Tunisia-Italy Power Interconnector Project

Environmental and Social Impact Assessment (ESIA)

Section 09 – Risks and potential impacts assessment – Marine domain

Draft for Consultations

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1. INTRODUCTION

The present impact assessment took into account the following environmental and social components potentially impacted by the Project, in alignment with the baseline analysis (Section 5):

Environmental risks and impacts on Physical Environment

- Meteorology and physical oceanography
- Seabed geology and geomorphology

Environmental risks and impacts on Biological Environment

- Noise
- Flora and vegetation
- Fauna and habitats

For each of the above components impacts have been identified and assessed for the following Project phases:

- Construction Phase
- Operation Phase
- Decommissioning Phase

The Project lifetime is estimated in 40 years: design of decommissioning works will be developed when the project will be close to its end of life: for this reason, no information is presently available as to the activities related to this phase. Impact assessment is based on the hypothesis that marine cables are not removed, as usual in the sector, since this approach would lead to minor impacts than those induced by removal.

Mitigation and prevention measures have been taken into account in the assessment and identified alongside each evaluation, where needed.

2. ENVIRONMENTAL RISKS AND IMPACTS

2.1 Meteorology and physical oceanography

The project will induce no impacts on these components: it consists in fact of a cable laid on the seabed and cannot determine alterations.

2.2 Seabed geology and geomorphology

The following Table provides a brief overview of the potential impacts induced by the Project on seabed geology and geomorphology.

Table 2.1: Seabed geology and geomorphology – Potential Impacts Overview

Construction Phase	Operation Phase	Decommissioning Phase
• Potential soil contamination by accidental spill or waste • Potential disturbance to seabed's structure	• Seabed temperature increase	No impact.

2.2.1 Definition of Sensitivity

2.2.1.1 Existing regulation and guidance

Marine flora and fauna can be adversely affected by diffusion of pollutants in the seabed. In response, regulations in force at both national and international level set standards for the protection of environmental quality for several potential pollutants in seabed sediments.

The UN Sustainable Development Goals (SDGs) of the Global Agenda to be achieved by 2030 included conservation and sustainably use the oceans, seas and marine resources for sustainable development.

Given the above, "*existing regulation and guidelines*" has been classified as *"Moderate".*

2.2.1.2 Societal Value

In general, seabed geology and geomorphology are not deemed of relevant societal value.

The number of people expected to be impacted by the Project is very small; considering the above "*societal value*" has been classified as *"Low".*

2.2.1.3 Vulnerability for change

Sensitive targets have not been found in the area. Therefore the "vulnerability for change" has been classified as "*Low*".

Overall, the Sensitivity of the component "Seabed geology and geomorphology" is thus classified as ***Low.***

Seabed geology and geomorphology			Sensitivity
Characteristics of sensitivity			
Existing Regulation and guidance	**Societal Value**	**Vulnerability for change**	
Moderate	Low	Low	Low

2.2.2 *Construction phase*

2.2.2.1 *Potential impacts*

During the project construction, potential impacts on seabed are primarily related to the following activities:

- Grapnel route clearing;
- Trenching for cable burial;
- Cable protection.

The above activities might induce the following potential direct negative impacts:

- potential seabed contamination by spills from vessels or from machinery;
- seabed disturbance and degradation (erosion, modification of morphology).

2.2.2.1.1 *Seabed contamination*

Contamination arising from seabed disturbance is a risk in contaminated coastal areas, due to release of contaminants in the water column. In any case, the preliminary marine survey and associated desktop study did not indicate contaminated sites close to the cable route.
A major risk, in the project areas may derive from accidental spills or waste dispersed during the construction phase, as:

- drilling mud;
- hydrocarbon or oil spills from vessels or machinery operating on the seabed (trenching or jetting machines);
- accidental dispersion of waste.

Considering the accidental nature of potential contamination and the nature of potential spills and taking into account standard design measures to prevent accidental pollution events implemented by the Project, the intensity of the impact is considered ***negligible***.

The extent of the potential impact is expected to be **low**, as well as the duration, limited to the construction phase and more specifically to the potentially contaminating activities.

Overall, the impact magnitude is ***negligible***.

