

ISO 19901-9:2019 (E)

Petroleum and natural gas industries — Specific requirements for offshore structures — Part 9: Structural integrity management

Contents

	Foreword
	Introduction
1	Scope
2	Normative references
3	Terms and definitions
4	Symbols
5	Abbreviated terms
6	SIM fundamentals
6.1	General
6.2	Limit states and performance levels
6.3	Fitness-for-service assessment
6.4	Management framework
6.5	Design
6.6	Topsides
6.7	Continued service
6.8	Structural integrity interfaces
7	SIM process
8	SIM data
8.1	General
8.2	Missing data
8.3	Data management
9	SIM evaluation
9.1	General
9.2	Data evaluation
9.3	Hazards, hazardous events and degradation mechanisms
9.4	Critical structure (CS)
9.5	Risk
9.5.1	General
9.5.2	Consequence
9.5.3	Likelihood
9.5.4	Risk presentation
9.6	Demonstrating fitness-for-service
9.7	Assessment
9.7.1	General
9.7.2	Assessment motive
9.7.3	Assessment initiators
9.8	Mitigation measures
9.8.1	General
9.8.2	Consequence reduction
9.8.2.1	Life-safety
9.8.2.2	Environmental
9.8.2.3	Abnormal storm preparedness
9.8.3	Likelihood reduction

- 10 SIM strategy**
 - 10.1 General
 - 10.2 Inspection strategy
 - 10.2.1 General
 - 10.2.2 Inspection motives
 - 10.2.3 Inspection type
 - 10.2.3.1 General
 - 10.2.3.2 Scheduled inspections
 - 10.2.3.3 Unscheduled inspections
 - 10.2.4 Inspection method
 - 10.2.5 Inspection interval
 - 10.2.5.1 General
 - 10.2.5.2 Periodic above water inspection
 - 10.2.5.2.1 General
 - 10.2.5.2.2 Consequence-based inspection interval
 - 10.2.5.2.3 Risk-based inspection interval
 - 10.2.5.3 Periodic underwater inspection
 - 10.2.5.3.1 Consequence-based inspection interval
 - 10.2.5.3.2 Risk-based inspection interval
 - 10.2.6 Inspection scope
 - 10.2.7 Pre-selected inspection areas
 - 10.3 Maintenance strategy
 - 10.4 Monitoring strategy
 - 10.4.1 General
 - 10.4.2 Weight and centre of gravity (CoG) monitoring
 - 10.4.3 Deck elevation monitoring
 - 10.4.4 Natural frequency monitoring
 - 10.4.5 Corrosion protection monitoring
 - 10.4.6 Metocean monitoring
 - 10.5 Evacuation strategy
 - 10.6 Marine site investigations
- 11 SIM Program**
 - 11.1 General
 - 11.2 Inspection program
 - 11.2.1 General
 - 11.2.2 Specifications
 - 11.2.3 Inspection method
 - 11.2.3.1 General
 - 11.2.3.2 General visual inspection (GVI)
 - 11.2.3.3 Coating survey (including passive fire protection)
 - 11.2.3.4 Survey of underwater cathodic protection
 - 11.2.3.5 Appurtenance and personnel safety devices surveys
 - 11.2.3.6 Air gap survey
 - 11.2.3.7 Close visual weld/joint survey
 - 11.2.3.8 Damage survey
 - 11.2.3.9 Supplemental surveys
 - 11.3 Maintenance program
 - 11.4 Monitoring program
- 12 Assessment**
 - 12.1 General
 - 12.2 Assessment information
 - 12.3 Assessment method
 - 12.3.1 General
 - 12.3.2 Qualitative method
 - 12.3.3 Semi-quantitative method
 - 12.3.3.1 General
 - 12.3.3.2 Simplified procedures
 - 12.3.3.3 Previous assessment
 - 12.3.3.4 Prior exposure
 - 12.3.3.5 Similarity
 - 12.3.4 Quantitative methods

