

DIN EN ISO 19345-2



ICS 75.200

**Erdöl- und Erdgasindustrie –
Fernleitungstransportsysteme –
Leitfaden für das Integritätsmanagement von Fernleitungen – Teil 2:
Integritätsmanagement des vollständigen Lebenszyklus von Offshore-
Fernleitungen (ISO 19345-2:2019);
Englische Fassung EN ISO 19345-2:2019, nur auf CD-ROM**

Petroleum and natural gas industry –
Pipeline transportation systems – Pipeline integrity management specification –
Part 2: Full-life cycle integrity management for offshore pipeline (ISO 19345-2:2019);
English version EN ISO 19345-2:2019, only on CD-ROM

Industries du pétrole et du gaz naturel –
Systèmes de transport par conduites –
Spécification de gestion de l'intégrité des conduites – Partie 2: Gestion de l'intégrité des
conduites en mer pendant leur cycle de vie complet (ISO 19345-2:2019);
Version anglaise EN ISO 19345-2:2019, seulement en CD-ROM

Gesamtumfang 109 Seiten

DIN-Normenausschuss Erdöl- und Erdgasgewinnung (NÖG)
DIN-Normenausschuss Materialprüfung (NMP)

Nationales Vorwort

Dieses Dokument (EN ISO 19345-2:2019) wurde vom Technischen Komitee ISO/TC 67 „Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries“ Subkomitee SC 2 „Pipeline transportation systems“ in Zusammenarbeit mit dem Technischen Komitee CEN/TC 12 „Materialien, Ausrüstungen und Offshore-Bauwerke für die Erdöl-, petrochemische und Erdgasindustrie“ (Sekretariat: NEN, Niederlande) erarbeitet.

Für Deutschland hat hieran der Arbeitsausschuss NA 109-00-02 AA „Fernleitungssysteme - Spiegelausschuss zu ISO/TC 67/SC 2“ im DIN-Normenausschuss Erdöl- und Erdgasgewinnung (NÖG) mitgearbeitet.

Diese Europäische Norm enthält unter Berücksichtigung des DIN-Präsidialbeschlusses 1/2004 nur die englische Fassung von EN ISO 19345-2:2019.

Für die in diesem Dokument zitierten internationalen Dokument wird im Folgenden auf die entsprechenden deutschen Dokumente hingewiesen:

ISO 15589-2	siehe	DIN EN ISO 15589-2
ISO 16708	siehe	DIN EN ISO 16708
ISO 31000	siehe	DIN ISO 31000
ISO/TS 12747	siehe	DIN CEN ISO/TS 12747
IEC 31010	siehe	DIN EN 31010

Nationaler Anhang NA (informativ)

Begriffe, Symbole und Abkürzungen

Reihenfolge und Inhalt der folgenden Begriffe, Symbole und Abkürzungen sind identisch mit denen im Abschnitt „Begriffe, Symbole und Abkürzungen“ der englischen Fassung.

3.1 Begriffe

Für die Anwendung dieses Dokuments gelten die folgenden Begriffe.

ISO und IEC stellen terminologische Datenbanken für die Verwendung in der Normung unter den folgenden Adressen bereit:

- ISO Online Browsing Platform: verfügbar unter <http://www.iso.org/obp>
- IEC Electropedia: verfügbar unter <http://www.electropedia.org/>

3.1.1

Stilllegung

Aktivitäten im Zusammenhang mit der dauerhaften Außerbetriebnahme einer Rohrleitung

Anmerkung 1 zum Begriff: Eine stillgelegte Rohrleitung kann nicht wieder in Betrieb genommen werden.

Anmerkung 2 zum Begriff: Je nach Gesetzgebung kann die Stilllegung die Abdeckung oder den Rückbau erfordern.

3.1.2

Anomalie

mögliche Abweichung des Rohrwerkstoffs oder der Schweißnaht vom einwandfreien Zustand

Anmerkung 1 zum Begriff: Anzeichen für eine Anomalie können durch zerstörungsfreie Prüfungen, wie z. B. Inline-Inspektion, erkannt werden.

3.1.3

Zustandsbeurteilung

erste Integritätsbeurteilung vor oder nach dem Betrieb

3.1.4

kathodischer Korrosionsschutz

Korrosionsschutzverfahren, bei dem die äußere Korrosion von Rohrleitungen aus Metall verhindert oder verringert wird, indem ein elektrischer Strom an das Rohr angelegt wird, um erhöhte negative elektrische Potentiale zu erzielen

3.1.5

Korrosion

Qualitätsminderung eines Werkstoffs, üblicherweise eines Metalls, die aus einer elektrochemischen Reaktion mit seiner Umgebung resultiert

3.1.6

Riss

Flächenfehler oder lineare Störstelle mit einem scharfen Spitzenradius

3.1.7

Bereich kritischer Folgen

Stelle, an der eine Freisetzung aus der Rohrleitung signifikant nachteilige Auswirkungen auf die öffentliche Sicherheit, Eigentum und die Umwelt haben könnte

Anmerkung 1 zum Begriff: Die in CCA befindlichen Rohrleitungsabschnitte sind bei Risikobeurteilungen und bei Bewertungen und Priorisierungen im Rahmen von Integritätsbeurteilungen von besonderem Interesse.

3.1.8

Deaktivierung

Außerbetriebsetzung einer Rohrleitung, obwohl diese nach einer vorschriftsmäßigen Beurteilung wieder in Betrieb genommen werden könnte

Anmerkung 1 zum Begriff: Wird auch als Außerbetriebnahme oder vorübergehende Absperrung definiert.

3.1.9

Verformung

Änderung der Form des Rohrs oder Bauteils, wie z. B. eine Krümmung, ein Knick, eine *Delle* (3.1.11), Ovalität, Rippeln, Falten oder jede sonstige Änderung, die Einfluss auf die Rundheit des Rohrs oder den ursprünglichen Querschnitt oder die Geradheit des Rohrs oder Bauteils hat

3.1.10

Fehler

Mangel einer Art oder Größenordnung, die die Annehmbarkeitskriterien überschreitet

3.1.11

Delle

Vertiefung, die eine Störung der Krümmung der Rohrwand erzeugt und durch den Kontakt mit einem Fremdkörper verursacht ist, die zu einer plastischen Verformung der Rohrwand führt

3.1.12

rechnerische Lebensdauer

Zeitraum, innerhalb dessen die Konstruktionsgrundlage Gültigkeit behalten soll

[QUELLE: ISO 13623:2017, 3.1.2]

3.1.13

Ausfall

Ereignis, bei dem ein Bauteil oder System nicht in Übereinstimmung mit den dafür geltenden Betriebsanforderungen arbeitet

3.1.14

Gebrauchstauglichkeit

quantitative ingenieurstechnische Bewertung, die vorgenommen wird, um die strukturelle Integrität eines in Betrieb befindlichen Bauteils nachzuweisen, das einen Mangel, *Fehler* (3.1.10) oder Schaden aufweisen kann

3.1.15

Riefe

Oberflächenschaden an einer Rohrleitung, die durch den Kontakt mit einem Fremdkörper verursacht wird, der durch Schrammen Material aus dem Rohr abgetragen (gerieft) hat, was zu Fehlern oder Mängeln in Form von Metallverlust führt

3.1.16**Störfall**

durch den *Ausfall* (3.1.13) einer Rohrleitung verursachte unabsichtliche Freisetzung von Gas oder Flüssigkeit

Anmerkung 1 zum Begriff: Einige Regelungsbehörden definieren „Störfall“ als an einer Rohrleitung auftretendes Ereignis, das der Betreiber der zuständigen Regelungsbehörde zu melden verpflichtet ist.

