defined as the combination of the likelihood of some event occurring during a time period of interest and the consequences (generally negative) associated with the event.

In mathematical terms, risk is expressed as:

$$\text{Risk} = \text{Likelihood} \times \text{Consequence}$$

The primary purpose of developing and implementing a risk-based approach is to highlight to the owner/operator risks from a safety/health/environment perspective and/or from an economic standpoint and appropriately target inspection, maintenance, and repair resources.

4.4 Limitations

4.4.1 Metocean Criteria

Metocean criteria are provided for the different exposure categories consistent with the supplement to the 20th Edition of API 2A-WSD that was subsequently adopted into the 21st Edition of API 2A-WSD. For certain exposure categories, use of the metocean criteria for assessment may leave an owner/operator with a platform that is vulnerable to damage or collapse in a hurricane, particularly for an L-2 or L-3 exposure category platform designed prior to the 20th Edition of API 2A-WSD.

4.4.2 Economic Risk

The assessment approach is structured so that the damage to or collapse of a platform will not increase life safety or environmental risk; however, it may create an economic burden to the owner in terms of facility and production losses. The determination of an acceptable level of economic risk is left to the operator's discretion. It may be beneficial for an operator to perform explicit cost-benefit risk analyses in addition to using the fitness-for-purpose performance criteria provided in this recommended practice.

4.4.3 Working Stress Design (WSD)

This recommended practice is based on WSD, although there is nothing to preclude the engineer from using load and resistance factor design (LRFD) as an acceptable alternative. However, no further guidance is given on the use of LRFD in this recommended practice.

5 Structural Integrity Management Process

5.1 General

Structural integrity management (SIM) is the process for demonstrating a structure's fitness-for-purpose over its entire life. SIM is a process for managing the effects of deterioration, damage, changes in loading, and accidental overloading.

The SIM process consists of four elements; data, evaluation, strategy, and program, which are described in detail in this section. A flowchart showing the components of the SIM process in relation to the organization of this recommended practice is shown in Figure 2.

The SIM process provides the opportunity for owners/operators and engineers to adopt risk principles for developing SIM strategies. The likelihood of failure during an extreme event such as a hurricane is the likelihood that a hurricane will occur at the platform location and is of sufficient magnitude to collapse or render the structure inoperable. The consequence of failure includes the potential for loss of life, environmental pollution, repairs, cleanup, facility replacement, site restoration, and the economic costs of deferred production. If the field is to be abandoned, then the consequence costs also may include the nonrecovery of hydrocarbon reserves, decommissioning, and restoration of the site. A risk-based approach recognizes that higher risk platforms may warrant more frequent, and more focused, inspection than lower risk platforms. During the development of an inspection strategy, the platform risk category may be used for setting survey intervals and work scopes as part of a risk-based SIM strategy. It is important to note that surveys alone do not guarantee structural integrity.

5.2 Data

5.2.1 General

Up-to-date platform information is required for the SIM process. Information on the original design, fabrication and installation (including results of structural analyses), in-service inspections, engineering evaluations, structural assessments, modifications, strengthening, repairs, and operational incidents all constitute parts of the SIM knowledge base.

SIM data falls into two broad categories: platform “characteristic data” and platform “condition data.”

5.2.2 Characteristic Data

The platform's characteristic data is the baseline data that represents the structure at installation. The characteristic data includes:

- general platform data,
- design data,
- fabrication data, and
- installation data.

This data is most easily collated into a data management system at the completion of the platform design/build/install phases of a project. Examples of characteristic data that should be considered for the SIM process are included in A.5.2.