- 12.3.4.1 General
- 12.3.4.2 Design level method (DLM)
- 12.3.4.3 Ultimate strength method (USM)
- 12.3.4.3.1 General
- 12.3.4.3.2 Static nonlinear analysis
- 12.3.4.3.3 Dynamic nonlinear analysis
- 12.3.4.3.4 Structural reliability analysis (SRA)
- 12.3.5 Fatigue analysis
- 12.4 Assessment model
- 12.4.1 General
- 12.4.2 Tubular members
- 12.4.3 Connections
- 12.4.4 Conductors
- 12.4.5 Damage
- 12.4.5.1 General
- 12.4.5.2 Dented tubular members
- 12.4.5.3 Uniformly corroded tubular members
- 12.4.5.4 Locally corroded tubular members
- 12.4.5.5 Cracked tubular members
- 12.4.6 Repaired and strengthened elements
- 12.4.7 Foundation model
- 12.4.7.1 General
- 12.4.7.2 Pile capacity
- 12.4.7.3 Available soil data
- 12.4.7.4 Pile driving records
- 12.4.7.5 Piles
- 12.4.7.6 Pile groups
- 12.4.7.7 Mudmats
- 12.4.8 Material strength
- 12.5 Assessment for gravity hazard
- 12.5.1 General
- 12.5.2 Design level method (DLM)
- 12.5.3 Ultimate strength method (USM)
- 12.6 Assessment for metocean hazard
- 12.6.1 General
- 12.6.2 Metocean criteria
- 12.6.3 Crest elevation
- 12.6.4 Metocean action combinations — Jacket
- 12.6.5 Metocean action combinations — Deck
- 12.6.6 Directionality of metocean hazards
- 12.6.7 Design level method (DLM)
- 12.6.7.1 Ultimate limit state (ULS)
- 12.6.7.2 Abnormal limit state (ALS)
- 12.6.8 Linear-elastic redundancy method
- 12.6.9 Ultimate strength method (USM)
- 12.6.9.1 General
- 12.6.9.2 Static nonlinear analysis
- 12.6.9.3 Dynamic nonlinear analysis
- 12.7 Assessment for seismic hazard
- 12.7.1 General
- 12.7.2 Seismic criteria
- 12.7.3 Seismic action combinations
- 12.7.4 Directionality of seismic hazards
- 12.7.5 Design level method (DLM)
- 12.7.6 Ultimate strength method (USM)
- 12.7.6.1 General
- 12.7.6.2 Static nonlinear analysis
- 12.7.6.3 Dynamic nonlinear analysis
- 12.8 Assessment for collision hazard
- 12.8.1 General
- 12.8.2 Collision zone
- 12.8.3 Collision criteria
- 12.8.4 Directionality of collision hazards
- 12.8.5 Collision assessment method

- 12.9 Assessment for ice hazard
- 12.10 Assessment for explosion hazard
- 12.11 Assessment for fire hazard
- 13 Reuse
 - 13.1 General
 - 13.2 Fatigue in reused structures
 - 13.3 Steel in reused structures
 - 13.4 Inspection of reused structures
 - 13.4.1 General
 - 13.4.2 Initial condition assessment of structural members and connections
 - 13.4.3 Extent of weld inspection
 - 13.4.4 Corrosion protection systems
 - 13.5 Removal and reinstallation
- 14 Decommissioning and removal
 - 14.1 General
 - 14.2 Decommissioning process
 - 14.3 Pre-decommissioning data gathering
 - 14.4 Planning and engineering
 - 14.5 Well decommissioning
 - 14.6 Facilities decommissioning
 - 14.7 Pipeline decommissioning
 - 14.8 Conductor removal
 - 14.9 Structure removal
 - 14.10 Site clearance

