

ISO 35104:2018 (E)

Petroleum and natural gas industries — Arctic operations — Ice management

Contents

	Foreword
	Introduction
1	Scope
2	Normative references
3	Terms, definitions and abbreviations
3.1	Terms and definitions
3.2	Abbreviated terms
4	General ice management requirements
4.1	Fundamental requirements for an ice management system
4.1.1	General
4.1.2	Ice management plan
4.1.3	Ice alert system
4.1.4	Hazardous ice conditions
4.2	Safety requirements
4.2.1	Ice management approach
4.2.2	Redundancy
4.2.3	Existing operations
4.3	Safe learning
4.3.1	Safe learning principles
4.3.2	Continuous improvement
4.4	Risk management
4.4.1	General requirements
4.4.2	Hazard identification and consequences
4.4.3	Responsibility for risk management
4.4.4	Use of risk assessment
4.5	Health, safety, security and environment
4.5.1	Health, safety, security and environment plan
4.5.2	Safe working environment
4.5.3	Incident reporting
4.5.4	Compliance with health, safety, security and environment requirements
4.6	Organizational functions and procedures
4.6.1	General requirements
4.6.2	Organization and communication
4.6.2.1	Organization
4.6.2.2	Operational organization
4.6.2.3	Operational management
4.7	Specific design, planning and execution requirements
5	Ice management plan (IM plan)
5.1	IM plan scope
5.2	IM plan implementation
5.3	IM plan maintenance
6	Ice management system performance
6.1	High-level IM system issues
6.2	Measures of IM performance
6.3	Demonstration of intended performance
6.4	IM system design
6.5	Degradation of ice alert and IM system performance
6.6	Operating ice envelope

- 6.7 Operational readiness of IM system
- 6.8 Performance monitoring and documentation
- 6.9 Maintenance and improvement
- 7 Data requirements
 - 7.1 General ice management data requirements
 - 7.2 Parameters and conditions
 - 7.2.1 Ice and metocean parameters
 - 7.2.2 Monitoring of operational parameters
 - 7.2.3 Combined situations
 - 7.2.4 Managed ice conditions
 - 7.2.5 Wildlife observations
 - 7.3 Timeline
 - 7.3.1 Planning situations
 - 7.3.2 Strategic situations
 - 7.3.3 Tactical situations
 - 7.3.4 Phases of operations
 - 7.4 Forecasting
 - 7.4.1 General
 - 7.4.2 Accuracy
 - 7.4.3 Metocean data
 - 7.4.4 Ice management forecast parameters
 - 7.4.4.1 List of parameters
 - 7.4.4.2 Wind forecasts
 - 7.4.4.3 Wave forecasting
 - 7.4.4.4 Swell forecasting
 - 7.4.4.5 Current forecasting
 - 7.4.4.6 Ice drift forecasting models
 - 7.4.4.7 Icing forecasting
 - 7.4.4.8 Forecasting polar lows
 - 7.4.5 Nowcasts
 - 7.4.6 Forecasts for weather windows
 - 7.5 Data collection
 - 7.5.1 General
 - 7.5.2 Data quality
 - 7.6 Data organization
 - 7.6.1 General requirements
 - 7.6.2 Accuracy and bias of data
 - 7.6.3 Instrument specifications
 - 7.6.4 Data backup
 - 7.7 Data dissemination
 - 7.7.1 General
 - 7.7.2 Communications and infrastructure
 - 7.7.3 Presentation
- 8 Ice detection and tracking
 - 8.1 Objectives
 - 8.2 System criteria
 - 8.3 Detection capabilities
 - 8.4 Tracking capabilities
- 9 Threat evaluation and response
 - 9.1 Threat evaluation strategy
 - 9.2 Identification of ice hazards
 - 9.3 Methods for threat evaluation
 - 9.4 Key concepts
 - 9.4.1 T-time
 - 9.4.2 T-distance
 - 9.4.3 Ice hazard distance
 - 9.4.4 Ice hazard time
 - 9.4.5 Ice drift speed
 - 9.4.6 Closest point of approach
 - 9.5 Ice alert levels and zones
 - 9.5.1 Zoning strategy