Seabed geology and geomorphology – Construction Phase				Magnitude
Characteristics of magnitude				
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	
Seabed contamination	Negligible	Low	Low	Negligible

2.2.2.1.2 *Seabed disturbance*

The laying of cables leads to seabed disturbance and increased turbidity. These effects are temporary and have limited spatial extent, in the order of maximum 10 m width if the cable has been ploughed into the seabed.
Impacts on the sediments such as mechanical stress caused by sediment displacement, compaction or vibrations during installation are rated as low-impact due to their small scale.
Specific equipment and installation techniques can reduce the re-suspension of sediment during cable burial.

Overall, the magnitude of impact is classified as ***Low***.

Seabed geology and geomorphology – Construction Phase					
Characteristics of magnitude					**Magnitude**
Impact	**Intensity and direction**	**Spatial extent**	**Duration**		
Seabed disturbance	Low	Low	Low	→	Low

2.2.2.1.3 *Impact Significance*

Seabed geology and geomorphology – Construction Phase			
Impact Significance matrix			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Seabed contamination	Low	Negligible	Negligible
Seabed disturbance	Low	Low	Low

2.2.2.2 *Mitigation Measures*

At the current stage of project design, the following design measures and operational/management procedures for the prevention of impacts during construction are anticipated:

- Operational procedure to prevent and manage potential seabed contamination:
  - Availability on site of emergency response kits;
  - Use the best available technologies for the equipment and machineries and periodic maintenance of the equipment and machineries during construction phase in order to prevent accidental spills;
  - Adequate management of drilling muds;
  - Adequate waste management procedures;
  - Adequate drilling and drilling mud management procedures.

- Procedures to prevent potential seabed disturbance during construction:
  - Use of floating machinery where seabed conditions require its application (see Section 3 for examples of this machinery both for jetting and trenching works).

2.2.2.3 *Residual Impacts*

The project design plans the implementation of the above-mentioned standard measures and management plans to prevent potential impacts on seabed geology and geomorphology. These measures were taken into account in the performed impact assessment.
No significant residual impacts are expected after application of these mitigation measures.

2.2.3 Operation phase

2.2.3.1 Potential impacts

During the operation phase of the project, the main environmental effects on the seabed and sediments are related to heat emission of the cables.
When electric energy is transported, a certain amount is lost as heat, leading to an increased temperature of the cable surface and subsequent warming of the surrounding environment. Important factors determining the temperature increase are cable characteristics, transmission rate and characteristics of the surrounding environment (ambient temperatures, thermal conductivity, thermal resistance of the sediment etc.).
The use of high voltages minimizes heat losses and resultant environmental warming effects because current loads are relatively small. Additionally, DC systems result in less heat loss to the environment for a given transmission rate than AC cables.
Where submarine power cables are buried, the surrounding sediment may be heated but cables, whether buried or not, have negligible capability to heat the overlying water column because of the very high heat capacity of water.
Modelling studies carried out for a similar project[1] (Viking Link, an HVDC link between United Kingdom and Denmark, consisting of two cables at ± 525 kV carrying 1400 MW) suggest that, depending upon cable design criteria, bundled cables will require between 0.7m and 1.15m of sediment cover to have a temperature increase at 0.2m sediment depth less than 2°C.
The impact intensity can thus be considered negligible.

Seabed geology and geomorphology – Operation Phase					
Characteristics of magnitude					**Magnitude**
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	→	
Seabed heating	Negligible	Low	Very high	→	Negligible

2.2.3.1.1 Impact Significance

Seabed geology and geomorphology – Operation Phase			
Impact Significance matrix			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Seabed heating	Low	Negligible	Negligible

2.2.3.2 Mitigation Measures

Design measures that will reduce potential impacts consist of:

- Choice of cable coating depending on expected resistive heating;
- Evaluation of adequate burial depth.

2.2.3.3 Residual Impacts

The performed assessment took into account above presented design measures. Residual impacts are therefore equal to the above presented impacts in absence of mitigations.

2.2.4 Decommissioning phase

Decommissioning of the power plant is not expected to include removing of marine cables, as per current global industry practice. Removal would in fact lead to significant impacts on marine biodiversity, whereas

[1] https://www.commissiemer.nl/projectdocumenten/00002753.pdf

leaving cables in place would not induce any significant disturbance; cables degradation will require hundreds of years.
The impact of this phase on the seabed can be estimated negligible.

2.3 Underwater noise

2.3.1 Definition of Sensitivity

The targets of underwater noise are both the physical environment (modification of the energy content of the underwater environment) and the inhabitant fauna, which takes part to the definition of the site ecosystem.