Annex A (informative) Additional information and guidance

- A.1 Scope
- A.2 Normative references
- A.3 Terms and definitions
- A.4 Symbols
- A.5 Abbreviated terms
- A.6 SIM fundamentals
 - A.6.1 General
 - A.6.2 Limit states and performance levels
 - A.6.3 Fitness-for-service assessment
 - A.6.4 Management framework
 - A.6.4.1 General
 - A.6.4.2 Policy
 - A.6.4.3 Written description
 - A.6.4.4 Management of change
 - A.6.4.5 Procedures
 - A.6.4.6 Investigation of incidents
 - A.6.4.7 Emergency response and control
 - A.6.4.8 Validation
 - A.6.4.9 Continual improvement
 - A.6.4.10 Organization
 - A.6.4.11 Roles and responsibilities
 - A.6.4.12 Capabilities and resources
 - A.6.5 Design
 - A.6.6 Topsides
 - A.6.7 Continued service
 - A.6.8 Structural integrity interfaces
- A.7 SIM process
 - A.7.1 General
 - A.7.2 Benefits
- A.8 SIM Data
 - A.8.1 General
 - A.8.1.1 General
 - A.8.1.2 Design data
 - A.8.1.3 Fabrication and installation data
 - A.8.1.4 Condition data
 - A.8.1.5 Operational data

- A.8.1.6 Engineering data
- A.8.2 Missing data
- A.8.3 Data management
- A.9 SIM Evaluation
 - A.9.1 General
 - A.9.2 Data evaluation
 - A.9.3 Hazard, hazardous events and degradation mechanisms
 - A.9.4 Critical structure (CS)
 - A.9.4.1 General
 - A.9.4.2 Major accident
 - A.9.4.3 Major environmental event
 - A.9.4.4 Major accident prevention or mitigation
 - A.9.4.5 Personnel safety
 - A.9.4.6 Financial loss
 - A.9.5 Risk
 - A.9.5.1 General
 - A.9.5.2 Consequence
 - A.9.5.2.1 General
 - A.9.5.2.2 F-N Curve
 - A.9.5.2.3 Life-safety risk
 - A.9.5.2.4 Regulators
 - A.9.5.3 Likelihood
 - A.9.5.4 Risk presentation
 - A.9.6 Demonstrating fitness-for-service
 - A.9.6.1 General
 - A.9.6.2 Linear-elastic analysis
 - A.9.6.3 Nonlinear analysis
 - A.9.7 Assessment
 - A.9.7.1 General
 - A.9.7.2 Assessment motive
 - A.9.7.3 Assessment initiators
 - A.9.7.3.1 General
 - A.9.7.3.2 Changes in condition
 - A.9.7.3.3 Changes in action
 - A.9.7.3.4 Changes in criteria
 - A.9.7.3.5 Changes in consequence
 - A.9.7.3.6 Changes in use
 - A.9.8 Mitigation measures
 - A.9.8.1 General
 - A.9.8.2 Consequence reduction
 - A.9.8.2.1 Life-safety
 - A.9.8.2.2 Environmental
 - A.9.8.2.3 Abnormal storm preparedness
 - A.9.8.3 Likelihood reduction
 - A.9.8.3.1 General
 - A.9.8.3.2 Increased inspection and/or monitoring
 - A.9.8.3.3 Strengthening, modification and/or repair (SMR) techniques
 - A.9.8.3.3.1 General
 - A.9.8.3.3.2 Damage removal
 - A.9.8.3.3.3 Gravity action effect reduction
 - A.9.8.3.3.4 Hydrodynamic action effect reduction
 - A.9.8.3.3.5 Localized strengthening or repair
 - A.9.8.3.3.6 Global strengthening or repair
- A.10 SIM Strategy
 - A.10.1 General
 - A.10.2 Inspection strategy
 - A.10.2.1 General
 - A.10.2.1.1 General
 - A.10.2.1.2 Damage tolerance
 - A.10.2.1.3 Appurtenances
 - A.10.2.1.4 Surveys
 - A.10.2.1.5 Fatigue issues
 - A.10.2.2 Inspection motives
 - A.10.2.3 Inspection type