- 9.5.2 Monitoring zone
- 9.5.3 Management zones
- 9.5.4 Secure zones
- 9.5.5 Exclusion zone
- 9.6 T-time calculations
- 9.7 Stages of threat assessment
- 9.8 Models for ice actions
- 9.9 Situations requiring increased vigilance
- 9.10 Infrequent, unanticipated and unforecast ice events
- 10 Physical ice management
 - 10.1 Selection criteria
 - 10.2 IM vessel requirements
 - 10.3 Operation-specific procedures
 - 10.4 Preparedness
 - 10.5 Physical IM strategies and techniques
 - 10.6 Ice-restricted operations
 - 10.7 Effects of IM
- 11 Personnel and training
 - 11.1 IM personnel requirements
 - 11.2 General training requirements
 - 11.3 Requirements for training
 - 11.3.1 Organizations offering ice management training
 - 11.3.1.1 General
 - 11.3.1.2 Use of internal audits for monitoring purposes
 - 11.3.2 Training personnel
 - 11.3.3 Training facility
 - 11.3.4 Training elements
 - 11.3.5 Training requirements for monitoring and advisory personnel
 - 11.3.6 Training requirements for other personnel
 - 11.3.7 Training curriculum
 - 11.4 Ice management training: specific requirements
 - 11.4.1 General
 - 11.4.2 Operations in arctic and cold regions
 - 11.4.3 Field experience

Annex A (informative) Ice management HAZID workbook

Annex B (informative) Additional information and guidance

- B.1 Scope
- B.2 Normative references
- B.3 Terms, definitions and abbreviations
- B.4 General ice management requirements
 - B.4.1 Fundamental requirements for an ice management system
 - B.4.1.1 General
 - B.4.1.2 Ice management plan
 - B.4.1.3 Ice alert system
 - B.4.1.4 Hazardous ice conditions
 - B.4.2 Safety requirements
 - B.4.2.1 Ice management approach
 - B.4.2.2 Redundancy
 - B.4.2.3 Existing operations
 - B.4.3 Safe learning
 - B.4.3.1 Safe learning principles
 - B.4.3.2 Continuous improvement
 - B.4.4 Risk management
 - B.4.4.1 General requirements
 - B.4.4.2 Hazard identification and consequences
 - B.4.4.3 Responsibility for risk management
 - B.4.4.4 Use of risk assessment
 - B.4.5 Health, safety, security and environment
 - B.4.5.1 Health, safety, security and environment plan
 - B.4.5.2 Safe working environment