2.3.1.1 Existing regulation and guidance

Italy has a specific legislation concerning underwater noise, due to the national transposition of the Marine Strategy Framework directive. For what concerns Tunisia, even though no national law is available, it has endorsed international agreements concerning environmental protection actions that could be considered as relevant legislation reference.

The main agreements that could be considered for the present study are listed in the Table below:

Table 2.2: List of the main relevant Protocols and Conventions ratified by boh Italy and Tunisia

Name of Protocol/ Convention	Brief Summary
Convention for the Protection of the Mediterranean Sea against Pollution (Barcelona Convention)	The convention was adopted in Barcelona on 16 February 1976 and last amended on 10 June 1995. The Convention entered into force on 12 February 1978. In 1995 the signatory parties adopted an amended version of the Barcelona Convention of 1976, renamed Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean, which entered into force on 9 July 2004. Cyprus is a contracting party to the Barcelona Convention, along with the European Commission and 21 other countries. The Barcelona Convention aims to protect and improve the marine and coastal environment in the Mediterranean Sea and to promote regional and national plans contributing to sustainable development. The Barcelona Convention has given rise to seven Protocols addressing specific aspects of Mediterranean environmental conservation. To the purpose of this study, the relevant Protocol is the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean and namely its Annex II: List of endangered and threatened species
Agenda 21 of the United Nations Conference on Environment and Development (1992)	Agenda 21, also known as the Rio Declaration, is a comprehensive plan of actions to be taken globally, nationally and locally by governments and organizations to reduce human impacts on the environment. Chapter 17 of Agenda 21 addresses protection of the oceans, and Section 17:30 calls for states to assess the need for additional measures to control degradation of the marine environment from sea-based activities, including activities associated with oil and gas platforms.
Convention on Biological Diversity (1992)	In support of conserving biological diversity, governments commit to the integration, conservation and sustainable use of biological resources into national decision-making, establishing a system of protected areas and requiring environmental impact assessment of proposed projects that may adversely affect biological diversity.

Name of Protocol/ Convention	Brief Summary
Horizon 2020	A key pillar of the environmental strategy for the Mediterranean is Horizon 2020, an initiative between signatories to the Barcelona Convention as well as parties to the Euro-Mediterranean Summit held in 2005. The goal of Horizon 2020 is to rectify the primary sources of pollution in the Mediterranean by 2020. Horizon 2020 outlines the essential features of a coordinated strategy for the protection of the Mediterranean marine environment and coastline by 2020. Horizon 2020 will operate within the existing regulatory framework, such as the Barcelona Convention and the EU Habitats Directive.
Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) (1979)	The Bern Convention covers the natural heritage in Europe, as well as in some African countries. It is particularly concerned about protecting natural habitats and endangered species, including migratory species. As a member of European Community, the Republic of Cyprus meets its obligations under the Convention by means of the Directive 79/409/EEC on the Conservation of Wild Birds (the Birds Directive) and the Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (the Habitats Directive). Cyprus ratified the Bern Convention in 1988. The project activities will take into consideration the provisions of the Bern Convention.
Convention on the Conservation of Migratory Species of Wild Animals (CMS CONVENTION - 1979)	The Convention aims to conserve terrestrial, marine and avian migratory species throughout their range. Its membership includes over 120 Parties from Africa, Central and South America, Asia, Europe and Oceania. The CMS is the only global and UN-based intergovernmental organization established exclusively for the conservation and management of terrestrial, aquatic and avian migratory species throughout their range. CMS and its daughter agreements determine policy and provide further guidance on specific issues through their Strategic Plans, Action Plans, resolutions, decisions and guidelines. The Republic of Cyprus has ratified CMS Convention with Law No. 17(III)/2001. Within this Convention Guidelines on Environmental Impact Assessment for Marine Noise – generating Activities (UNEP/CMS/COP12/Doc.24.2.2 – 2017) have been developed in order to assist in the implementation of the CMS Resolution 9.19 and ACCOBAMS Resolutions 5.15, 6.17, 6.2, 8.11