- A.10.2.3.1 General
- A.10.2.3.2 Scheduled inspections
 - A.10.2.3.2.1 General
 - A.10.2.3.2.2 Baseline inspection
 - A.10.2.3.2.3 Periodic inspection
 - A.10.2.3.2.4 Special inspections
- A.10.2.3.3 Unscheduled inspection
- A.10.2.4 Inspection method
 - A.10.2.4.1 General
 - A.10.2.4.2 General visual inspection (GVI)
 - A.10.2.4.3 Close visual inspection (CVI)
 - A.10.2.4.4 Flooded member detection (FMD)
 - A.10.2.4.5 Non-destructive examination (NDE)
- A.10.2.5 Inspection interval
 - A.10.2.5.1 General
 - A.10.2.5.2 Periodic above water inspection
 - A.10.2.5.2.1 General
 - A.10.2.5.2.2 Consequence-based inspection interval
 - A.10.2.5.2.3 Risk-based inspection interval
 - A.10.2.5.3 Periodic underwater inspection
 - A.10.2.5.3.1 Consequence-based inspection interval
 - A.10.2.5.3.2 Risk-based inspection interval
- A.10.2.6 Inspection scope
 - A.10.2.6.1 General
 - A.10.2.6.2 Baseline inspection scope
 - A.10.2.6.3 Above water periodic inspection scope
 - A.10.2.6.4 Underwater periodic inspection scope
 - A.10.2.6.5 Special inspection scope
 - A.10.2.6.6 Unscheduled inspection scope
- A.10.2.7 Pre-selected inspection areas
- A.10.3 Maintenance strategy
- A.10.4 Monitoring strategy
 - A.10.4.1 General
 - A.10.4.2 Weight and centre of gravity (CoG) monitoring
 - A.10.4.3 Deck elevation monitoring
 - A.10.4.4 Natural frequency monitoring
 - A.10.4.5 Corrosion protection monitoring
 - A.10.4.6 Metocean monitoring
- A.10.5 Evacuation strategy
- A.10.6 Marine site investigations
- A.11 SIM Program
 - A.11.1 General
 - A.11.2 Inspection program
 - A.11.2.1 General
 - A.11.2.2 Specifications
 - A.11.2.3 Inspection method
 - A.11.2.3.1 General
 - A.11.2.3.2 General visual inspection (GVI)
 - A.11.2.3.3 Coating survey (including passive fire protection)
 - A.11.2.3.4 Survey of underwater cathodic protection
 - A.11.2.3.5 Appurtenance and personnel safety devices surveys
 - A.11.2.3.5.1 Conductor visual survey
 - A.11.2.3.5.2 Riser survey
 - A.11.2.3.5.3 Pipeline flange isolation
 - A.11.2.3.5.4 Attachment tie-down points
 - A.11.2.3.5.5 Escape routes
 - A.11.2.3.6 Air gap survey
 - A.11.2.3.7 Close visual weld/joint survey
 - A.11.2.3.8 Damage survey
 - A.11.2.3.9 Supplemental surveys
 - A.11.3 Maintenance program
 - A.11.4 Monitoring program
- A.12 Assessment
 - A.12.1 General