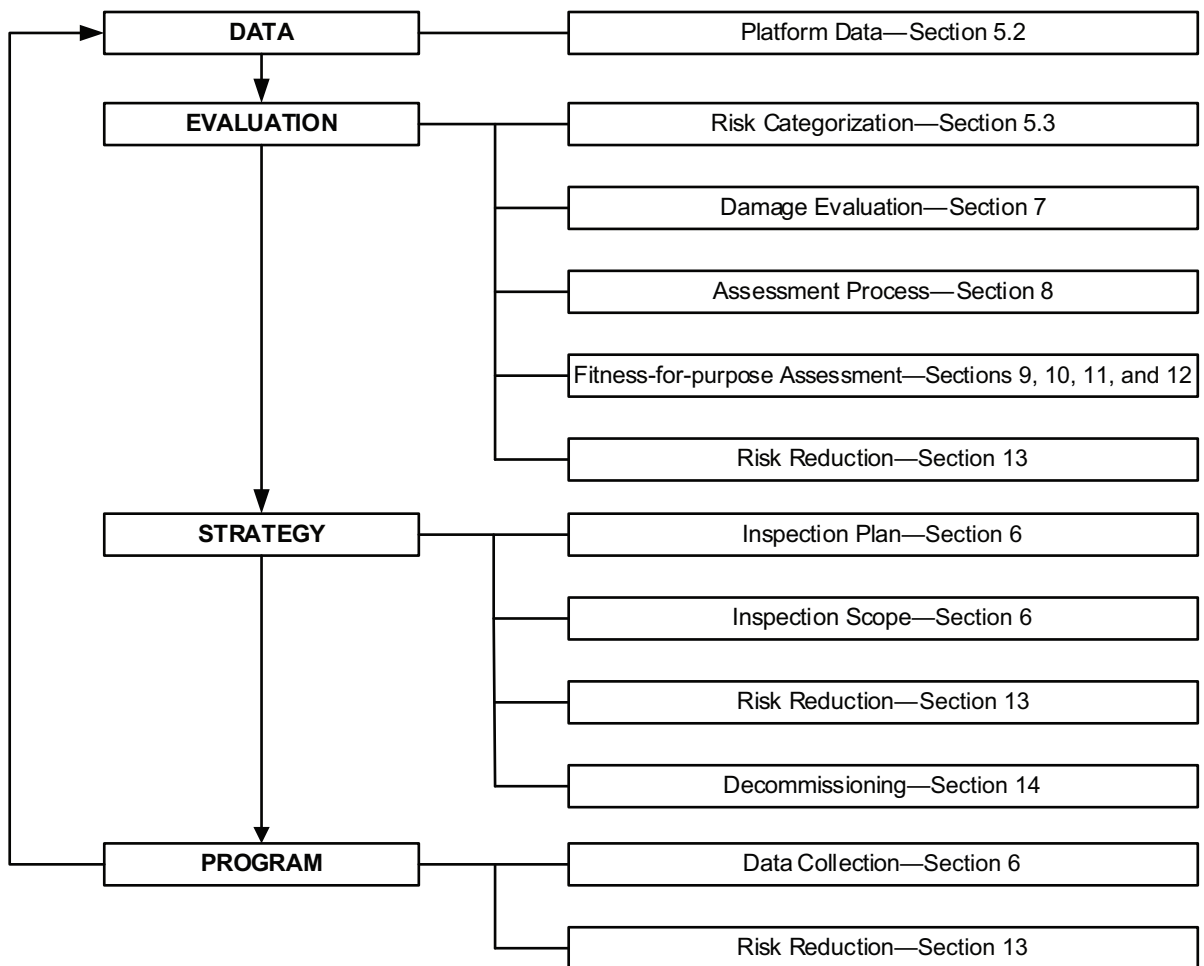


Figure 2—SIM Process and Document Organization

5.2.3 Condition Data

The platform condition data represents the changes to the characteristic data that may occur during the life of the platform. The condition data includes the following:

- a) in-service inspection data,
- b) damage evaluation data,
- c) corrosion protection data,
- d) SMR data,
- e) platform modifications,
- f) condition monitoring data,
- g) operational incident data.

5.2.4 Data Management

SIM data collected throughout the life of a platform should be maintained in a data management system. The data should be compiled in a timely manner and be in a form suitable to be retained as a permanent record. Data shall be collected during inspections and shall be defined by the SIM strategy. Examples of typical condition data are included in A.5.2.

The operator shall retain detailed records for the life of the platform. During change of ownership, the operator should transfer all platform data to the new operator.

5.3 Evaluation

5.3.1 General

SIM evaluation is the method of applying competent engineering to assess the impact that new data has on the fitness-for-purpose and the SIM strategy for the platform. Evaluation is routinely performed throughout the life of a platform. As additional data is collected, an evaluation should be performed by a competent structural engineer. The evaluation should consider all relevant SIM data for the platform and similar platforms, where appropriate. Evaluation does not automatically imply a detailed structural analysis; evaluation can include engineering judgment based on specialist knowledge or operational experience, simplified (screening) analysis, or reference to research data, detailed analysis of similar platforms, etc.

Recommendations for performing the data evaluation are provided in the following sections:

- a) factors to consider (see 5.3.2),
- b) risk categorization (see 5.3.3),
- c) the platform exposure category (see 5.3.4),
- d) the likelihood of platform failure (see 5.3.5),
- e) the requirement for platform assessment (see 5.3.6).

5.3.2 Factors to Consider

Evaluation requires consideration of numerous factors, including:

- a) platform age, condition, original design criteria;
- b) analysis results and assumptions for original design or subsequent assessment;
- c) platform reserve strength and degree of structural redundancy;
- d) degree of conservatism or uncertainty in metocean criteria;
- e) fabrication quality and occurrence of any rework or rewelding;
- f) occurrence of any damage during transportation or installation;
- g) extent of inspection during fabrication, transportation, and installation;
- h) in-service inspection findings;
- i) learning from other similar platforms;

- j) platform modifications, additions, and repairs/strengthening;
- k) accidental (i.e. fire, blast, vessel impact, dropped object, etc.) or metocean or other design event overload;
- l) fatigue sensitivity;
- m) past performance of corrosion protection system;
- n) criticality of platform to other operations;
- o) platform monitoring data.

In many instances much of this data will not be available; however, missing data may impact the evaluation, strategy and program for the ongoing SIM of the platform. Where characteristic data are not available, or are inaccurate, surveys of the structure and facilities should be considered to collect the necessary information. It may be more expedient to proceed with an appropriate premise, recognizing the inherent uncertainties and assumptions.

5.3.3 Risk Categorization

5.3.3.1 General

An owner/operator may choose to adopt a risk-based strategy to better focus inspection resources and optimize inspection planning. If a risk-based SIM strategy is adopted, platforms should be assigned to the risk category based upon the product of their exposure category, as defined in 5.3.4, and their likelihood of failure, as defined in 5.3.5.

5.3.3.2 Risk Matrix

Risk may 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 may be helpful in accomplishing this goal.

An example risk matrix is shown in Figure 3. In this figure, the exposure category and likelihood categories are arranged such that the highest risk ranking is toward the upper right-hand corner. Owner/operators may decide to adopt more detailed risk assessment techniques or more complex matrices to further subdivide the platform exposure category and/or likelihood.

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

5.3.3.3 Using a Risk Matrix

Risk categories may be used for setting inspection intervals and work scopes as part of a risk-based SIM strategy. For example, a 3×3 risk matrix, as shown in Figure 3, can be used to categorize the platforms as follows.