Name of Protocol/ Convention	Brief Summary
Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS - 2001)	ACCOBAMS is a cooperative tool for the conservation of marine biodiversity in the Mediterranean and Black Seas. It aims to reduce threats to cetaceans in Mediterranean and Black Sea waters and improve our knowledge of these animals and is the first Agreement binding the countries in the two subregions, enabling them to work together on a matter of general interest. The ACCOBAMS Agreement was ratified by the Republic of Cyprus with Law No. 21(III)/2005. Within the Agreement the Policy – oriented initiatives are represented by the Resolutions 2.16 (2004), 3.10 (2007), 4.17 (2010), 5.15 (2013) 6.17-18 (2016). These Resolutions supports the implementation of measures for balancing human activities at sea and cetacean conservation. Moreover, three Guidelines have to be mentioned: the Guidance on underwater noise mitigation measures (2013) is a guide meant to support the implementation of noise mitigation measures at sea, the Guidelines concerning best practices and procedures for addressing cetacean mortality events related to chemical, acoustic and biological pollution and the Guidelines to address the impact of anthropogenic noise on cetaceans in the ACCOBAMS Area.
European Marine Strategy Framework Directive (2008/56/CE)	The main purpose of this Directive is to protect the marine environment across Europe and to achieve a Good Environmental Status of EU's marine waters. The Directive appendixes also supply a set of criteria and standards meant to help Member States to implement the Directive itself. To the purpose of this study the mainly relevant descriptor is Descriptor 11: Energy included Underwater Noise. Transposed in Italy as D.lgs. n. 190 del 13th of October 2010.

2.3.1.1.1 Reference documents and guidelines

2.3.1.1.1.1 CMS/ACCOBAMS GUIDELINES

CMS and ACCOBAMS have in several resolutions recognized underwater noise as a major threat to many marine species. These resolutions also call for noise-related considerations to be taken into account as early as the planning stages of activities, especially by making effective use of Environmental Impact Assessments (EIAs).

According to CMS Resolution 12.14 (UN Environment CMS, 2017), Environmental Impact Assessment for any noise-generating activity proposal, proponents need to have expertly modelled the noise of the proposed activity in the region and under the conditions they plan to operate. All EIAs should include operational procedures to mitigate impact effectively during activities, and there should be proof of the mitigation's efficacy. These are the operational mitigation procedures that should be detailed in the national or regional regulations of the jurisdictions where the activity is proposed.

CMS Guidelines (UNEP/CMS/COP12/Doc.24.2.2.) (UNEP CMS, 2017a) provide minimum contents to be reported when assessing anthropogenic noise impacts on marine environment. The guidelines are divided in sections, each dedicated to different kind of human activities at sea. For the activities of interest of this study, the relevant sections are:

- V. EIA Guideline for shipping and Vessels Traffic,
- VI. EIA Guideline for seismic surveys
- VIII. EIA Guideline for Offshore Platforms

The Guidelines are provided in combination with the "Technical Support Information to the CMS Family Guidelines on Environmental Impact Assessment for Marine Noise – generating Activities" (UNEP/CMS/COP12/Inf.11/Rev.1, 2017) (UNEP CMS, 2017b), which provides information about CMS - listed species' vulnerabilities and habitat along with assessment criteria for impact of exposure levels on these species and their preys.

ACCOBAMS addressed the impact of anthropogenic noise on cetaceans through Resolution 2.16 on *Impact Assessment of Man-Made Noise* (ACCOBAMS, 2004), Resolution 3.10 on *Guidelines to Address the Impact of Anthropogenic Noise on Marine Mammals in the ACCOBAMS Area* (ACCOBAMS, 2007), Resolution 4.17 on *Guidelines to address the impact of anthropogenic noise on cetaceans in the ACCOBAMS area* (ACCOBAMS, 2010), Resolution 5.15 on *Addressing the Impact of Anthropogenic Noise* (ACCOBAMS, 2015) and Resolution 6.17 on *Anthropogenic Noise* (ACCOBAMS, 2017).

Specifically, the Guidelines endorsed by Resolution 4.17 include a number of measures for the mitigation of impacts of anthropogenic underwater noise on cetaceans from various sources, providing for general concepts and specific procedures to be taken into account for any activity in the Mediterranean Sea.

The ACCOBAMS Guidelines cover the following matters:

- general concepts;
- high power sonar;
- seismic surveys and air guns;
- coastal and offshore construction works;
- offshore platforms;
- playback and sound exposure experiments;
- shipping;
- other mitigation cases.

A need for the precautionary principle is stressed, as well as a need for the undertaking of an EIA before granting approval for noise-producing activities.

Guidelines for offshore platforms require the implementation of monitoring and mitigation procedures to be defined on a case by case basis, provided that the lowest possible underwater noise during all activity phases is produced.