3.1.17**Inline-Inspektion**

Inspektion der Innenseite einer Rohrwand mithilfe spezieller Werkzeuge

3.1.18**Integritätsbeurteilung**

Prozess, der die Inspektion und Prüfung einer Rohrleitung umfasst, um physikalische Eigenschaften zu ermitteln und den Integritätszustand der Rohrleitung zu bewerten, durch eine Kombination aus einer Datenanalyse, der Anwendung von Methodiken zur Zuverlässigkeitsbewertung des Objektes sowie einer Beurteilung des sicherheitsbezogenen Zustands der Rohrleitung

3.1.19**Integritätsmanagementplan**

dokumentiertes Programm, das die Verfahren festlegt, die von der Betreiberfirma anzuwenden sind, um den sicheren, umweltverträglichen und zuverlässigen Betrieb eines Rohrleitungssystems über dessen gesamte Lebensdauer proaktiv zu lenken und zu verwalten, und das einen fortwährenden Verbesserungsprozess umfasst

3.1.20**Verlängerung der Lebensdauer**

zusätzlicher Zeitraum, der sich an die ursprüngliche rechnerische Lebens- oder *Nutzungsdauer* (3.1.36) anschließt, (die in der Beurteilung ermittelte Restlebensdauer jedoch nicht überschreitet) und für den die zuständigen Behörden die Genehmigung zum Weiterbetrieb des Rohrleitungssystems erteilt haben

Anmerkung 1 zum Begriff: Die Verlängerung der Lebensdauer wird als Modifizierung der Konstruktionsgrundlage angesehen.

[QUELLE: ISO/TS 12747:2011, 3.7]

3.1.21**magnetischer Streufluss**

Verfahrensweise der Inline-Inspektion, bei der in der Rohrwand zwischen zwei Magnetpolen ein Magnetfeld induziert wird

Anmerkung 1 zum Begriff: Anomalien beeinträchtigen die Verteilung des magnetischen Streuflusses in der Rohrwand. Für den Nachweis und zur Beschreibung der Anomalien wird das magnetische Streuflussmuster herangezogen.

3.1.22**Änderungsmanagement**

Prozess, mit dessen Hilfe Änderungen technischer, physischer, verfahrenstechnischer oder organisatorischer Art, die Einfluss auf die Systemintegrität haben können, systematisch erfasst und den erforderlichen Parteien mitgeteilt werden

3.1.23**Herstellungsfehler**

während der Herstellung des Rohrs oder Bauteils oder bei dessen Beschichtung entstandener *Fehler* (3.1.10) im Rohrkörper oder der Beschichtung

3.1.24

höchstens zulässiger Arbeitsdruck

höchster Innendruck, mit dem ein Rohrleitungssystem oder dessen Teile betrieben werden darf/dürfen

Anmerkung 1 zum Begriff: Der MAOP (en: maximum allowable operating pressure) wird durch den während der Prüfung erreichten Höchstdruck festgelegt (siehe ISO 13623).

3.1.25

Metallverlust

Rohrleitungsanomalie, in der Metall abgetragen wurde

Anmerkung 1 zum Begriff: Metallverlust ist üblicherweise die Folge von Korrosion, es können aber auch Riefen, Herstellungsfehler, Erosion oder mechanische Beschädigung zu Metallverlust führen.

3.1.26

zerstörungsfreie Prüfung

große Gruppe von Analyseverfahren, die zur Bewertung der Eigenschaften von Werkstoffen, Bauteilen oder Systemen dienen, ohne diese zu beschädigen

Anmerkung 1 zum Begriff: Häufig werden auch „zerstörungsfreie Inspektion“ (en: non-destructive inspection, NDI) und „zerstörungsfreie Bewertung“ (en: non-destructive evaluation, NDE) verwendet, um diese Technologie zu beschreiben.

3.1.27

Offshore-Rohrleitung

Teil eines Rohrleitungssystems, das mit Ausnahme von Steigleitungen auf dem Meeresboden oder im Meeresboden in einem Graben verlegt wird

Anmerkung 1 zum Begriff: Die Rohrleitung könnte ganz oder teilweise auf dem Meeresboden aufliegen oder im Meeresboden verlegt werden.

3.1.28

Betreiber

Person oder Organisation, die ein Rohrleitungssystem oder Rohrleitungseinrichtungen besitzt oder betreibt und die die endgültige Verantwortung für den Betrieb und die Integrität des Rohrleitungssystems trägt

3.1.29

Rohrleitungsintegritätsmanagement

Gruppe von Prozessen und Verfahrensweisen, die proaktiv den störungsfreien sicheren und umweltverträglichen Transport von Fluiden durch ein Rohrleitungssystem sicherstellt

3.1.30

Rohrleitungsintegritätsmanagementplan

auf fortwährende Verbesserung ausgerichtetes Kreislaufsystem, das zur Umsetzung von Funktionen wie Datenerfassung und -integration, Integritäts- und *Risikobeurteilung* (3.1.33), Risikominderung und Reparaturmaßnahmen sowie für die im Rahmen der Wartung erforderlichen Entscheidungsprozesse Informationstechnik mit umfassendem Änderungsmanagement und kontinuierlichen Überprüfungs- und Verbesserungsprozessen nutzt

3.1.31

Druckprüfung

Hilfsmittel zur Beurteilung der Integrität einer neuen oder bestehenden Rohrleitung, die das Befüllen der Rohrleitung mit Wasser und deren Druckbeaufschlagung bis zu einem über dem MAOP liegenden Wert einschließen, um nachzuweisen, dass die Rohrleitung für den Betrieb beim MAOP über einen gegebenen und von den ermittelten Integritätsgefährdungen abhängigen Zeitraum geeignet ist

Anmerkung 1 zum Begriff: Siehe ISO 13623:2017, 6.7.