- a) Risk Level 1—Platforms that reside in this risk category should be considered for a major focus of resources, which may include an increased inspection frequency and intensity of inspection and/or more detailed engineering.
- b) Risk Level 2—Platforms that reside in this risk category may be considered for a moderate focus of resources.
- c) Risk Level 3—Platforms that reside in this risk category may be considered for less focus of resources, which may include a reduced inspection frequency and scope of inspection.

Exposure Category	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 3—Risk Categorization Matrix Example

5.3.4 Exposure Categories

5.3.4.1 General

Existing platforms are categorized by their life safety and environmental exposure to determine the criteria for fitness-for-purpose assessment and for developing inspection strategies.

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

Categories for life safety are as follows:

- S-1 is manned-nonevacuated,
- S-2 is manned-evacuated,
- S-3 is unmanned.

The consequence of failure should include consideration of the anticipated impact to the environment, and the possible economic impact through losses to the owner (platform and equipment repair or replacement, lost production, etc.), anticipated losses to other operators (lost production through trunk lines), and anticipated losses to industry and government.

Categories for consequence of failure are as follows:

- C-1 is high consequence of failure,
- C-2 is medium consequence of failure,
- C-3 is low consequence of failure.

The platform exposure category to be used is the more restrictive of either life safety or consequence of failure. Platform categorization may be revised over the life of the platform as a result of changes in factors affecting the platform life safety or platform consequence of failure.

The exposure category should be determined using the matrix provided in Table 1.

Table 1—Exposure Category Matrix

Life Safety Category	Consequence Category		
	C-1, High Consequence	C-2, Medium Consequence	C-3, Low Consequence
S-1 manned-nonevacuated	L-1 ^a	L-1 ^a	L-1 ^a
S-2 manned-evacuated	L-1	L-2	L-2
S-3 unmanned	L-1	L-2	L-3
^a In the U.S. Gulf of Mexico, the S-1 manned-nonevacuated category is applicable to the full population metocean design event. For sudden hurricanes and winter storms, it is possible that the platform will be manned-nonevacuated during these design events; however, for developing assessment criteria and for developing a default inspection program, these platforms should be categorized as S-2.			

5.3.4.2 Life Safety

5.3.4.2.1 General

The determination of the applicable category for life safety should be based on the descriptions defined in 5.3.4.2.2 through 5.3.4.2.4.

5.3.4.2.2 S-1 Manned-nonevacuated

The manned-nonevacuated category refers to a platform that is continuously (or nearly continuously) occupied by persons accommodated and living thereon and from which personnel evacuation prior to the design environmental event is either not intended or impractical. Design environmental events for which evacuation is not practical include winter storms, sudden hurricanes, and earthquakes.

A platform shall be categorized as S-1 manned-nonevacuated unless the particular requirements for S-2 or S-3 apply throughout the design service life of the platform.

5.3.4.2.3 S-2 Manned-evacuated

The manned-evacuated category refers to a platform that is normally manned except during a forecast design environmental event. For categorization purposes, a platform shall not be categorized as a manned-evacuated platform unless all of the following apply:

- reliable forecast of a design environmental event is technically and operationally feasible and the weather between any such forecast and the occurrence of the design environmental event is not likely to inhibit an evacuation;
- prior to a design environmental event, evacuation is planned;
- sufficient time and resources exist to safely evacuate all personnel from the platform and all other platforms likely to require evacuation for the same storm.

5.3.4.2.4 S-3 Unmanned

The unmanned category refers to a platform that is not normally manned or a platform that is not classified as either manned-nonevacuated or manned-evacuated. Platforms in this classification may include emergency shelters. However, platforms with permanent quarters are not defined as unmanned and should be classified as manned-nonevacuated or as manned-evacuated as defined in 5.3.4.2.3. An occasionally manned platform could be categorized as unmanned in certain conditions, as discussed in A.5.3.4.2.

5.3.4.3 Consequence of Platform Failure

5.3.4.3.1 General

The consequences of failure should include consideration of anticipated losses to the owner, the other operators, and the industry in general. The following descriptions of relevant factors serve as a basis for determining the appropriate category for the platform consequence of failure. In addition, the consequences of failure should consider the factors discussed in A.5.3.4.3. The consequence definitions for U.S. Gulf of Mexico platforms are contained in API 2A-WSD.

5.3.4.3.2 C-1 High Consequence

The high consequence of failure category refers to major platforms and/or those platforms that have the potential for well flow of either oil or sour gas in the event of platform failure. In addition, it includes platforms where the shut-in of the oil or sour gas production is not planned or not practical prior to the occurrence of the design event (such as areas with high seismic activity). Platforms that support major oil transport lines, as discussed in A.5.3.4.3.2, and/or storage facilities for intermittent oil shipment are also considered to be in the high consequence category.

5.3.4.3.3 C-2 Medium Consequence

The medium consequence of failure category refers to platforms where production would be shut in during the design event. All wells that could flow on their own in the event of platform failure must contain fully functional subsurface safety valves (SSSVs), which are manufactured and tested in accordance with the applicable API specifications. Oil storage is limited to process inventory and “surge” tanks for pipeline transfer.

5.3.4.3.4 C-3 Low Consequence

The low consequence of failure category refers to minimal platforms where production would be shut in during the design event. All wells that could flow on their own in the event of platform failure must contain fully functional SSSVs, which are manufactured and tested in accordance with applicable API specifications. These platforms may support production departing from the platform and low volume infield pipelines. Oil storage is limited to process inventory.

U.S. Gulf of Mexico platforms in this category include caissons and small well protectors with no more than five well completions either located on or connected to the platform and with no more than two pieces of production equipment. Total deck area (excluding helideck) is limited to 37 m² (400 ft²) and contains no more than two pieces of production equipment. In addition, platforms in this category are defined as structures in water depths not exceeding 30 m (100 ft).