- A.12.2 Assessment information
- A.12.3 Assessment method
 - A.12.3.1 General
 - A.12.3.2 Qualitative method
 - A.12.3.3 Semi-quantitative methods
 - A.12.3.3.1 General
 - A.12.3.3.2 Simplified procedure
 - A.12.3.3.3 Previous assessment
 - A.12.3.3.4 Prior exposure
 - A.12.3.3.5 Similarity
 - A.12.3.4 Quantitative methods
 - A.12.3.4.1 General
 - A.12.3.4.2 Design level method (DLM)
 - A.12.3.4.3 Ultimate strength method (USM)
 - A.12.3.4.3.1 General
 - A.12.3.4.3.2 Static nonlinear analysis
 - A.12.3.4.3.3 Dynamic nonlinear analysis
 - A.12.3.4.3.4 Structural reliability analysis (SRA)
 - A.12.3.4.4 Fatigue analysis
- A.12.4 Assessment model
 - A.12.4.1 General
 - A.12.4.2 Tubular members
 - A.12.4.2.1 Elastic members
 - A.12.4.2.2 Axially loaded members
 - A.12.4.2.3 Moment resisting members
 - A.12.4.3 Connections
 - A.12.4.4 Conductors
 - A.12.4.5 Damage
 - A.12.4.5.1 General
 - A.12.4.5.2 Dented tubular members
 - A.12.4.5.3 Uniformly corroded tubular members
 - A.12.4.5.4 Locally corroded tubular members
 - A.12.4.5.5 Cracked tubular members
 - A.12.4.6 Repaired and strengthened elements
 - A.12.4.7 Foundation model
 - A.12.4.7.1 General
 - A.12.4.7.2 Pile capacity
 - A.12.4.7.3 Available soil data
 - A.12.4.7.4 Pile driving records
 - A.12.4.7.5 Piles
 - A.12.4.7.6 Pile groups
 - A.12.4.7.7 Mudmats
 - A.12.4.8 Material strength
- A.12.5 Assessment for gravity hazard
 - A.12.5.1 General
 - A.12.5.2 Design level method (DLM)
 - A.12.5.3 Ultimate strength method (USM)
- A.12.6 Assessment for metocean hazard
 - A.12.6.1 General
 - A.12.6.2 Metocean criteria
 - A.12.6.3 Crest elevation
 - A.12.6.4 Metocean action combinations — Jacket
 - A.12.6.5 Metocean action combinations — Deck
 - A.12.6.6 Directionality of metocean hazards
 - A.12.6.7 Design level method (DLM)
 - A.12.6.7.1 Ultimate limit state (ULS)
 - A.12.6.7.2 Abnormal limit state (ALS)
 - A.12.6.8 Linear-elastic redundancy method
 - A.12.6.9 Ultimate strength method (USM)
- A.12.7 Assessment for seismic hazard
 - A.12.7.1 General
 - A.12.7.2 Seismic criteria
 - A.12.7.3 Seismic action combinations
 - A.12.7.4 Directionality of seismic hazards

- A.12.7.5 Design level method (DLM)
- A.12.7.6 Ultimate strength method (USM)
 - A.12.7.6.1 Static nonlinear analysis
 - A.12.7.6.2 Dynamic nonlinear analysis
- A.12.8 Assessment for collision hazard
 - A.12.8.1 General
 - A.12.8.2 Collision zone
 - A.12.8.3 Directionality of collision hazards
- A.12.9 Assessment for ice hazard
- A.12.10 Assessment for explosion hazard
- A.12.11 Assessment for fire hazard
- A.13 Reuse
 - A.13.1 General
 - A.13.2 Fatigue in reused structures
 - A.13.3 Steel in reused structures
 - A.13.4 Inspection of reused structures
 - A.13.4.1 General
 - A.13.4.2 Initial condition assessment of structural members and connections
 - A.13.4.3 Extent of weld inspection
 - A.13.4.3.1 General
 - A.13.4.3.2 Primary tubular members
 - A.13.4.3.3 Primary tubular joints
 - A.13.4.3.4 Non-redundant bracing and subassemblies
 - A.13.4.3.5 Redundant bracing and subassemblies
 - A.13.4.3.6 Deck members and connections
 - A.13.4.4 Corrosion protection systems
 - A.13.5 Removal and reinstallation
- A.14 Decommissioning and removal
 - A.14.1 General
 - A.14.2 Decommissioning process
 - A.14.2.1 General
 - A.14.2.2 Planning
 - A.14.2.3 Option assessment
 - A.14.2.4 Risks
 - A.14.2.5 Responsibility
 - A.14.2.6 Personnel qualifications
 - A.14.2.7 Records and documentation
 - A.14.3 Pre-decommissioning data gathering
 - A.14.4 Planning and engineering
 - A.14.5 Well decommissioning
 - A.14.6 Facilities decommissioning
 - A.14.7 Pipeline decommissioning
 - A.14.8 Conductor removal
 - A.14.9 Structure removal
 - A.14.9.1 General
 - A.14.9.2 Deck and modules removal
 - A.14.9.3 Jacket removal
 - A.14.9.4 Jacket removal — Partial
 - A.14.9.5 Jacket removal — Remote reefing
 - A.14.10 Site clearance

Page count: 144