3.1.32**Risiko**

Maß für den entweder qualitativen oder quantifizierbaren Verlust in Bezug auf sowohl die Wahrscheinlichkeit eines Störfalls als auch die Größenordnung der Folgen eines Störfalls

3.1.33**Risikobeurteilung**

systematischer, analytischer Prozess, bei dem die von dem Rohrleitungssystem ausgehenden potentiellen Gefährdungen proaktiv ermittelt und die Wahrscheinlichkeit und die Folgen möglicher nachteiliger Ereignisse bestimmt werden

3.1.34**Risikomanagement**

koordinierte Tätigkeiten zum Leiten und Lenken einer Organisation in Bezug auf das *Risiko* (3.1.32)

[QUELLE: ISO Guide 73:2009, 2.1]

3.1.35**sicherer Arbeitsdruck**

Druck, der unter Anwendung der für die spezielle erkannte *Fehlerart* (3.1.10) geeigneten Analyse und mathematischen Gleichungen berechnet wird

BEISPIEL Bei Korrosionsfehlern werden Gleichungen für die erkannte verbleibende Festigkeit korrodierter Rohrleitungen, wobei alle korrodierten Bereiche einem berechneten sicheren Arbeitsdruck standhalten, angewendet.

3.1.36**Nutzungsdauer**

Zeitspanne, die für den Betrieb des Rohrleitungssystems vorgesehen ist

[QUELLE: ISO/TS 12747:2011, 3.21]

Anmerkung 1 zum Begriff: Als Nutzungsdauer gilt die tatsächliche Betriebsdauer bis zum gegenwärtigen Datum, sie kann jedoch alle künftig geplanten Nutzungen der Leitung umfassen. Die Nutzungsdauer kann kürzer oder länger als die rechnerische Lebensdauer sein.

3.1.37**Maßgenauigkeit**

Genauigkeit, mit der Maße oder Eigenschaften einer Anomalie angegeben werden

Anmerkung 1 zum Begriff: Üblicherweise wird die Genauigkeit in Form von Grenzabweichungen und Sicherheiten angegeben.

BEISPIEL Die Tiefenmaßgenauigkeit für den mithilfe zerstörungsfreier Prüfverfahren, wie z. B. einem ILI-Werkzeug, gemessenen Metallverlust wird üblicherweise mit $\pm 10\%$ der Wanddicke (Grenzabweichung) und 80 % der Zeit (Sicherheit) angegeben.

3.1.38**Beschädigung durch Dritte**

Beschädigung der Rohrleitung aufgrund von Tätigkeiten von Personen, die nicht zu dem mit der Rohrleitung befassten Personal gehören

3.1.39**Bedrohung**

Tätigkeit oder Zustand, die/der, sofern nicht angemessen gesteuert, das Rohrleitungssystem beeinträchtigen kann

[QUELLE: ISO/TS 12747:2011, 3.23]

3.2 Abkürzungen

AC	Wechselstrom (en: alternating current)
CP	kathodischer Schutz (en: cathodic protection)
CCA	Bereich kritischer Folgen (en: critical consequence area)
CoF	Folgen eines Ausfalls (en: consequence of failure)
DA	direkte Beurteilung (en: direct assessment)
ECDA	direkte Beurteilung von Korrosion an der Außenseite (en: external corrosion direct assessment)
FFP	Gebrauchstauglichkeit (en: fitness for purpose)
GIS	Geoinformationssystem (en: geographic information system)
HIC	wasserstoffinduzierte Rissbildung (en: hydrogen-induced cracking)
ICDA	direkte Beurteilung von Korrosion an der Innenseite (en: internal corrosion direct assessment)
ILI	Inline-Inspektion (en: in-line inspection)
IMP	Integritätsmanagementplan (en: integrity management program)
MAOP	größtmöglicher zulässiger Arbeitsdruck (en: maximum allowable operating pressure)
MFL	magnetischer Streufluss (en: magnetic flux leakage)
NDT	zerstörungsfreie Prüfung (en: non-destructive testing)
PIM	Rohrleitungsintegritätsmanagement (en: pipeline integrity management)
PoF	Ausfallwahrscheinlichkeit (en: probability of failure)
SCC	Spannungsrissskorrosion (en: stress corrosion cracking)
SCCDA	direkte Beurteilung von Spannungsrissskorrosion (en: stress corrosion cracking direct assessment)
SMYS	festgelegte Mindeststreckgrenze (en: specified minimum yield strength)
SSC	Sulfid-Spannungsrisssbildung (en: sulfide-stress cracking)

Nationaler Anhang NB (informativ)

Literaturhinweise

DIN CEN ISO/TS 12747, *Erdöl- und Erdgasindustrie — Rohrleitungstransportsysteme — Empfehlungen für die Verlängerung der Lebensdauer von Rohrleitungen*

DIN EN 31010, *Risikomanagement — Verfahren zur Risikobeurteilung*

DIN EN ISO 15589-2, *Erdöl- und Erdgasindustrie — Kathodischer Schutz für Transportleitungssysteme — Teil 2: Offshore-Pipelines*

DIN EN ISO 16708, *Erdöl- und Erdgasindustrie — Rohrleitungstransportsysteme — Zuverlässigkeitsanalysen*

DIN ISO 31000, *Risikomanagement — Leitlinien*

— Leerseite —

English Version

**Petroleum and natural gas industry - Pipeline
transportation systems - Pipeline integrity management
specification - Part 2: Full-life cycle integrity management
for offshore pipeline (ISO 19345-2:2019)**

Industries du pétrole et du gaz naturel - Systèmes de
transport par conduites - Spécification de gestion de
l'intégrité des conduites - Partie 2: Gestion de
l'intégrité des conduites en mer pendant leur cycle de
vie complet (ISO 19345-2:2019)

Erdöl- und Erdgasindustrie -
Fernleitungstransportsysteme - Leitfaden für das
Integritätsmanagement von Fernleitungen - Teil 2:
Integritätsmanagement des vollständigen
Lebenszyklus von Offshore Fernleitungen
(ISO 19345-2:2019)

This European Standard was approved by CEN on 9 February 2019.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (EN ISO 19345-2:2019) has been prepared by Technical Committee ISO/TC 67 "Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries" in collaboration with Technical Committee CEN/TC 12 "Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries" the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2019, and conflicting national standards shall be withdrawn at the latest by December 2019.

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Endorsement notice

The text of ISO 19345-2:2019 has been approved by CEN as EN ISO 19345-2:2019 without any modification.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*, Subcommittee SC 2, *Pipeline transportation systems*.

