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Marine technology — Marine environment impact assessment (MEIA) — General technical requirements

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Contents

Page

Foreword

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Introduction

Deep-sea environments are faced with cumulative effects of many human activities, such as ocean acidification, waste deposition, oil exploitation, fishing, maritime transport, and potential seabed mining. Criteria to manage marine environmental conditions, including offshore and deep-sea areas, have been proposed by agencies of the United Nations. These suggested criteria include ecologically and biologically significant areas (EBSAs) by the Convention for Biological Diversity; vulnerable marine ecosystems (VMEs) by the Food and Agriculture Organization; and particularly sensitive sea areas (PSSAs) by the International Maritime Organization[1]. The Commission of the International Seabed Authority (ISA) has published recommendations for the guidance on environmental impact assessments (EIA) for seabed mining in the Area, for use by countries which have any deep-sea mining contracts and which recognize the primary importance of appropriate performance standards on the related environmental issues[2,3].

Since the mid-1990s, attention has been paid to potential environmental impacts caused by deep-sea mining. Developing protocols for EIA has been discussed in the meetings conducted by the scientific communities and ISA[4]. A practical issue to address is the development of a cost-effective operation for observation and monitoring in seabed mining sites[5,6].

Under these circumstances, this document gives a technical concept and requirements to conduct a practical marine EIA for exploration and exploitation of mineral resources and in situ monitoring of deep-sea mining sites.

Marine technology — Marine environment impact assessment (MEIA) — General technical requirements

1 Scope

This document provides general technical guidance for the operation of marine environment impact assessments (MEIA) to assess the degree of impact of deep-sea activities of exploration and exploitation for mineral resources to the marine environment. It does not cover matters related to the legal framework for MEIA and deep-sea activities on energy resources.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
baseline data
data set used to assess the impacts of post-implementation of a deep-sea activity

3.2
habitat mapping
mapping of the marine habitat by data sets of observations and measures collected from the environment, providing a tool for ecological research and management of the conservation and sustainable use of marine resources

3.3
soundscape
marine acoustic environment consisting of natural sounds ranging between 1 Hz and 100 kHz, from animals, weather and waves, or of anthropogenic origin, that provides a baseline for acoustic ecology

4 General principles

Technical guidance is provided on MEIA for deep-sea mining, in order to conduct operations of deep-sea survey and monitoring with economic efficiency, and to keep the data quality on assessment. The MEIA described in this document provide guidance on the following:

— cost effective operation of deep-sea survey and monitoring;

— habitat mapping by baseline data,

— estimation of impacts from seabed mining;

— monitoring of measures for mitigation;

— post-mining monitoring.

5 Technical guidance

5.1 Cost-effective operation

An environmental survey and actual process of MEIA should be planned after the conclusive results of exploration for mineral deposition site of target ore. Reducing expenditure for deep-sea cruise is an important issue to make a cost-effective operation plan.

To reduce the cost for exploration ships, the collection of baseline data for MEIA shall start within the early phase of the exploration cruise, to progress habitat mapping and environmental assessment. Annex A provides a comparison between conventional and new strategic processes of MEIA[7,8].

5.2 Habitat mapping

Geological Information System (GIS) mapping is a common technique to determine the habitat condition and faunal distribution. The technique using underwater vehicles equipped with an acoustic positioning system is suitable for the GIS mapping at deep-seafloor[9,10].

Sample collection can provide an evidence of faunal distribution and abundance in pinpointed sites. The technique on imaging data are useful to collect faunal data in broad areas by underwater vehicles[11] and to determine the long-term fluctuation by seafloor observatories[12].

The habitat mapping shall be employed to analyse the baseline condition of the deep-sea ecosystem. It provides a reference that should be compared with habitat condition and impact assessment.

ISO 23732 provides useful methodologies for the observation of meiofaunal community, and can be employed for the purpose of habitat mapping of upper bathyal sediments.

ISO 19101-1 and ISO 19101-2 give information concerning phenomena implicitly or explicitly associated with a location relative to the earth. Geospatial information is often used as the basis to integrate assessments, situation reports, and incident notification into a common operating picture. It is also used as a data fusion and an analysis tool to synthesize many kinds and sources of data and imagery.

ISO 19105 provides methodologies to capture, add and maintain data sets which shall be created and populated for MEIA. Information shall not be considered complete unless it has associated metadata. Where possible, individuals generating the information should be those creating the metadata. The very minimum metadata that should be captured is the provenance of the data.

ISO 19123 supports mapping from a spatial, temporal or spatiotemporal domain to feature attribute values where feature attribute types are common to all geographic positions within the domain. A coverage domain consists of a collection of direct positions in a coordinate space that can be defined in terms of up to three spatial dimensions as well as a temporal dimension. Examples of coverages include rosters, triangulated irregular networks, point coverages and polygon coverages. Coverages are the prevailing data structures in a number of application areas, such as remote sensing, meteorology and mapping of bathymetry, elevation, soil and vegetation.

5.3 Estimation of impacts

Deep-sea ecosystems are dynamic systems under various effects of natural factors caused by periodical physicochemical fluctuation and unpredictable geophysical disasters[13]. In case of seabed mining, the potential impacts shall be identified from the exploitation process, e.g. operation of mining machines on the seafloor, ore transportation to the support ship, fluid discharge from the support ship. MEIA for anthropogenic disturbances should be performed with consideration of the effects from natural factors to avoid the false result synergistically emerged.