Resolution 4.17 was further supplemented by Resolution 5.15 and therein proposed Methodological Guide "Guidance on underwater noise mitigation measures" (ACCOBAMS-MOP5/2013/Doc.24[2]) (ACCOBAMS, 2013), covering impulsive noise sources and its mitigation techniques.

2.3.1.1.1.2 EUROPEAN MARINE STRATEGY FRAMEWORK DIRECTIVE – GOOD ENVIRONMENTAL STATUS.

In the frame of the Marine Strategy Directive, 11 Descriptors of Good Environmental Status for marine waters have been identified. Among these Descriptors, the last one, "Energy included Underwater Noise" should be considered as relevant for this study. Concerning underwater noise, the Report of technical Subgroup on Underwater Noise and other forms of energy (Van der Graaf et al., 2012) describes two indicators one related to the assessment of the presence of low and mid frequency impulsive noise and the other related to ambient noise.

The first indicator is described as follows:

Indicator 11.1.1: Proportion of days and their distribution within a calendar year over areas of a determined surface, as well as their spatial distribution, in which anthropogenic sound sources exceed levels that are likely to entail significant impact on marine animals measured as Sound Exposure Level (in dB re 1µPa2.s) or as peak sound pressure level (in dB re 1µPa peak) at one meter, measured over the frequency band 10 Hz to 10 kHz (11.1.1).

The report specifies that the above sentence should be interpreted as follows:

The proportion of days and their distribution within a calendar year, over geographical locations whose shape and area are to be determined, and their spatial distribution in which either the monopole energy source level (in units of dB re 1 $\mu Pa^2 m^2 s$), or the zero to peak monopole source level (in units of dB re 1 $\mu Pa^2 m^2$) of anthropogenic sound sources, measured over the frequency band 10 Hz to 10 kHz, exceeds a value that is likely to entail significant impact on marine animals (11.1.1).

In addition, it warns that:

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[2] Rev2 2016

- The indicator should be applied to cumulative impact;
- The measures should be backpropagated to 1 m in order to avoid sound distortion;
- The quantities do not include a frequency weighting

It should be also noted that the TSG Noise considers “pulses” to be “all sounds for which the output of a sound level meter on (fast or slow) impulse setting exceeds that on continuous setting by at least 3 dB” and has an effective duration of 125 ms.

The second indicator is defined as follows:

Indicator 11.2.1: Trends in the ambient noise level within the 1/3 octave bands 63 and 125 Hz (center frequency) (re 1μPa RMS; average noise level in these octave bands over a year) measured by observation stations and/or with the use of models if appropriate (11.2.1).

On the basis of the Technical Report above mentioned, in the following paragraphs the significance of the sound sources here investigated for a good environmental status maintenance has been assessed.

2.3.1.1.1.3 NOAA GUIDELINES

The “Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing” (Version 2.0, 2018) is a guideline developed by the U.S. National Marine Fisheries Service. This Guideline provides updated thresholds for onset of temporary (TTS) and permanent thresholds shifts (PTS) for impulsive and non – impulsive sound sources on different kinds of marine mammals. The guideline divides marine mammals in groups on the basis of their auditory range and defines, for each auditory group, weighting functions to be applied to sound sources in order to assess perceived levels for each group.

NMFS provides also a “Level B” criterion, still not updated and distinctively defined for all auditory groups, which sets “behavioral disruption” thresholds for impulsive and non – impulsive sound sources.

This lack of up-to-date thresholds for behavioral effects depends on the fact that behavior in animals depends on a huge number of factors, so that the response to a stimulus can vary not only between species but also within the same species depending on factors such as sex, age, size and motivation (feeding, mating, etc.). Moreover, no reliable data can be derived from the observation of captive animals in order to forecast wild animals’ behavioral response to stimuli as a huge difference in general behavior has been noted.

Recognizing that the permanent threshold shift (PTS) onset thresholds and marine mammal auditory weighting functions provided in the Technical Guidance (NMFS 2018) are more complex than NMFS’ previous thresholds, NOAA’s NMFS has delivered a User Spreadsheet tool, which provides a mean to estimates distances associated with the Technical Guidance’s PTS onset thresholds. This spreadsheet can be used for the quick evaluation of the noise impact on mammals due to the main human activities that could occur at sea. Within the scope of this study the User Spreadsheet tool has been used for the screening evaluation of noise impact due to DP System transceiver.

