TECHNICAL STANDARD

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The acoustic impact of maritime activities related to Deep Sea Mining (DSM): Minimum standards of admissibility

Requirements

The Italian Institution for research and promotion of standardization

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Index

PREFACE

This document (Technical standard ENR 14001:2019) has been elaborated by a special Technical Committee for the realization of a voluntary technical standard to define the potential minimum criteria of acceptability of the acoustic impact of the sea-shore activities related to Deep Sea Mining (DSM)

1. Introduction

Anthropic noise is now considered to be a serious cause of pollution. EU Member States shall develop strategies to maintain good environmental status in their seas (Marine Strategy Framework Directive, MSFD; Monitoring Guidance for Underwater Noise in European Seas - Part II).

In 2010 the European Commission published standards and criteria for achieving these objectives (Commission Decision 2010/477/EU), but to date data on anthropogenic noise are still incomplete. Noise has become part of the descriptors of good environmental status such as descriptor 11 (Noise/Energy) and in particular Indicator 11.1.1 for low and medium frequency impulsive sounds and Indicator 11.2.1 for low frequency continuous sounds (environmental noise) (Monitoring Guidance for Underwater Noise in European Seas - Part II).

Given the recent increase in anthropogenic noise, it is essential to consider the acoustic impact of maritime-sea activities related to mining in the depths of the ocean.

Noise monitoring is essential to prevent impacts on the marine ecosystem as much as possible and is an indispensable factor to be included in all phases of these activities. This is consistent with the possible balance between reducing noise impacts on ecosystems and socio-economic development.

The drafting of the following standard takes into account the different conclusions that exist today between the scientific results obtained in the field and in the laboratory. It is taken into account that possible biological responses, obtained from scientific research in the field of "noise pollution", may be difficult to assess due to ecosystem variability and incomplete scientific information on anthropogenic noise at sea.

In the standard under consideration, the difficulty of assessing acoustic impacts has been taken into account together with the high variability and interaction with different environmental aspects.

It is therefore difficult to develop plans to contain anthropogenic noise given the lack of scientific knowledge of the sounds emitted, the exposure thresholds and any responses triggered at the ecosystem level by these activities.

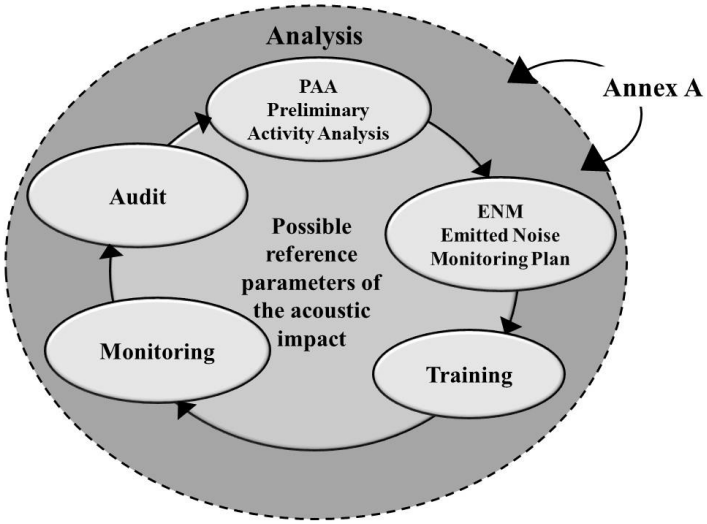
Despite this, efforts are being made to develop mitigation strategies that take into account biological information or possible changes to sound sources in order to minimize the resulting noise impacts as far as possible.

The multidisciplinary approach is the basis for the drafting of this standard, the result of an Innovative PhD course with industrial characterization PON 2014-2020 carried out at the University of Palermo focused on the study of acoustic impacts of the activities of Deep Sea Mining.

The standard provides guidance on the behaviors to be implemented in all operational phases for the management of acoustic impact.