A list of all parts in the ISO 19345 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document addresses the integrity of petroleum and natural gas pipelines through their entire life-cycle, from design to eventual abandonment. For this reason, considerations relating to design, construction and abandonment have been included. This approach supports the development and implementation of a holistic and integrated pipeline integrity management program that bridges between life-cycle elements and thereby avoids compartmentalizing of the pipeline life-cycle into essentially independent data and functional silos, which has traditionally been the case. The integrated approach was developed on the basis of extensive research and examination of best practices and results from pipeline integrity audits world-wide.

This document is intended to be used by companies that have not yet developed an official program or are developing a program for new pipelines. This document can also be used to guide continual improvement of existing programs by both operating companies and regulators to evaluate integrity management program effectiveness.

Petroleum and natural gas industry — Pipeline transportation systems — Pipeline integrity management specification —

Part 2: Full-life cycle integrity management for offshore pipeline

1 Scope

This document specifies requirements and gives recommendations on the management of integrity of a pipeline system throughout its life cycle, which includes design, construction, commissioning, operation, maintenance and abandonment.

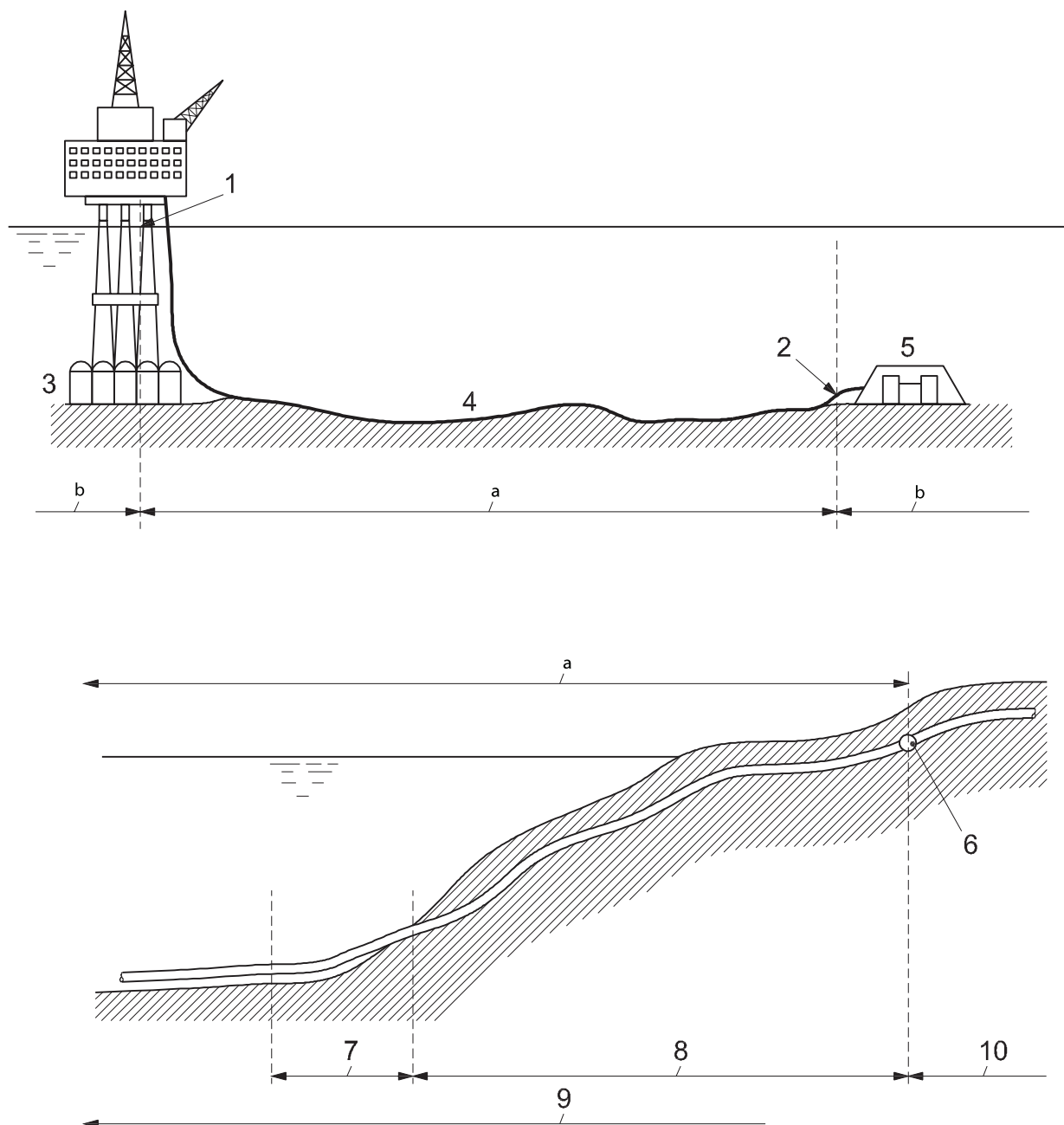
This document is applicable to offshore pipelines for transporting petroleum and natural gas. It is applicable to rigid steel pipelines. It is not applicable to flexible pipelines, dynamic risers or those constructed from other materials, such as glass-reinforced plastics.

NOTE 1 An offshore pipeline system extends to:

- the first valve, flange or connection above water on platform or subsea mechanical connector with subsea structure (i.e. manifold or dynamic riser);
- the connection point to the offshore installation (i.e. piping manifolds are not included);
- the first valve, flange, connection or isolation joint at a landfall, unless otherwise specified by the onshore legislation.

NOTE 2 The components mentioned above (valve, flange, connection, isolation joint) include also any pup pieces, i.e. the offshore pipeline system extends to the weld beyond the pup piece, see Figure 1.

This document is used for integrity management, which is initiated at the design and construction stage of the pipeline. Where requirements of a design and construction standard (e.g. ISO 13623) are different, the provisions of this document will enhance the design and construction from an integrity perspective.



Key

1	first valve, flange, connection or isolation joint	7	nearshore section
2	connector point to subsea piping	8	shore approach
3	topside	9	offshore section
4	pipeline system	10	onshore section
5	pipeline subsea structure	a	covered by this document
6	first valve, flange, connection or isolation joint	b	not covered by this document

Figure 1 — Extent of pipeline systems covered by this document

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 13623, *Petroleum and natural gas industries — Pipeline transporting system*

ISO 15589-2, *Petroleum, petrochemical and natural gas industries — Cathodic protection of pipeline transportation systems — Part 2: Offshore pipelines*

ISO 31000, *Risk management — Guidelines*

IEC 31010, *Risk assessment techniques*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1.1

abandonment

activities associated with taking a pipeline permanently out of operation

Note 1 to entry: An abandoned pipeline cannot be returned to operation.

Note 2 to entry: Depending on the legislation abandonment can require cover or removal.

3.1.2

anomaly

possible deviation from pipe material or weld soundness

Note 1 to entry: The identification of an indication of an anomaly can be generated by non-destructive inspection, such as in-line inspection.