ISO 23734 provides useful methodologies on monitoring the ecological impacts left on photosynthetic process from deep-sea mining activities.

5.4 Estimation of resilience

The deep-sea ecosystem possesses a potential of resilience to impacts[14]. The recoverability of community, including deep-sea fauna and flora, is a suitable indicator to estimate the biological resilience to anthropogenic disturbance. The larval dispersal resulting from water circulation is a major driving factor of recoverability of faunal community in deep-sea environments [15,16].

The genetic connectivity among remotely distant communities is an indicator to estimate the pattern of larval dispersion[15,16]. Knowing the potential of resilience provides valuable knowledge to plan for mitigation and environmental management for sustainable usage. The ecosystem resilience or community recoverability shall be estimated using model analysis method[19,20].

5.5 Monitoring

Monitoring provides indispensable data for MEIA and environmental management. The measurement of mitigation and a preservation plan are necessary to determine whether the plan progresses without problems. The following are long-term monitoring targets: dispersion of sediment plumes generated by mining machines[21], soundscape and noise effects of mining sites[22,23], pollution from discharged fluids from support ships[24], and observation of post-mining areas. Techniques and tools for deep-sea monitoring have been developed.

Imaging by camera and soundscape by hydrophone enable a cost-effective monitoring system for deep-sea environments and biological diversity. ISO 23731 provides useful methodologies on long-term in situ monitoring in deep-sea environments. ISO 12913 and ISO 18405 provide useful methodologies on measurement of soundscape and noise.

Annex A
(informative)

Comparison between conventional and new strategic MEIA processes

A.1 Conventional process

In the conventional process, the environmental survey and EIA is operated after the exploration cruise to search deposition site of target ore, as shown in Figure A.1[7,8].

A.2 New strategic process

The new strategic process modifies the schedule arrangement of exploration and environmental survey to reduce the ship time, as shown in Figure A.1. The strategic process in MEIA can start within the early phase of exploration[7,8].

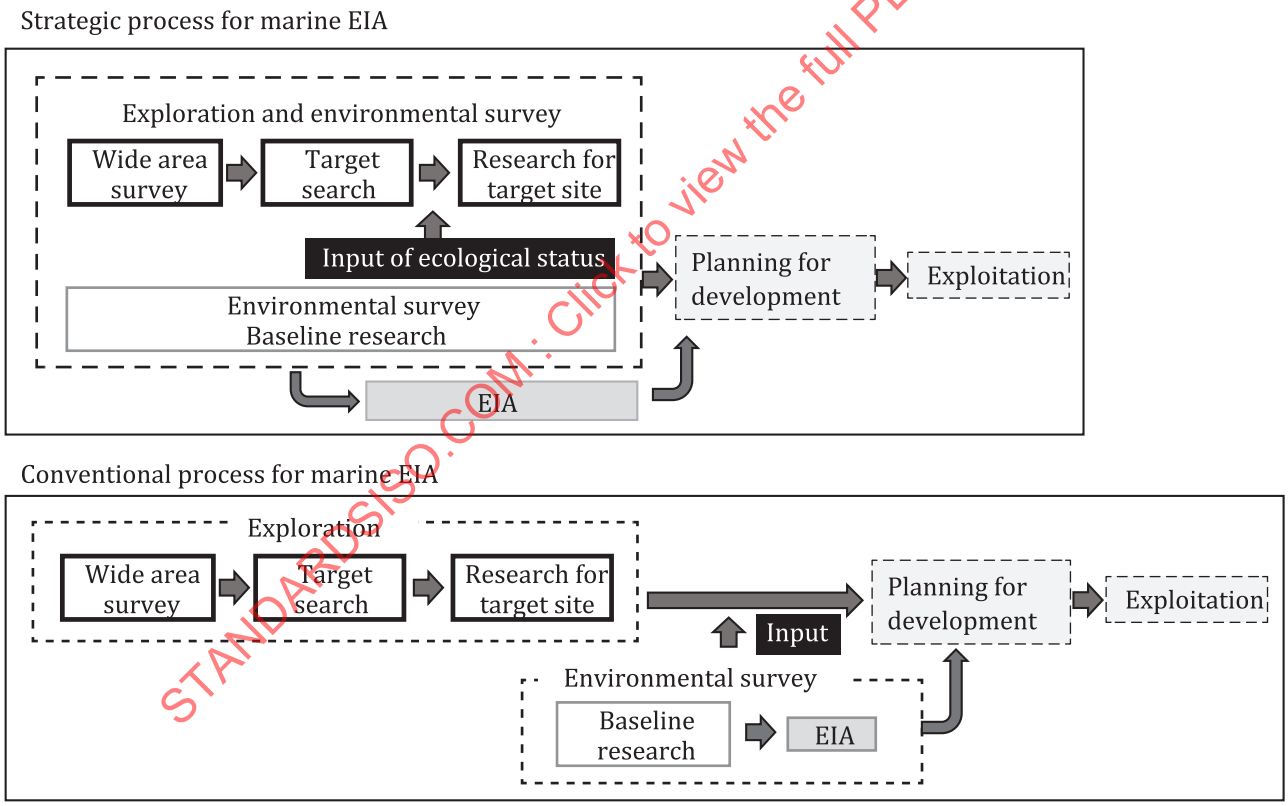

Figure A.1 — Diagram of new strategic process

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