Annex A contains a summary of the scientific results (bibliographic data) that have been taken as a reference in the drafting of this standard.

The following diagram represents the description of a careful and precise analysis in order to carry out an efficient and effective acoustic monitoring.



In this Standard, the following verbal forms are used:

— “shall” indicates a requirement;
— “should” indicates a recommendation;
— “may” indicates a permission;
— “can” indicates a possibility or a capability.

2. Aim and Scope of Application

The purpose of this standard is to suggest possible ways of managing the acoustic impact of Deep Sea Mining (DSM) marine activities operating in the range between 10 Hz and 10 kHz.

The standard aims to provide stakeholders with references and/or guidance to reduce the noise impact by ensuring business continuity.

Interested parties may improve their environmental performance by following the minimum noise acceptability criteria set out in the following standard.

The problem of noise pollution is now relevant in order to improve environmental performance; an organization that will follow the indications of the following standard can take it into account in the course of its activities and contain it.

This standard is aimed at organizations that need a reference for noise pollution control.

The ultimate aim is to carry out these activities by controlling and reducing as much as possible the noise emissions and therefore the environmental impacts that could result from them. It will therefore be possible to improve the environmental performance and achieve the objectives set before the start of the activities.

3. Preliminary analysis

3.1 PRELIMINARY ACTIVITY ANALYSIS (PAA)

Before the start of the activities, the organization shall carry out a Preliminary Analysis of the Activities to be carried out (PAA).

In the PAA, the organization shall demonstrate that it is fully aware of all activities and has taken into account the resulting environmental impacts.

This will involve the analysis of some points such as:

a) Type of activity;
b) Technical characteristics of the equipment involved;
c) Actions likely to have a significant environmental impact;
d) Timing of activities;
e) Responsibilities and risks of the different levels of activity;
f) Type and characteristics of the environment of interest;
g) Structure of the ecosystem and of the biodiversity of the area, its mapping and monitoring;
h) Methods for the assessment and analysis of environmental indicators for environmental monitoring;
i) Noise emissions from machinery used before and during operation;
j) Possible emergency situations, in particular those with an environmental impact;

k) Environmental goals and the processes by which they are achieved;
l) Acoustic impacts and how to mitigate them;
m) Environmental aspects that the activities will be able to control and/or influence and those that they will not be able to control;
n) Operational measures to prevent or reduce undesirable effects which may be caused by external environmental conditions;
o) Expected environmental conditions throughout the period of activity and any climate and/or sea current changes that could affect safety conditions;
p) Human resources involved and their training.

The PAA aims to improve environmental performance by reducing noise impact.

The results of the PAA shall be recorded; the organization involved shall therefore document and leave tangible traces of the preliminary analysis of the activities carried out and their final results.

The related documents shall therefore:

a) Be dated and signed by all the people who have attended and/or participated in the preliminary analysis;
b) Provide details of all decisions taken regarding the conduct of activities and their management;
c) Identify the environmental criteria used for the decisions taken;
d) Identify the potential expected environmental impacts;
e) Identify the environmental aspects considered;
f) Identify which measures will be taken to reduce the impacts referred to in point (d)
g) Identify the environmental aspects not covered and justify the choice;

On the basis of the complexity of the site and the activity itself, which will be evaluated through the PAA, it is essential the presence of professionals with specific skills necessary for the analysis of the site where the activity will be carried out. Marine/biological, environmental (e.g. ecological, taxonomic, biological, ethological-naturalistic, geological and geochemical) and technical-acoustic (e.g. engineering-physical) skills are required for the monitoring of the noise emitted as per points 2.2 and 3. Expertise in laboratory techniques and technologies is recommended.

The professionals involved shall have skills in environmental, acoustic and conservation / environmental protection.

It is also possible to include professionals from other sectors, not included in the list above, where necessary. This list can be modified according to the characteristics of the site, the area involved and the type of activity carried out.