3.1.3

baseline assessment

first integrity assessment prior to or after operation

3.1.4

cathodic protection

corrosion control technique to prevent or reduce the external corrosion of metal pipelines by transferring an electrical current onto the pipe to achieve increased negative electrical potentials

3.1.5

corrosion

deterioration of a material, usually a metal that results from an electrochemical reaction with its environment

3.1.6

crack

planar flaw, or linear discontinuity, with a sharp tip radius

3.1.7

critical consequence area

location where a pipeline release might have a significant adverse effect on public safety, property and the environment

Note 1 to entry: The pipeline segments in CCAs are of particular interest in risk assessment and integrity assessment evaluations and prioritizations.

3.1.8

deactivation

removal of a pipeline from service, though the pipeline might be returned to service after a proper assessment

Note 1 to entry: Also defined as decommissioning or suspension.

3.1.9

deformation

change in shape of the pipe or component, such as a bend, buckle, *dent* (3.1.11), ovality, ripple, wrinkle, or any other change that affects the roundness of the pipe or original cross-section or straightness of the pipe or component

3.1.10

defect

imperfection of a type or magnitude exceeding acceptable criteria

3.1.11

dent

depression which produces a disturbance in the curvature of the pipe wall, caused by contact with a foreign body resulting in plastic deformation of the pipe wall

3.1.12

design life

period for which the design basis is planned to remain valid

[SOURCE: ISO 13623:2017, 3.1.2]

3.1.13

failure

event in which a component or system does not perform according to its operational requirements

3.1.14

fitness for purpose

quantitative engineering evaluation that is performed to demonstrate the structural integrity of an in-service component that can contain an imperfection, *defect* (3.1.10) or damage

3.1.15

gouge

surface damage to a pipeline caused by contact with a foreign object that has scraped (gouged) material out of the pipe, resulting in a metal loss defect or imperfection

3.1.16

incident

unintentional release of gas or liquid due to the *failure* (3.1.13) of a pipeline

Note 1 to entry: Some regulatory authorities define “incident” as an event occurring on a pipeline for which the operator is required to make a report to the concerned regulatory authority.

3.1.17

in-line inspection

inspection of a pipe wall from the interior of the pipe using specialized tools

3.1.18

integrity assessment

process that includes the inspection and testing of a pipeline in order to determine physical characteristics and assess its integrity condition by combination of an analysis of data, use of reliability assessment methodologies of the structure and an evaluation of the safety state of the pipeline

3.1.19

integrity management program

documented program that specifies the practices used by the operating company to proactively manage the safe, environmentally responsible, and reliable service of a pipeline system throughout its lifecycle and which incorporates a continuous improvement process

3.1.20

life extension

additional period of time beyond the original design or *service life* (3.1.36) (but within the assessed remnant life) for which permission to continue operating a pipeline system is granted by the regulatory bodies

Note 1 to entry: Life extension is considered as a modification to the design basis.

[SOURCE: ISO/TS 12747:2011, 3.7]

3.1.21

magnetic flux leakage

type of in-line inspection technology in which a magnetic field is induced in the pipe wall between two poles of a magnet

Note 1 to entry: Anomalies affect the distribution of the magnetic flux in the wall. The magnetic flux leakage pattern is used to detect and characterize anomalies.

3.1.22

management of change

process that systematically recognizes and communicates to the necessary parties changes of a technical, physical, procedural or organizational nature that can impact system integrity

3.1.23

manufacturing defect

defect (3.1.10) in the pipe body or coating created during the pipe or component manufacturing or coating processes

3.1.24

maximum allowable operating pressure

maximum internal pressure at which a pipeline system, or parts thereof, is allowed to be operated

Note 1 to entry: The MAOP is established by the maximum pressure achieved during testing (see ISO 13623).

3.1.25

metal loss

pipe anomaly in which metal has been removed

Note 1 to entry: Metal loss is usually the result of corrosion, but gouging, manufacturing defects erosion, or mechanical damage can also result in metal loss.

3.1.26

non-destructive testing

wide group of analysis techniques used to evaluate the properties of a material, component or system without causing damage

Note 1 to entry: “Non-destructive inspection” (NDI) and “non-destructive evaluation” (NDE) are also commonly used to describe this technology.

3.1.27

offshore pipeline

part of a pipeline system that, except for pipeline risers, is laid on the seabed or below it inside a trench

Note 1 to entry: The pipeline might be resting wholly or intermittently on, or buried below, the seabed.

3.1.28

operator

person or organization who owns or operates a pipeline system or facilities who is ultimately responsible for the operation and integrity of the pipeline system

3.1.29

pipeline integrity management

set of processes and procedures that proactively assures incident-free safe and environmentally responsible transportation of fluids through a pipeline system

3.1.30

pipeline integrity management program

continuous improvement closed-loop system using information technology to realize functions such as data acquisition and integration, integrity and *risk assessment* (3.1.33), mitigation and repair activity and maintenance decisions, with comprehensive management of change and continual review and improvement processes

3.1.31

pressure test

means of assessing the integrity of a new or existing pipeline that involves filling the pipeline with water and pressurizing to a level in excess of the MAOP of the pipeline to demonstrate that the pipeline is fit for service at the MAOP for a given time frame dependent on the identified integrity hazards

Note 1 to entry: See ISO 13623:2017, 6.7.

3.1.32

risk

measure of loss, either qualitative or quantifiable, in terms of both the likelihood of incident occurrence and the magnitude of the consequences of the incident occurrence

3.1.33

risk assessment

systematic, analytical process in which potential hazards from the pipeline system are proactively identified, and the likelihood and consequences of potential adverse events are determined

3.1.34

risk management

coordinated activities to direct and control an organization with regard to *risk* (3.1.32)

[SOURCE: ISO Guide 73:2009, 2.1]

3.1.35

safe operating pressure

pressure, calculated using the appropriate analysis and mathematical formulas for the specific type of *defect* (3.1.10) identified

EXAMPLE For corrosion defects using recognized remaining strength of corroded pipeline formulas, where all corroded regions will withstand a calculated safe operating pressure.

3.1.36

service life

length of time over which the pipeline system is intended to operate

[SOURCE: ISO/TS 12747:2011, 3.21]

Note 1 to entry: Service life is considered the actual operational life to date, but can include any planned future use of the line. Service life can be less or longer than design life.

3.1.37

sizing accuracy

accuracy with which an anomaly dimension or characteristic is reported

Note 1 to entry: Typically, accuracy is expressed by tolerance and certainty.

EXAMPLE Depth sizing accuracy for metal loss using NDT methods, such as an ILI tool, is commonly expressed as $\pm 10\%$ of the wall thickness (the tolerance) and 80 % of the time (the certainty).