- B.4.5.3 Incident reporting
- B.4.5.4 Compliance with health, safety, security and environment requirements
- B.4.6 Organizational functions and procedures
 - B.4.6.1 General requirements
 - B.4.6.2 Organization and communication
 - B.4.6.2.1 Project organization
 - B.4.6.2.2 Operational organization
 - B.4.6.2.3 Operational management
- B.4.7 Specific design, planning and execution requirements
- B.5 Ice management plan (IM plan)
 - B.5.1 IM plan scope
 - B.5.2 IM plan implementation
 - B.5.3 IM plan maintenance
- B.6 Ice management system performance
 - B.6.1 High-level IM system issues
 - B.6.2 Measures of IM performance
 - B.6.3 Demonstration of intended performance
 - B.6.4 IM system design
 - B.6.5 Degradation of ice alert and IM system performance
 - B.6.6 Operating ice envelope
 - B.6.7 Operational readiness of IM system
 - B.6.8 Performance monitoring and documentation
 - B.6.9 Maintenance and improvement
- B.7 Data requirements
 - B.7.1 General ice management data requirements
 - B.7.2 Parameters and conditions
 - B.7.2.1 Ice and metocean parameters
 - B.7.2.2 Monitoring of operational parameters
 - B.7.2.3 Combined situations
 - B.7.2.4 Managed ice conditions
 - B.7.2.5 Wildlife observations
 - B.7.3 Timeline
 - B.7.3.1 Planning situations
 - B.7.3.2 Strategic situations
 - B.7.3.3 Tactical situations
 - B.7.3.4 Phases of operations
 - B.7.4 Forecasting
 - B.7.4.1 General
 - B.7.4.2 Accuracy
 - B.7.4.3 Metocean data
 - B.7.4.4 Ice management forecast parameters
 - B.7.4.4.1 List of parameters
 - B.7.4.4.2 Wind forecasts
 - B.7.4.4.3 Wave forecasting
 - B.7.4.4.4 Swell forecasting
 - B.7.4.4.5 Current forecasting
 - B.7.4.4.6 Ice drift forecasting models
 - B.7.4.4.7 Icing forecasting
 - B.7.4.4.8 Forecasting polar lows
 - B.7.4.5 Nowcasts
 - B.7.4.6 Forecasts for weather windows
 - B.7.5 Data collection
 - B.7.5.1 General
 - B.7.5.2 Data quality
 - B.7.6 Data organization
 - B.7.6.1 General requirements
 - B.7.6.1.1 Organization of data collected
 - B.7.6.1.2 Data access
 - B.7.6.1.3 Data organization
 - B.7.6.2 Accuracy and bias of data
 - B.7.6.3 Instrument specifications
 - B.7.6.4 Data backup
 - B.7.7 Data dissemination
 - B.7.7.1 General

- B.7.7.2 Communications and infrastructure
- B.7.7.3 Presentation
- B.8 Ice detection and tracking
- B.8.1 Objectives
- B.8.2 System criteria
- B.8.3 Detection capabilities
- B.8.3.1 Visibility considerations
- B.8.3.2 Sensors
- B.8.3.3 Aerial reconnaissance
- B.8.3.4 Radar observations from ship or structure
- B.8.4 Tracking capabilities
- B.9 Threat evaluation and response
- B.9.1 Threat evaluation strategy
- B.9.2 Identification of ice hazards
- B.9.3 Methods for threat evaluation
- B.9.4 Key concepts
- B.9.4.1 T-time
- B.9.4.2 T-distance
- B.9.4.3 Ice hazard distance
- B.9.4.4 Ice hazard time
- B.9.4.5 Ice drift speed
- B.9.4.6 Closest point of approach
- B.9.5 Ice alert levels and zones
- B.9.5.1 Zoning strategy
- B.9.5.1.1 Sea ice example
- B.9.5.1.2 Iceberg example
- B.9.5.2 Monitoring zone
- B.9.5.3 Management zones
- B.9.5.4 Secure zones
- B.9.5.5 Exclusion zone
- B.9.6 T-time calculations
- B.9.7 Stages of threat assessment
- B.9.8 Models for ice actions
- B.9.9 Situations requiring increased vigilance
- B.9.10 Infrequent, unanticipated and unforecast ice events
- B.10 Physical ice management
- B.10.1 Selection criteria
- B.10.2 IM vessel requirements
- B.10.3 Operation-specific procedures
- B.10.4 Preparedness
- B.10.5 Physical IM strategies and techniques
- B.10.5.1 Sea ice regimes
- B.10.5.2 Iceberg regimes
- B.10.6 Ice-restricted operations
- B.10.7 Effects of IM
- B.11 Personnel and training
- B.11.1 IM personnel requirements
- B.11.2 General training requirements
- B.11.3 Requirements for training
- B.11.3.1 Organizations offering ice management training
- B.11.3.1.1 General
- B.11.3.1.2 The use of internal audits for monitoring purposes
- B.11.3.2 Training personnel
- B.11.3.3 Training facility
- B.11.3.4 Training elements
- B.11.3.5 Training requirements for monitoring and advisory personnel
- B.11.3.6 Training requirements for other personnel
- B.11.3.7 Training curriculum
- B.11.4 Ice management training: specific requirements
- B.11.4.1 General
- B.11.4.2 Operations in arctic and cold regions
- B.11.4.3 Field experience