5.3.5 Likelihood of Platform Failure

5.3.5.1 General

If the platform owner/operator chooses to adopt a risk-based SIM strategy, the SIM data should be evaluated to determine the likelihood of platform failure. The likelihood that a platform will fail as a result of loading, whether that is an extreme storm load, ice load, earthquake, or some other foreseeable design load, is a function of the robustness of the structure. Additional discussion and definition of robustness and damage tolerance is provided in A.5.3.

Each platform has a likelihood of failure based on key structural characteristics, such as the deck elevation and robustness provided by the number of legs and bracing configuration. Damage or deterioration may indicate that the strength of a platform has reduced, thus increasing the likelihood of failure.

The platform likelihood of failure should be categorized using qualitative, semiquantitative, or fully quantitative methods. The owner/operator may choose to select three or more categories of failure likelihood. General guidelines for three likelihood categories are defined in 5.3.5.2 through 5.3.5.4.

5.3.5.2 High Likelihood

The high likelihood of failure category refers to platforms that are likely to fail in the design event. This implies a reserve strength ratio (RSR) of less than 1.0 for the platform's present condition, including all modifications and known damage, against the 100-year environmental design event. Platforms in this category may have limited tolerance to damage or overload. Overload may result from having deck structure and/or equipment that could be inundated during the metocean event.

5.3.5.3 Medium Likelihood

The medium likelihood of failure category refers to platforms that are not expected to fail during the design event. However, these structures may sustain damage that requires inspection after the design event. These are essentially platforms that do not meet the high likelihood or low likelihood definitions.

5.3.5.4 Low Likelihood

The low likelihood of failure category refers to platforms that are very unlikely to fail under the design environmental event. This implies sufficient reserve strength in the platform's present condition, including all modifications and known damage, for the specified criteria. Such platforms should not suffer damage in the design environmental event, and they are robust and tolerant of any damage and overload that does occur.

5.3.6 Requirement for Platform Assessment

A platform fitness-for-purpose assessment is a detailed evaluation or structural analysis that compares the estimated strength of a structure against performance criteria. An assessment may also consist of comparing an actual proof or overload against the performance criteria. A fitness-for-purpose assessment of the structure shall be performed if the engineering evaluation of relevant SIM data determines that an assessment initiator, as defined in 8.3, has been triggered. This process is shown in Figure 4.

The assessment will determine whether a platform is fit-for-purpose or whether risk reduction measures should be considered. The structural assessment process is defined in Section 8. The fitness-for-purpose performance criteria, which are based on the platform exposure category as defined in 5.3.4, are provided in Section 9 for metocean loading assessments, Section 10 for fatigue loading, Section 11 for seismic loading, and Section 12 for ice loading.

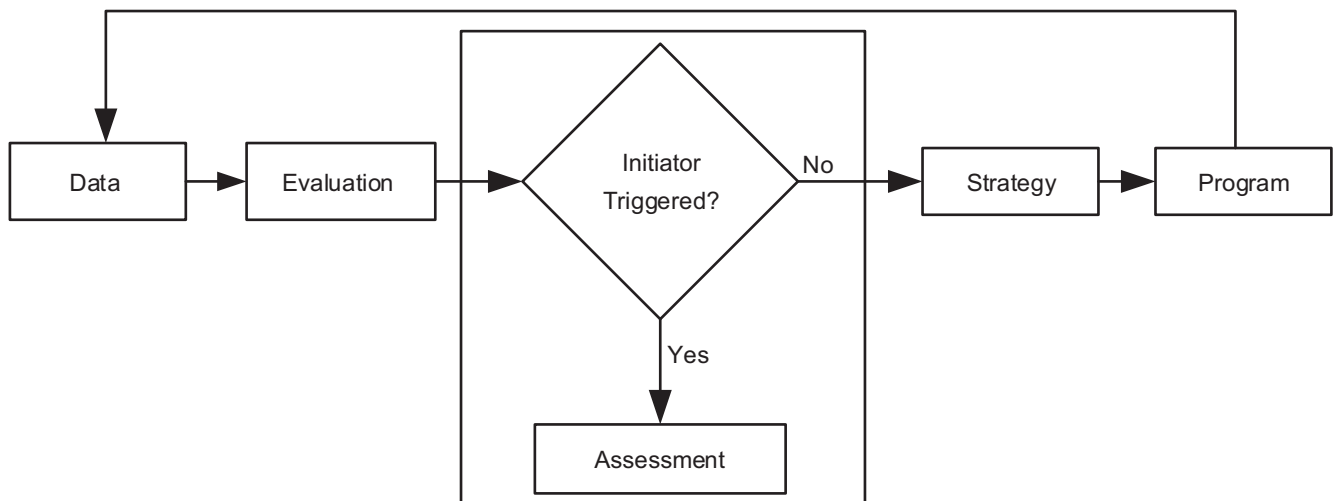


Figure 4—Assessment Within the SIM Process

5.4 Strategy

5.4.1 General

The SIM strategy defines the overall inspection philosophy and mitigation philosophy for the platform or fleet of platforms. This recommended practice provides guidance for the development of a SIM strategy based on the platform risk, as defined in 5.3.3, or platform exposure category, as defined in 5.3.4, with specific recommendations for inspection planning and mitigation and risk reduction options.

5.4.2 Inspection Plan

5.4.2.1 Inspection Scope

The inspection plan defines the frequency and scope of the inspection, the tools/techniques to be used, and the deployment methods. The inspection plan shall be developed for the operated platforms and shall cover a number of years. The plan should be periodically updated throughout the platform's service life following receipt and evaluation of relevant SIM data (e.g. inspection data, results of platform assessments, etc.). The following basic elements should be included in the inspection plan.