3.1.38

third-party damage

damage done to the pipeline as a result of activities by personnel not associated with the pipeline

3.1.39

threat

activity or condition that can adversely affect the pipeline system if not adequately controlled

[SOURCE: ISO/TS 12747:2011, 3.23]

3.2 Abbreviated terms

AC	alternating current
CP	cathodic protection
CCA	critical consequence area
CoF	consequence of failure
DA	direct assessment
ECDA	external corrosion direct assessment
FFP	fitness for purpose
GIS	geographic information system
HIC	hydrogen-induced cracking
ICDA	internal corrosion direct assessment
ILI	in-line inspection
IMP	integrity management program
MAOP	maximum allowable operating pressure
MFL	magnetic flux leakage
NDT	non-destructive testing
PIM	pipeline integrity management

PoF	probability of failure
SCC	stress corrosion cracking
SCCDA	stress corrosion cracking direct assessment
SMYS	specified minimum yield strength
SSC	sulphide-stress cracking

4 General

4.1 Key principles

The operator uses integrity management programs (IMPs) to enable it to manage its pipeline systems in a safe, environmentally responsible and reliable manner. An effective IMP anticipates and mitigates or eliminates integrity issues before they lead to incidents or failures.

Key principles for an effective IMP are listed below:

- a) Pipeline system integrity shall be viewed as a lifecycle approach from initial planning, design, construction, operation and maintenance up to and including abandonment.
- b) The operator shall provide adequate resources in terms of funds, equipment and competent personnel to implement the IMP.
- c) Clearly defined roles and responsibilities with clear communication processes are necessary.
- d) Document and records control and retention and data gathering are key mandatory elements that enable informed decisions.
- e) Performance measures of the IMP's effectiveness should include both leading and lagging indicators to identify trends and areas for continuous improvement.
- f) An effective IMP uses risk-based decisions to prioritize integrity-related activities.

4.2 Integrity management program

4.2.1 General

The operator shall establish, implement, maintain and document an IMP or equivalent, and continually review its adequacy and implementation and improve its effectiveness.

The pipeline IMP shall be part of a comprehensive management system which includes, as a minimum, integration with safety and environment programs.

To facilitate the development and implementation of the initial IMP for a pipeline system, the operator shall develop an integrity management plan, which includes a plan for initial data acquisition, threat and hazard consequence identification and risk assessment, and improve it with integrity elements introduced in 4.2.2. If applicable, the operator can also choose to incorporate mature IMP elements from other pipeline systems, and customise them to their pipeline system or segment.

4.2.2 Introduction to IMP elements

The pipeline IMP shall address operators' approach to the following elements, as illustrated in Figure 2.

- a) Life cycle phases for integrity management:

Integrity shall be applied through the entire life cycle of pipeline, including:

- 1) feasibility;
- 2) design;
- 3) procurement;
- 4) installation;
- 5) transportation and storage;
- 6) construction;
- 7) pre-commissioning and commissioning;
- 8) handover;
- 9) operation and maintenance;
- 10) modification;
- 11) suspension/abandonment.

b) Pipeline integrity management process:

As part of the continuous improvement process, the inputs into these elements shall be routinely updated, as required, to reflect the dynamic nature of pipeline systems:

- 1) data acquisition, review and integration;
- 2) risk assessment (threat, consequence, probability, CCAs);
- 3) inspection and monitoring;
- 4) integrity assessment;
- 5) mitigation activity;
- 6) performance measurement and improvement.

NOTE 1 Understanding the pipeline's integrity and threats in the context of the surrounding environment is key to making informed integrity management decisions.

NOTE 2 Performance measurement can verify that the goals, targets and objectives of the integrity program are being met and can be used during management reviews to identify improvement opportunities.

The following elements shall be developed for the operational phase to ensure that adequate management practices are in place to assess failures and manage and respond to emergencies:

- failure assessment plan;
- emergency response plan;
- remaining life assessment plan.

NOTE 3 The failure assessment plan considers failure causes and contributing factors and provides critical information to the IMP. The goal is to prevent recurrence of similar failures.

NOTE 4 The emergency response plan is designed to ensure that the operator is prepared to deal with accidents and incidents in a timely manner to aid in the reduction of consequences. These accidents or incidents can occur because the IMP did not foresee or was unable to effectively mitigate the threat. Emergency response plans also include contingency repair plans and procedures.

NOTE 5 The remaining life assessment provides input into the economic viability assessment of the pipeline. As the pipeline ages, the operational risks and mitigation costs increase until continuing the operation is no longer viable.

c) Management elements:

The following elements shall form part of an IMP and might be written to encompass more than one pipeline or system. These elements usually interact with other management systems within an organization:

- 1) policy and commitment;
- 2) scope of the IMP;
- 3) organizational structure including key roles and responsibilities.

The following mandatory elements predominately deal with information flow, providing the core of the data system providing information for assessment and review. They are usually presented as plans with procedures:

- communication;
- records and documents control;
- management of change;
- management review and audit;
- training and skills.