It is therefore essential to form a team of professionals competent in the environmental and engineering sectors related to the activities.

The ultimate aim of the preliminary analysis is to have a picture as clear as possible of the current state of the underwater environment and the consequences of the activity that will be carried out on it. The PAA provides a snapshot of the previous status at the start of the

activity and is useful for continuous monitoring.

3.2 EMITTED NOISE MONITORING PLAN (ENM)

Taking into account all the elements mentioned in paragraph 2.1, it will be possible to program the noise emitted monitoring plan (ENM). This will be essential for analyzing and monitoring the environmental performance of the activity carried out.

The monitoring plan allows the organization not to deviate from the plans and objectives of this standard.

The ENM shall be documented and the controls carried out shall be recorded (e.g. methods, periodicity, personnel involved).

In the management of the ENM, it is necessary to take into account the skills required under point 2.1.

During the preparation of the ENM, the organization shall demonstrate that it has taken into account all environmental aspects and possible impacts by establishing analysis and monitoring timescales and the instruments to be used.
Below you can find a reference list for the preparation of the ENM:

a) The environmental objectives set shall be measurable, monitored, updated and reported;
b) Significant environmental aspects shall be monitored during the activities;
c) The frequency and responsibility of the planned activities shall be clearly defined;
d) The competences necessary for the activities to be carried out shall be defined in detail, ensuring the competence of the professionals chosen;
e) The type of ecosystem and the presence of any reproductive areas shall be determined;
f) It should be assessed whether the site involved is a sanctuary of reproduction of certain species;
g) The timing and type of analyses to be carried out shall be defined;
h) Methods of acoustic measurement and analysis shall be defined;
i) Noise emission measurements during the activities shall be carried out at a reference distance of 500 m. The choice of any different reference distances (not exceeding 500 m) shall be justified and signed by the technical staff involved.
j) The time interval in which measurements are to be made shall be managed as above;
k) The instruments used for the measurements shall be correctly calibrated and maintained by appropriate standards;
l) The quality of water and sediment before, during and at the end of the activities shall be taken into account;
m) Consideration shall be given to any contamination that may affect the noise impact;
n) The possible presence and maintenance of endemic and bacterial species typical of the site in question and their maintenance shall be assessed;
o) A census shall be made of the biodiversity, the species present and their breeding periods;
p) Any behavioral changes in the species present shall be considered;
q) The protection of a part of the area characterized by the same biodiversity shall be

ensured to allow future re-colonization and gene flow;
r) The oxygen content at different depths shall be considered;
s) Salinity at different depths shall be assessed;

The organization shall provide evidence that all measurements performed will be carried out in accordance with recognized international technical standards.

Particular attention shall be paid to trends of environmental noise levels (annual average values measured in RMS re 1μPa) emitted within the 1/3 octave bands with center frequencies at 63 and 125 Hz.

Acoustic and visual monitoring activities should be carried out throughout the duration of the emission.

Software may be required to compile a log line at regular time intervals (e.g. every 30 minutes). Sampling should be ensured with adequate timing. A sampling of at least 6 hours equally distributed during the 24 hours is strongly recommended.

Due to the variability of the species present in the sea and the variability of their acoustic ranges, their anatomy and physiology, it is difficult to establish fixed and unique distances for a safe monitoring. However, it is recommended to monitor and measure the emission at a minimum (and no more than) 500 m distance from the emission source. In this context, regulators should consider the levels of noise source and reception by animals.

The depth at which the noise measurements will need to be made:

a) It will depend on the type of site and the depth of extraction;
b) It should be assessed with the person in charge (e.g. a physicist);
c) It shall be documented and justified;
d) Provide information on the acoustic impact on the whole water column involved in the activities.

It is necessary to evaluate the pressure levels and the movement of the particles of the sounds produced before, during and after the activities.
The physics of sound propagation shall be taken into account in any acoustic impact assessment.