- a) Routine above-water inspections should be conducted to provide the information necessary to evaluate the condition of the platform topsides and should be conducted on an annual basis. Recommendations for the above-water inspections are provided in 6.3.
- b) Baseline underwater inspection should be conducted to determine the as-installed platform condition and as a benchmark for the future SIM of the platform. A baseline inspection shall be conducted prior to implementation of risk-based inspection. Recommendations for the baseline inspections are provided in 6.4.
- c) Routine underwater inspections should be conducted to provide the information necessary to evaluate the condition of the platform and appurtenances and should be conducted at an interval consistent with the SIM strategy adopted by the owner/operator. This may be a prescriptive exposure-based strategy with a default frequency and work scope or a more focused risk-based strategy. Recommendations for the routine underwater inspections are provided in 6.5.
- d) Special inspections are nonroutine inspections, which should be conducted after events such as a hurricane or collision. Recommendations for special inspections are provided in 6.6.

5.4.2.2 Inspection Strategy

Two contrasting routine inspection strategies can be used as part of the overall SIM strategy. Each approach is valid under different circumstances, and the choice of inspection strategy depends on the characteristics of the owner/operator structures inventory and the recommendations provided in Section 6. The following are two contrasting strategies.

- a) A significant commitment to ongoing in-service inspection with the goal of reducing the possibility of major repairs (clamps, member replacements) in the future. This approach relies on early detection of damage and defects with prompt implementation of relatively inexpensive repairs and preventive measures. Early detection of defects typically requires greater use of nondestructive testing (NDT) techniques.
- b) Minimization of in-service inspection scope where adequate measures have been taken to reduce the risk of damage, defects, or deterioration that would require major repair efforts in the future. This approach assumes that in-service inspection without the use of NDT techniques will be able to detect damage, defects, or deterioration before structural integrity is threatened. This approach may be appropriate for robust structures that are tolerant to damage and overload.

5.4.3 Risk Reduction

5.4.3.1 General

Exposure mitigation and likelihood reduction options should be considered at all stages of the SIM process.

5.4.3.2 Exposure Mitigation

Exposure mitigation is defined as changes that reduce the exposure of the platform. Mitigation includes measures that reduce the consequence of platform failure through hydrocarbon inventory reduction and by reducing the manning levels, either during a forecast event or permanently. Exposure mitigation recommendations are provided in 13.2.

5.4.3.3 Likelihood Reduction

Likelihood reduction is defined as modifications that reduce the likelihood of structural failure. It includes measures such as load reduction and/or an increase in system strength through global and or local strengthening and/or repairing known damage. Likelihood reduction recommendations are provided in 13.3.

5.5 Program

5.5.1 General

The SIM program represents the execution of the detailed work scope and should be conducted to complete the activities defined in the SIM strategy. The SIM program may include one or more of the following:

- baseline inspections,
- routine above-water inspections,
- routine underwater inspections,
- special inspections,
- SMR activities.

To complete the SIM process, all data collected during the SIM program should be incorporated back into the SIM data management system. Consistency, accuracy, and completeness of inspection records are important since these data form an integral part of the SIM system. Specific requirements for the execution of the work scope for any inspections, including data recording and reporting requirements, are provided in Section 6.

5.6 Decommissioning

Decommissioning is the process followed by the owner/operator of an offshore oil and/or gas facility to plan for, gain approval, and then implement the removal, disposal, or reuse of the platform structure, equipment, and associated pipelines and wells. The decommissioning process involves closing down operations at the end of field life, including permanently abandoning the wells, making the platform safe, removing some or all of the facilities, and reusing or disposing of them as appropriate. The stages of the decommissioning process are defined in Section 14.

Predecommissioning data gathering should be conducted to gain knowledge of the platform and associated facilities, wells, pipelines, risers, and subsea equipment where present. The SIM strategy should integrate with the decommissioning planning process to align late-life structural inspections to collect the condition data as defined in Section 6. In many cases it may be advantageous to permanently abandon wells as they become nonproductive or uneconomic to reduce the potential environmental and life safety exposure from platform failure.

6 Surveys

6.1 Inspection Strategy

The in-service inspection program is developed from the inspection strategy and will include above-water inspections and below-water inspections, as defined in 5.4. Details on the inspection strategy are provided in:

- 6.3 for above-water inspections,
- 6.4 for post-installation baseline below-water inspections,
- 6.5 for routine below-water risk-based (see 6.5.2) or exposure-based (see 6.5.3) inspections,
- 6.6 for nonroutine special inspections.

6.2 Personnel Qualifications

6.2.1 Planning

The work scope for the inspection including the preselection of areas for close visual or NDT should be compiled and approved by a competent structural engineer. The recommended qualifications for personnel employed in developing the inspection plan are provided in A.6.2.

6.2.2 Surveys

Surveys should be performed by qualified personnel. The personnel conducting above-water surveys (see 5.3) should be experienced in performing all surveys and in recognizing situations that could lead to damage, how to take cathodic protection (CP) readings, and how to review coating system conditions and deterioration.

The personnel conducting remotely operated vehicle (ROV) or diver surveys below water (see 5.4 and 5.5) should work with the guidance of personnel experienced in the methods to conduct cathodic potential surveys and/or visual inspection and other surveys of the underwater portion of a platform.

Only personnel trained and experienced in application of the survey method being used should perform NDT examination on the platforms.

6.3 Level I Surveys—Routine Above-water Inspection

6.3.1 General

The Level I survey should be carried out on an annual basis. The purpose of the inspection is to detect or verify the following.