2.3.1.1.1.4 SOUND EXPOSURE GUIDELINES FOR FISHES AND SEA TURTLES

These Guidelines take into consideration NMFS interim criteria for assessing the effect of pile diving on fishes and other relevant literature in order to define specific thresholds for different kinds of human activities at sea and for species under different circumstances. Fishes and sea turtles were grouped in five classes based on auditory structures and anthropogenic sound sources were grouped in five classes as well. Finally, five types of effects were defined ranging from “mortality and mortal injury” to “behavioral effects”.

It has to be noted that the guidelines recommend specific received sound levels only when data on these levels is considered appropriate. When no data or not appropriate one is available, the guideline recommends a subjective approach in which the risk of an effect is related to distance from the source.

2.3.1.2 Societal Value

The societal value of the physical environment is mainly linked to the value of the inhabitant ecosystem components, which are a receptor for anthropogenic noise. These **fauna** receptors, mainly marine mammals and turtles but also fish, can be considered of a **high** social value due to their importance in the ecosystem and for the economy, therefore, also the **physical environment** could be considered of a **moderate** social value, as noise is not the only element of physical environment that could affect the presence of marine fauna.

2.3.1.3 Vulnerability for change

The **physical environment** receptor has a **low** vulnerability as any change would be reversible, as it would lasts only until the noise source is active. For what concerns the **fauna** receptor, its vulnerability to underwater noise generated by mainly continuous sources of moderate intensity and short duration could be considered as **moderate**: the expected response to this type of noise, its duration and intensity would presumably be of a temporary avoidance of the area where activities are carried out and its proximities, with an almost immediate return after the activities would be set elsewhere or ended.

2.3.1.4 Overall sensitivity

As per what said in the previous paragraphs, the overall sensitivity of both physical environment and marine fauna to underwater noise result to be **Moderate.**

2.3.2 Construction phase

2.3.2.1 Potential impacts

For what concerns noise the underwater environment, the construction phase is the one during which the main impact is foreseen. The impact will vary on the base of the different context (e.g. shallow or deep water, type and stratification of bottom layers, season, water column properties) and activities (e.g. cable laying, trenching activities, rocks deployment, near shore installations).
It must be noted, though, that:

- noise has a limited duration, restricted to a specific activity duration in a specific operational area within the construction phase itself;
- on the base of the active operational areas during the construction, the impact on the overall project area won't be equally distributed but it will decrease with distance from operations;
- nearshore the impact of further noise sources results to be of a minor relevance due to the amount an intensity of near and onshore anthropogenic sound sources;
- the project area is located in a region whit a highly intense maritime traffic, resulting in a high average ambient noise also far from shore.

The main noise sources could be identified,

- offshore, with:
  - support vessels movements,
  - trenchers,
  - cables lay vessels,
- near shore, with:
  - dredgers,
  - HDD.

The construction phases during which these impacts are foreseen are:

- Route clearance and trenching (offshore),
- Backfilling (offshore),
- cable installation offshore and near shore.

For the near shore, it must be noted that the HDD emissions should be limited both in time and in emission level as the drilling depth under the bottom surface is usually of approximately 10m, so that the emission level could be of some influence only during the very first phases of the activities. Dredgers in the near shore could be used only on limited areas and for a short period of time to prepare the site for the HDD activities.
For what concerns offshore cables laying, this activity implies the lay vessel to keep moving, resulting in a limited duration of maximum impact for each area interested by the activity.

Concerning sound emission levels, few bibliographical data are available.
Measurements on HDD activities in a river environment at a 39 m depth below the riverbed directly measured above the operational area without any interference by ship noise gave a result of 129.5 dB re 1μPa @ 1m.
Nedwell and Howell, 2004, report the spectra of two suction dredgers, which both peak at 80 Hz (low frequencies) with a maximum level of 178 dB re 1μPa@1m for that frequency. In the 20-1000 Hz band the