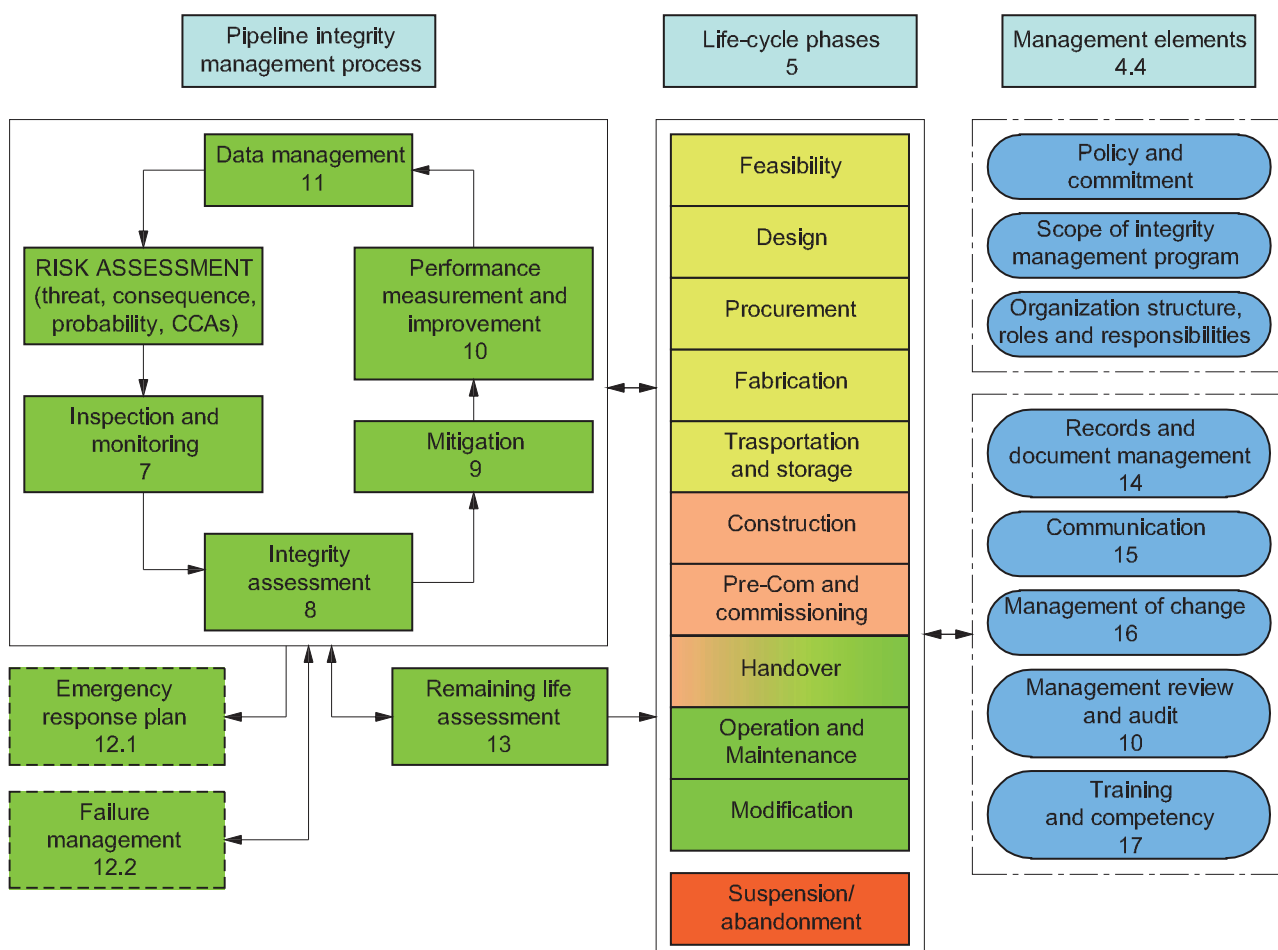


Figure 2 — Pipeline integrity management program structure

4.3 Integrity management process elements

4.3.1 Data acquisition, review and integration

The first step in evaluating the potential threats for a pipeline system or segment is to define and gather the necessary data and information that characterize the segments and the potential threats to that segment. A plan for collection of historical data shall be established and maintained for the pipeline system lifecycle. The operator shall perform the initial collection, review and integration of relevant data and information from pipeline design, construction, operation, maintenance, monitoring, inspection and failure investigation data. Data acquisition is needed to understand the condition of the pipeline, identify the location-specific threats to its integrity; and understand the public, environmental, and operational consequences of an incident.

4.3.2 Risk assessment

Risk analysis is an analytical process through which the operator considers the likelihood of the threats occurring and the nature and severity of the resulting consequences.

Risk assessment shall be performed for all scenarios including low consequence—high likelihood and critical consequence—low likelihood events. Every plausible failure mode shall be listed and assigned risk evaluation. Where multiple consequences occur from a single failure mode, multiple assessments are required.

The operator shall consider all the threats and any interactive threats that can be applicable to its system. It can be appropriate to consider risks in pipeline segments where the consequence of failure is particularly high and where explicit integrity management measures have to be implemented.

Completed risk assessment shall be reviewed at regular intervals and when substantial changes occur to the pipeline. The assumptions and variables used in the risk assessment shall be validated and updated, where applicable as part of the review.

4.3.3 Inspection and monitoring

The operator shall select and conduct appropriate inspection and monitoring based on the risk assessment made in the previous step, typically including in-line inspection, pressure testing, direct assessment, or other inspection and monitoring methods based upon the threats that have been identified. More than one inspection or monitoring method can be required to address all the threats to a pipeline segment.

4.3.4 Integrity assessment

Integrity assessment will implement the following hierarchy of controls:

- physical controls;
- procedural controls;
- elimination.

Where risks cannot be sufficiently controlled, mitigation activities shall be implemented until the risk is considered satisfactory.

The process of establishing and implementing effective preventive and mitigation measures requires suitable data collection, data integration, and informational analysis within the IMP. Data integration and the analysis can identify aspects of the operator's operations and maintenance that allow the operator to address the threats. Most importantly, local knowledge of the operational environment around the pipeline and the incident history associated with certain components or circumstances should be considered.

4.3.5 Mitigation activity

Where a threat cannot be controlled, the operator shall develop appropriate actions to mitigate the threat to an acceptable level of risk.

The results of mitigation assessments shall be used to determine what additional prevention or mitigation measures are required to reduce unacceptable risks identified in the assessment. Prevention and mitigation activities should be applied to reduce the likelihood of failure and/or the consequence of the failure to an acceptable level. Preventative measures typically involve activities to reduce the likelihood of an event.

The operator shall perform mitigation activities to ensure the pipeline system remains safe for its intended service. Where applicable, these mitigation activities shall provide a factor of safety that is notionally similar to the design factor of safety. This notional equivalent design factor of safety shall be maintained, throughout the life of the pipeline. The mitigation activities can include activities such as increased internal and external inspections and survey and pressure reductions.

4.3.6 Performance measurement and improvement

The operator shall develop procedures to regularly measure and evaluate the adequacy of implementation and effectiveness of IMP and its conformity to relevant standards.

The operator shall also evaluate the effectiveness of its other related management programs and processes in supporting integrity management decisions.

A combination of performance measures and system audits can be necessary to evaluate the overall effectiveness of a pipeline integrity system.

Performance measurement results shall be used to continuously identify areas for improvement of the IMP. In addition, advances in technology and industry best practices shall be considered.

4.3.7 Emergency response plan

Plans and response procedures for emergency situations shall be established and maintained based on a systematic evaluation of possible scenarios that can affect the safe and reliable operation of the pipeline system. Plans and procedures for contingency repair of the pipeline shall be established depending on the criticality of the pipeline system, based on factors such as safety, environmental, legislative or commercial considerations.

4.3.8 Failure management plan

The operator shall develop procedures for pipeline failure investigation to ensure that a structured approach is adopted and all aspects of a failure are reviewed. The failure investigation shall aim to determine the root cause and contributing factor of a pipeline failure and recommend corrective actions to prevent similar failures. This can include a targeted risk management program for causes that are not isolated. The operator shall setup a database to record relevant pipeline failure information to support failure management.

4.3.9 Remaining life assessment

The operator shall develop a remaining life assessment for all pipeline segments and systems and apply updates as new integrity information is gathered e.g. ILLI, or when the operational parameters change (e.g. pressure or temperature). The remaining life assessment shall be reviewed at regular intervals, such as at the end of the design life and after pipeline failures, or when changes in key operating design parameters occur.