- a) Indications of obvious overloading, deteriorating coating systems, excessive corrosion, and bent, missing, or damaged members of the structure in the splash zone and above water. Guidance on the grading of coating systems is provided in NACE SP0108.
- b) Damage or deterioration to appurtenances and personnel safety, escape, and evacuation devices.
- c) The performance of the platform's under water CP system using dry operator technique (e.g. a drop cell survey).

6.3.2 Above-water Visual Survey

The Level I survey should include an above-water visual examination of all structural members in the splash zone and above water, concentrating on the condition of the more critical areas such as deck legs, girders, trusses, members,

joints, leg/pile shim welds, etc. Components should be inspected for presence of damage, straightness, corrosion, weld integrity, and modifications.

If above-water damage is detected, a complete record of the damage should be made with sufficient detail to allow engineering personnel to determine if repairs or further NDT are required. Damage records should include detailed measurements, photographic documentation, and drawings. If the above-water survey indicates that underwater damage may have occurred, for example, a missing boat landing or previously unrecorded damage, an underwater inspection should be conducted as soon as conditions permit.

6.3.3 Coating Survey

The Level I survey should include a coating survey to assess the effectiveness and condition of the various protective coating systems on the topsides. The inspection should detect deteriorating coating systems and excessive corrosion. The inspection should describe the type of coating systems for the components inspected (i.e. Monel cladding or elastomers on the splash zone members and jacket legs, paint on the conductors, etc.) and record specific locations and extent of coating deterioration.

6.3.4 Underwater CP Survey

The Level I survey should include a below-water measurement over the full water depth of the CP system by silver/silver chloride drop cells or other approved drop cells. The survey should be performed to NACE SP0176 by qualified personnel.

6.3.5 Appurtenance and Personnel Safety Devices Surveys

6.3.5.1 General

The Level I survey should include an inspection of appurtenances and personnel safety devices for damage or deterioration. Appurtenances and personnel safety devices include handrails, grating, stairs, swing ropes, boat landings, helideck, bridges, supports to risers, survival craft supports, crane pedestals, communications tower deck connections, and structural elements supporting evacuation routes and temporary refuge. Crane pedestal support framing should be inspected in accordance with API 2D.

6.3.5.2 Conductor Visual Survey

During the Level I survey, a visual inspection of the overall condition of all conductors from the splash zone area and upward should be performed. The conductors should be inspected for coating condition, extent of corrosion, damage, presence of shims, movement, and operational status (i.e. flowing, shut in, temporarily abandoned, or permanently abandoned).

6.3.5.3 Riser Survey

Level I surveys should include a visual inspection of the overall condition of all risers from the splash zone area and upward. The risers should be inspected for breakdown of coating, the extent of corrosion, the integrity of supporting steelwork and clamps, and operational status (i.e. live, out-of-service, permanently abandoned).

6.3.5.4 Pipeline Flange Isolation

The Level I survey should include a review of the effectiveness of pipeline riser insulation kits. The purpose of this inspection is to assess the condition of pipeline flange insulation kits to determine if the pipeline riser is electrically isolated from the structure. In general, the survey is accomplished by taking measurements on either side of an actual or potential isolation barrier. Identical measurements indicate electric continuity whereas different measurements indicate isolation.

6.3.5.5 Attachment Tie-down Points

Level I surveys should include a walk-down survey to assess the vulnerability of relevant personnel safety equipment and supports to damage from shock loading and strong vibration induced from extreme metocean, seismic events, or accidental loadings. The survey should be performed in accordance with API 2TD. The walk-down is primarily a visual inspection, with special emphasis directed to tie-downs that may have been designed without consideration for lateral loads. The support may be permanent or temporary; however, sufficient data should be recorded to allow a competent engineer to evaluate the ability of the tie-down to resist lateral loads.

6.3.5.6 Escape Routes

During the Level I survey, a visual survey of the personnel escape routes should be performed. Escape routes consist of open decks, walkways, stairs, and landings. The routes should be established and surveyed to confirm clear access to the escape routes is provided from all locations on the structure. Swing ropes and connections should be examined for signs of damage or deterioration. API 54 provides further inspection guidance.

6.3.6 Deck Elevation Survey

In operational areas of known or suspected subsidence, the Level I survey should include a survey of the gap between the cellar deck bottom of steel and the mean water level.

For other areas, consideration should be given to measuring the deck elevation on a periodic basis to provide up-to-date and accurate information. Measurements may be made with a plumb line and should be recorded against the time of measurement to allow later agreement with tidal information or changes. Suspected subsidence or differential settlement of the structure should be recorded and if significant (e.g. the deck is lower than assumed) could trigger an assessment.

6.3.7 Supplemental Surveys

The Level I survey may include supplemental surveys to characterize damage as specified in the scope of work (e.g. NDT, material sampling, wall thickness measurements, etc.).

6.4 Baseline Underwater Inspection

A baseline underwater inspection should be performed to establish the as-installed platform condition. A baseline inspection shall be conducted prior to implementation of a risk-based inspection planning for the platform.

The minimum scope of work should consist of the following, unless the information is available from the installation records:

- a) a visual survey of the platform for structural damage, from the mudline to top of jacket, including coating integrity through the splash zone;
- b) a visual survey to verify the presence and condition of the anodes;
- c) a visual survey to confirm the presence and condition of installed appurtenances;
- d) measurement of the as-installed mean water surface elevation, with appropriate correction for tide and sea state conditions;
- e) record the as-installed platform orientation;
- f) measurement of the as-installed platform level.