It is essential to consider that any changes in pH and/or temperature may affect the propagation of acoustic waves (e.g. changes in the thermocline).

It is necessary to measure the vibrations created in the seabed during the activities.

The analysis of biological samples and the results should not exceed a time interval of 10 hours. This will allow you to control any emergency situations that are not immediately visible.
It may be desirable to monitor behavior and perform statistically significant random biological sampling (e.g. blood and/or tissue, analysis of the state of internal organs) at different time intervals for the evaluation of cellular and molecular stress indicators. For this type of analysis it will be necessary to carry out control sampling prior to the start of activities in the absence of noise emissions themselves. The possibility of carrying out these analyses will be evaluated

by the biologist and the body and/or organization involved.

If the above analyses can be carried out, it will be necessary to evaluate also the juvenile individuals of the species present in order to know their impact on fitness, therefore the future impact on the ecosystem as a whole.

It will be the type of analysis carried out and indicators studied that will determine the environmental value considered during the activities carried out with a view to mitigating anthropogenic noise.

It may be necessary to continuously monitor activities to implement any mitigation actions of impacts caused by sudden and unexpected events.

Competent personnel shall select the tools used to carry out the analyses. These may vary according to the environmental conditions of the site and the economic conditions of the project. The same applies to the monitoring times recommended in the above points.

The personnel involved shall document and leave traceability of the planned monitoring plan, of the instruments used, of the time intervals in which the analyses have been carried out.

All information shall be documented, stored and collected over time. The persons responsible for the different monitoring steps identified in the same documents.
The monitoring plan may be modified for a reasonable cause on the basis of needs that may arise and are not foreseeable. However, it shall comply with all the controls and criteria set out in points 2.1 and 2.2.

3.3 TRAINING OF THE STAFF INVOLVED

A proper monitoring plan shall assess the competence and training of the operators involved.

Operators or professionals shall be selected on the basis of the skills required by the PAA referred to in point 2.1.

The figures involved shall give evidence of adequate competence with respect to the requirements and the organization shall ensure that the competences in question are in place.

Operators should be competent and aware. They should also be involved in and undergo training courses and their knowledge and/or preparation on the issue of environmental/acoustic impact shall be assessed.

All operators involved should be informed about the practices and good behavior to be maintained to minimize acoustic impacts, promoting and encouraging continuous improvement.

Staff involved in activities should be fully aware of the consequences of their actions on the environment or of any negligence on their part; they should also be aware of the importance of their contribution to minimizing the acoustic impacts of the activities carried out.

The organization shall monitor the constant updating of the personnel involved, verify their knowledge of the environmental aspects, the environmental policy, the possible impacts and the importance of their contribution.

4. Monitoring of the noise emitted

4.1 MANAGEMENT OF THE EMITTED NOISE MONITORING PLAN (ENM)

Once the Preliminary Activity Analysis (PAA) and the Noise Emitted Monitoring Plan (ENM) referred to in points 2.1 and 2.2 have been carried out, it will be essential to manage the monitoring of the noise impact.

It is a matter of implementing all the controls foreseen in the ENM, in the methodology and in the timing foreseen.

Constant, continuous and detailed documentation of the measurements carried out according to the indications provided for in the ENM shall be guaranteed.

It will be necessary to provide specific action plans for any unforeseeable conditions and assess any emergency situations.

The organization shall monitor all types of non-voluntary changes through strategic mitigation actions.

The biological and environmental parameters referred to in point 2.2 shall be monitored at statistically significant time intervals chosen on the basis of the machinery used, the type of maritime activity carried out, the type of ecosystem involved, the type of extraction and the type of deposit, according to the requirements of the ENM.

If some parameters do not respect the biological sustainability ranges and/or in emergency situations, the activities shall be stopped immediately.

The results obtained from the different monitoring phases shall be evaluated and compared to detect any changes at the end of each sampling and analysis.