The remaining life assessment will be used to enable lifecycle management processes to balance the risks of ongoing operation with safety and protection of the environment and associated costs of operations and management.

4.4 Management elements

4.4.1 Policy and commitment

The operator shall have a policy that expresses management commitment for developing, implementing, reviewing and continuous improvement of a pipeline IMP. The operator shall instruct personnel to meet its requirements.

4.4.2 Scope of integrity management program

The operator shall determine the scope of the IMP, including identifying the applicable pipeline systems and the goal and objectives of the IMP for the identified pipeline system.

The operator shall maintain a documented IMP that addresses the management of the pipeline integrity and specific treatment for all unacceptable risk.

4.4.3 Organization structure, roles and responsibilities

The operator shall have a clearly defined organizational structure to implement the IMP. Pipeline integrity management shall be carried out by personnel with clearly defined roles, responsibilities, authority and accountability in implementing and reviewing the IMP.

Where applicable, the organizational structure shall identify the linkages to other related management system programs, such as the safety and environmental programs.

The organizational structure should also take into account both upstream and downstream system inputs/outputs to ensure no changes in one system can have a negative effect on an adjacent system not within the control of the operator.

4.4.4 Records and document control plan

The IMP shall be documented and effectively updated. Program items to be documented shall include the following:

- documents and records needed by the operator to ensure the effective operation and control of its processes;
- statements of integrity management policy and objectives;
- procedures required by the implementation of integrity management.

A records and documents control plan shall be developed to facilitate the storing and retrieving of records and documents in a timely manner. The plan shall include means to confirm accuracy and quality of inputs.

4.4.5 Communication plan

A plan for reporting and communication to all stakeholders, including but not limited to employees, management, authorities, customers, public, local officials and responders, shall be established and maintained.

4.4.6 Management of change plan

A systematic process shall be used to ensure that, prior to implementation, changes to the pipeline system product being shipped, design, operation or maintenance are documented and evaluated for their potential risk impacts, and to ensure that changes are documented and evaluated.

4.4.7 Management review and audit plan

Management review and audit of the pipeline IMP shall be conducted at regular intervals to determine the adequacy, implementation and effectiveness of the integrity program. The focus of management reviews and audits shall be on evaluating the following:

- effectiveness and adequacy of the IMP to meet its stated goals and targets;
- implementation of the IMP;
- conformity to regulatory and operator's requirements;
- identification of corrective actions for continual improvement.

4.4.8 Training and skill plan

The IMP shall establish clear skill requirements for all roles involved in pipeline integrity management, including operators, contractors, engineers, and other persons using this document.

Training needs shall be identified and training shall be provided for relevant personnel in relation to management of pipeline integrity.

5 Integrity management for the pipeline lifecycle phases

5.1 General

5.1.1 Objectives

Pipeline system design (including material procurement and selection) and installation (including installation testing and commissioning) along with operations and maintenance activities have an impact on pipeline integrity.

Although these activities follow recognized standards, it is important to realize that conformity to a minimum standard might not identify potential long-term integrity issues. Therefore, it is important to review pipeline risks at handover from each pipeline phase and throughout the integrity lifecycle.

Designers, procurers, constructors, operators and maintenance personnel and integrity management practitioners shall be aware of 5.3, that highlight the interrelation between the pipeline lifecycle phases (which entails includes components such as design, procurement, installation, commissioning, operation and maintenance) and integrity. 5.3 identifies areas where changes in each of the pipeline lifecycle phases could be needed to aid in long-term integrity management.

5.1.2 Principles

The following high-level principles shall be considered during each of the pipeline lifecycle phases:

- a) Risk-based approaches to integrity management shall be applied. Clause 6 provides guidance on risk assessment methodologies.
- b) Functional requirements for integrity management shall be incorporated into each lifecycle phase.
- c) The concepts and requirements of IMP shall be regarded as the basis for long-term asset management.
- d) Any deviations shall be reviewed to evaluate impacts on integrity.
- e) Pipeline segments shall be designed according to ISO 13623, or a similar standard, to accommodate in-line inspection (ILI) tools. Where ILI accommodation is not practical, e.g. short service life, short connections or off-takes, the operator shall identify an appropriate alternative integrity assessment method.

- f) Data is regarded as the foundation of a pipeline integrity management and the operator shall have a comprehensive plan for collecting, managing, retrieving and analysing all data sets.

5.2 Key lifecycle integrity processes

Integrity assessment is an ongoing process that utilizes data from the various pipeline lifecycle phases to enable the operator to determine the integrity or soundness of the pipeline for its continued operation or design purpose.

The integrity assessment process for new pipelines utilizes construction inspection data and for operating pipelines utilizes data from pipeline condition monitoring activities, such as seabed movement monitoring, ILI, and pressure test to identify threats. The potential consequence and likelihood of identified threats are further evaluated using the appropriate method to determine fitness for purpose that includes a notional factor of safety. The operator shall determine the appropriate integrity assessment methods based on the threat and the capabilities and limitations of the integrity assessment method.

An integrity assessment can be conducted to evaluate the risk, and the interval for the next integrity assessment shall be determined based on the findings.

For pipelines already in operation, an integrity assessment shall be completed within 3 years if no previous integrity assessment has been performed.

5.3 Lifecycle phases for integrity management

5.3.1 General

Integrity management occurs throughout the whole lifecycle of an asset from the initial feasibility studies through to abandonment and heavily influences the design considerations and the ongoing maintenance/management techniques.

All threats to the integrity of the asset shall be identified and controlled throughout the lifecycle; therefore, the elimination of the threats by improvements in design can provide a significant advantage to the on-going safe and reliable operations of the pipeline.

Each of the lifecycle phases has opportunities to mitigate or control integrity threats and each life cycle phase shall be adequately designed and controlled to optimise the integrity oversight.

The personnel responsible for each lifecycle phase should be familiar with basic pipeline integrity issues and concepts. In addition, a process shall be developed where the pipeline integrity subject matter experts will review each lifecycle phase to determine if there are potential pipeline integrity issues that need resolution.

5.3.2 Feasibility

5.3.2.1 Objectives

At the feasibility phase of the integrity management lifecycle, the key integrity risks are associated with the physical attributes of the route. Proactive avoidance of threats is a critical design objective, and action at this phase in the lifecycle can provide significant benefits during construction. This could reduce the level of future mitigation being applied throughout the pipeline lifecycle leading to improved reliability and reduced operating cost.

5.3.2.2 Principles

At this phase in pipeline development, the basic route selection is often a straight line between supply and delivery points. Modifying the route would typically increase the overall pipeline length, but reduced operation and maintenance costs can warrant the increased installation cost.