6.5 Level II, III, and IV Surveys—Routine Underwater Inspection

6.5.1 General

Routine underwater platform inspections using either Level II, III, or IV surveys should be conducted to detect, properly measure, and record any platform defects, deterioration, or anomalies that affect the structural integrity. Platform deterioration may include excessive corrosion to welds and members, weld/joint damage (including deformation due to overload and cracking due to fatigue damage), and mechanical damage in the form of dents, holes, bows, and gouges. Anomalies may include nonoperating or ineffective corrosion protection system, scour, seafloor instability, hazardous or detrimental debris, and excessive marine growth.

The routine underwater inspection should be carried out at an interval consistent with the SIM strategy adopted by the owner/operator. Inspection intervals are provided based on either the platform risk as recommended in 6.5.2 or based on the platform exposure category as recommended in 6.5.3.

If during the course of an inspection program, anomalies are discovered that could potentially affect the structural integrity of the platform, conductors, risers and J-tubes, or appurtenances, qualified personnel should conduct an evaluation to determine if and when additional inspection and/or remedial measures should be undertaken. Additional inspection may require use of more detailed survey techniques. All damage, anomalies, and any follow-up activities shall be documented, with all records and reports retained.

6.5.2 Risk-based Inspection Program

6.5.2.1 General

Risk, as defined in 5.3.3, may be used as a basis for developing an in-service inspection program. A risk-based approach allows an owner/operator to prioritize and optimize the use of inspection resources. The risk-based strategy for the development of inspection scopes of work requires a thorough understanding of a platform's susceptibility to damage, the tolerance of damage, and the known condition.

For an owner/operator that has adopted a risk-based SIM strategy, surveys included in the inspection program should be consistent with the overall strategy, based on the data evaluation. The SIM strategy should be comprised of a risk-based inspection interval, a risk-based inspection scope, the relevant deployment method (diver versus ROV), and survey technique (general visual versus close visual/NDT).

The underwater inspection in a risk-based program should be a minimum of Level II; however, the risk-based inspection strategy should specify if Level III or Level IV inspections are required. Damage or deterioration found during a risk-based inspection may trigger a Level III or Level IV inspection.

6.5.2.2 Risk-based Inspection Intervals

Where the owner/operator has adopted a risk-based SIM strategy, the inspection intervals shown in Table 2 should be used. Platforms with higher consequence appurtenances may require more frequent inspection than that based on the structure's risk-based interval. In addition, the risk-based interval may require adjustment to account for the design life or present condition of the CP system.

Table 2—Risk-based Inspection Program Intervals

Risk Category	Inspection Interval Ranges
Higher	3 years to 5 years
Medium	6 years to 10 years
Lower	11 years to 15 years

The timing for the first risk-based underwater routine inspection should be determined from the completion date of the baseline inspection.

The setting of intervals between inspections greater than 10 years requires the operator/owner to demonstrate that the platform is unmanned, that risk of platform failure has been quantified through an ultimate strength analysis, that inspection trends are understood, and that annual Level I CP readings are performed and are acceptable. This interval is only applicable to structures designed to API 2A-WSD, 20th Edition and later.

6.5.3 Default Inspection Program

6.5.3.1 General

When the owner/operator has not adopted a risk-based inspection strategy, an exposure-based inspection program should be used. The exposure-based inspection program provides predefined in-service inspection intervals and survey levels.

6.5.3.2 Inspection Intervals

The inspection program intervals and survey requirements are shown in Table 3 and should be established based on the platform exposure category, as defined in 5.3.4.

6.5.4 Level II, III, and IV Surveys

6.5.4.1 Level II Survey

A Level II survey consists of general underwater visual inspection by divers or ROV to detect the presence of any or all of the following:

- a) deterioration due to corrosion;
- b) deformation or fracture due to accidental or metocean overloading;
- c) scour, seafloor instability, etc.;
- d) advanced fatigue cracking detectable in a visual swim-around;
- e) in-service damage (e.g. dents, holes, bows, cracks, abrasion, etc.);
- f) debris, and possible damage caused by the debris;
- g) excessive compressed soft or hard marine growth;
- h) condition of appurtenances.

The survey should include the measurement of cathodic potentials of preselected locations using divers or ROV. Detection of significant structural damage during a Level II survey should become the basis for the initiation of a Level III survey. The Level III survey, if required, should be conducted as soon as conditions permit.

6.5.4.2 Level III Survey

A Level III survey consists of an underwater visual inspection of preselected locations and/or, based on results of the Level II survey, areas of known or suspected damage. Such locations should be sufficiently cleaned of marine growth to permit thorough inspection (e.g. closure welds for prefabricated or cast nodes). Preselection of areas to be surveyed should be based on an engineering evaluation of areas particularly susceptible to structural damage or areas where repeated inspections are desirable in order to monitor their integrity over time.

Table 3—Default Inspection Program

Interval (Years)	Exposure Category ^a		
	L-3	L-2	L-1
	5–10	5–10	3–5
Level II			
General visual survey	X ^b	X ^b	X ^b
Damage survey	X	X	X
Debris survey	X	X	X
Marine growth survey	X	X	X
Scour survey	X ^c	X ^c	X ^c
Anode survey	X	X	X
Cathodic potential	X	X	X
Riser/J-tubes/caisson	X	X	X
Interval (Years)	Exposure Category ^a		
	L-3	L-2	L-1
	d	11–15	6–10
Level III			
Visual corrosion survey	X ^e	X ^e	X
Flooded member detection or member close visual inspection	X	X	X
Weld/joint close visual inspection, after cleaning to bright metal	If required	If required	X
Level IV ^f			
Weld/joint NDT	g	g	g
Wall thickness	g	g	g
^a Exposure category is defined in 5.3.4. ^b Detection of significant structural damage should form the basis for initiation of a Level III survey in 6.5.1. ^c If seafloor is conducive (loose sand) or seafloor instability is known/suspected, a scour survey should be performed. ^d Only required if the results from the Level II survey indicate suspected damage. ^e Not required if the annual above-water inspection CP survey indicates uninterrupted protection below water. ^f Only required if the results from the Level III survey indicate suspected damage. ^g Surveys should be performed as indicated in 5.5.4.3.			