The results of the analyses should be: reliable, reproducible, traceable, documented and transparent.

In the case of significant changes in parameters, the actions to be taken to bring them back to the safe limit values should be planned.

The cause of the change in parameters should be determined and, if possible, reduced or eliminated in future phases of the activities concerned.
The organization shall plan actions to mitigate possible impacts on the environment or biodiversity, be able to respond to different types of emergency situations, ensure a periodic review of the processes carried out and the actions implemented.

Everything shall be documented and the communication and/or information to the parties involved ensured.

4.2 AUDIT

Audits shall be planned and carried out at predetermined time intervals.

The purpose of the audits shall be to assess the conformity of the process with this technical standard.

The personnel involved in the audits should have the necessary technical and scientific skills.

All audit findings shall be taken into account by the competent technical staff.

5. Possible reference parameters of the acoustic impact

On the basis of the elaboration of the scientific literature (see Annex A), considering the frequency bands between 10 Hz and 10 kHz below some parameters that can be taken as reference in the management of the emitted noise:

Severe impact

- Deep sea mining and marine-sea activities carried out above 130 dB_{rms} re 1 µPa can cause a serious impact on biodiversity.

Medium impact

- Deep sea mining and marine-sea activities with noise levels between 90 dB_{rms} re 1 µPa and 130 dB_{rms} re 1 µPa may cause an average impact on biodiversity. However, it is possible to limit and/or reduce the impacts as described below.

Low impact

- Deep sea mining and marine-sea activities with noise levels below 90 dB_{rms} re 1 µPa can cause low impact on biodiversity.

In the case of impulsive emissions, where the emissions are greater than:

1. SPL_{peak} 207 dB re 1 µPa
2. SEL_{ss} 174 dB re 1 $\mu Pa^2\ s^{-1}$
3. SEL_{cum} 204 dB re 1 $\mu Pa^2\ s^{-1}$

The noise impact shall be considered serious.
The above values shall be respected within 24 hours of observation.

Impacts can be reduced by considering the following **Impact Mitigation Parameters (IMP)**:

a) Reduce as much as possible the operating times, in the case of the drilling DSM, by

taking advantage of any resting sessions. All this bearing in mind that the acoustic conditions and pressure levels depending on the type of environment may change;

The assessment of these timescales should be considered in the monitoring plan.

b) Minimize the time required for 24-hour operation, including by using alternative technologies. All of this by ensuring a proper balance between the company's business and any impact on biodiversity;

Break times can be reduced to a minimum only for activities with noise levels lower than those mentioned above.

c) Use possible sound inhibitors (bubble curtains, blasting mats, etc.) to contain noise emissions in a restricted area;

d) Evaluate the possibility of carrying out activities in the non-reproductive months;

e) Reduce activities to a minimum number of possible months within a year so as to allow for a possible recovery of species and ecosystems;

f) Assess the possibility of creating any Areas of Particular Environmental Interest (APEI);

g) Ensure the presence of a Marine Mammals Observer (MMO) that supports the figure of the biologist before, during and at the end of the activities for the possible sighting of mammals.

The MMO shall guarantee the absence of mammals at least 30 minutes before the start of activities within a 500 m radius.

h) Establish safety areas around the source where the noise emitted can be deactivated or reduced in case of animal sightings;

i) Reduce noise levels to the lowest possible level, especially at night;

j) Ensure the presence of additional professionals who work alongside the biologist and who can contribute to the development of work as appropriate for the protection of biodiversity (eg. geochemical for water analysis, ecologist for the evaluation of ecosystems);

k) Evaluate the Response Severity Index (RSI), determining the maximum sound pressure levels associated with different levels of RSI. Tissue damage increases with increasing SEL_{cum} and SEL_{ss};

l) Use of soft start techniques (gradual increases in energy levels);

m) Evaluate the use of drilling compared to piling, with the latter having a greater impact.