Flooded member detection (FMD) can provide an acceptable alternative to close visual inspection (CVI) (Level III) of preselected areas. Engineering judgment should be used to determine optimum use of FMD and/or CVI of joints. For example, FMD cannot detect punching shear or fatigue failure of the chord at the ends of the member being surveyed. CVI of preselected locations for corrosion monitoring should be included as part of the Level III survey.

Detection of significant structural damage during a Level III survey should become the basis for initiation of a Level IV survey in those instances where visual inspection alone cannot determine the extent of damage. The Level IV survey, if required, should be conducted as soon as conditions permit.

6.5.4.3 Level IV Survey

A Level IV survey consists of underwater NDT of preselected locations and/or, based on the results of the Level III survey, areas of known or suspected damage. A Level III and/or Level IV survey of fatigue-sensitive joints and/or locations susceptible to cracking could be used to detect early stage fatigue cracking.

If crack indications are reliably reported, they should be assessed by a competent engineer. Suspected false alarms may be resolved by a second inspection using a different method or by shallow surface grinding.

6.5.4.4 Preselected Survey Locations

It is important to the effectiveness of each survey to select a sufficient number of inspection locations to provide representative condition data on the overall structure. Where the SIM strategy determines that close visual survey is required, the selection of the welded joints to be surveyed should be made by a competent engineer familiar with the SIM strategy for the platform.

Selection of survey locations should include consideration of the following:

- a) data collected from the baseline survey,
- b) relevant information about the specific platform(s) under consideration,
- c) general inspection findings in the offshore industry,
- d) the significance of members and joints to the platform system capacity,
- e) the platform robustness and damage tolerance,
- f) joint and member stresses and stress concentrations,
- g) joint fatigue lives.

During platform design and any subsequent assessment, members and joint loading should be recorded and used to define requirements for future platform surveys.

While fatigue has not been a common problem for primary structural members in U.S. Gulf of Mexico platforms, fatigue damage and subsequent structural member failures have occurred in the upper conductor guide framing of some older platforms. This damage can occur if conductor framing is plated, which increases the vertical wave loading area. Conductor guides located at (–) 12 m (40 ft) or shallower are particularly susceptible, although cracking has been seen in water depths up to (–) 43 m (140 ft). This type of fatigue damage is identified by fatigue cracks at the 12 o'clock and/or 6 o'clock positions of the members supporting the conductor tray and is not typically identified by standard structural strength or fatigue analysis. Specific inspection of these areas should be considered for platforms with this type of conductor framing. FMD can be useful in locating this type of damage.

6.6 Special Inspections

6.6.1 General

Special inspections are nonroutine inspections. Data collected during a special inspection is needed to evaluate the structural condition of a platform for a specific purpose. Details on the inspection program for five types of special inspections are provided in:

- 6.6.2 for strengthening, modification, and repair monitoring;

- 6.6.3 for post-event inspections;
- 6.6.4 for inspection for assessment;
- 6.6.5 for inspection for decommissioning; and
- 6.6.6 for inspection for reuse.

Subject to qualified engineering evaluation, the timing of a special inspection may be advanced or delayed to coincide with other planned inspections. The planned routine scope of work should be adjusted to ensure that the special inspection data is also collected. Particular attention should be given to detecting damage and indirect signs of damage, such as localized areas of missing marine growth. Specific details of the work scopes are provided in 6.7.

6.6.2 SMR and Damage Monitoring

Special inspections should be performed to determine the performance of structural or appurtenance repairs, for example, nondestructive examination (NDE) of underwater wet welds and tightness of bolts in stressed clamps or mechanical connectors. Special inspections should also be performed to determine if damage that has been evaluated through the assessment process as not requiring a repair has become more extensive through fatigue, corrosion, or another mechanism.

The integrity of SMRs to areas of the structure that are critical to its structural integrity should be confirmed by visual inspection (with marine growth cleaning as necessary) within a reasonable time frame following the completion of the SMR work. The inspection frequency of the SMR should be determined as part of the overall SIM strategy.

6.6.3 Post-event Inspections

6.6.3.1 General

Post-event inspections are conducted to evaluate the platform's structural condition following a potential overload event (storm, earthquake, mudslide, tsunami, ice) or incident (vessel impact, dropped objects, explosion, abrasion, floating debris, riser damage from anchor drag on pipeline). All post-event inspections should be developed based on an evaluation of the available data, including any event/incident reports.

6.6.3.2 Potential Overload

Above-water inspection should be conducted after direct exposure to the extreme design event (e.g. extreme storm, hurricane, ice movement or earthquake, etc.). A general visual underwater survey should be conducted if the above-water inspection indicates overload or wave-in-deck and/or if underwater damage may have occurred. The minimum scope consists of the following.

- a) A visual inspection without marine growth cleaning that provides full coverage from seafloor to top of jacket of the platform structure (members and joints), conductors, risers, and various appurtenances. This inspection includes checking the seabed conditions at the legs/piles and looking for scour, debris, or damage.
- b) Visual confirmation of the existence of the CP system (i.e. sacrificial anodes, impressed current, cables, electrodes, etc.).

Particular attention should be given to detecting damage and indirect signs of damage, such as areas of missing marine growth.