dredgers were measured to have a 133 dB re 1 µPa level at 0.19 km and a 140 dB re 1 µPa level at 0.2 km respectively.
Measurements of a hopper dredger loading at a range of 0.93 km and pumping out at a range of 13.3 km gave 20-1000 Hz band levels of 142 and 117 dB re 1 µPa respectively in 20 m deep water (shallow water).
Jasco Research group (2006) reports the primary source of cable laying activities to be the lay vessels dynamic positioning system, with an overall acoustic source level of the cable ship of 177 dB re 1 µPa @1m, which results in 130 dB, 120 dB and 110 dB sound level reached respectively at 0.38 km, 3.03 km and 13.95 km (modelled with a maximum 300m bottom depth).
Supply vessel noise is considered to be equal to any other type of generic vessel (approx. 157 dB re 1 µPa @1m) and considered as negligible.
Considering a behavioral threshold value for marine mammals of 120 dB re 1 µPa, the extent of the behavioral impact area for this highly sensitive marine fauna could be considered, for each activity, to be in a maximum range of 10 km while a major impact (temporary or permanent injury) could be considered as limited to the very proximity of sound sources. It must be noted, though, that these spatial extent evaluations do not take into account that animals would possibly tend to dive away from disturbing sound sources, resulting in presumably temporary avoidance to be the mayor impact of the activities.

In the table below the characteristics of magnitude for the potential impacts above described is defined:

Underwater noise – Construction Phase				
Characteristics of magnitude				
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	**Magnitude**
Change in the energy of the physical environment	Moderate	Moderate	Low	Low
Disturbance and/or harm to marine fauna	High	Moderate	Low	Moderate

2.3.2.1.1 Impact Significance

Underwater noise – Construction Phase			
Impact Significance matrix			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Change in the energy of the physical environment	Moderate	Low	Low
Disturbance and/or harm to marine fauna	Moderate	Moderate	Moderate

2.3.2.1.2 Mitigation Measures

The following mitigation measures could be used for minimizing the impact of noise, considering that no specific threshold are set by law in marine environment:

- Manage the schedule of activities in order to avoid most sensitive periods in marine mammals life cycle (e.g. mating);
- Follow the GUIDELINES FOR THE REDUCTION OF UNDERWATER NOISE FROM COMMERCIAL SHIPPING TO ADDRESS ADVERSE IMPACTS ON MARINE LIFE recommendations;
- All the machinery would have noise reduction measures according to environmental protection laws.

2.3.3 Operational phase

2.3.3.1 Potential impacts

During operational phase, no sound sources are foreseen except for scheduled or extraordinary maintenance, for which ships and submersible machinery could be used, which sound emission do not differ from the emissions of the ordinary ships (approx. 157 dB re 1 μPa @1m).
As the cable is HVDC, no tonal sounds due to vibrations (usually detectable for HVAC) are foreseen.
It must be noted that:

- The project lays in an area where the marine traffic is intense;
- Submersible machinery, being electrical, usually has very low emission levels;
- Maintenance operations are usually of limited duration and diluted over time.

In the table below the characteristics of magnitude for the potential impacts above described is defined:

Underwater noise – Operational Phase					
Characteristics of magnitude					
Impact	**Intensity and direction**	**Spatial extent**	**Duration**	→	**Magnitude**
Change in the energy of the physical environment	Negligible	Low	Low	→	Low

2.3.3.1.1 Impact Significance

Underwater noise – Operational Phase			
Impact Significance matrix			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Change in the energy of the physical environment	Moderate	Low	Low
Disturbance and/or harm to marine fauna	Moderate	Low	Low

2.3.3.1.2 Mitigation Measures

The following mitigation measures could be used for minimizing the impact of noise, considering that no specific threshold are set by law in marine environment:

- Follow the GUIDELINES FOR THE REDUCTION OF UNDERWATER NOISE FROM COMMERCIAL SHIPPING TO ADDRESS ADVERSE IMPACTS ON MARINE LIFE recommendations.

2.3.4 Decommissioning phase

For what concerns decommissioning phase, two scenarios should be considered:

- The cable is left on the bottom: no impacts are foreseen;
- The cable is retrieved from the bottom: the impacts foreseen are the same of the construction phase, as the instruments used (lay and supply ships) are the same.

2.3.5 References

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2.4 Biodiversity

Even though lay and burial and post lay burial usually displace sediments, marine cable installation has an effect that is quite limited. The majority of the displaced sediments will be deposited within tens of meters of the cable route. Regardless of the technique (ploughing or jetting), the effects will be localized as sediment plume impacts created by marine cable installation are of smaller magnitude than those associated with other marine activities. Different techniques though will potentially have slightly different effects.
Regarding shallow areas and intertidal habitats, they display low sensitivity to, and high recoverability from temporary disturbances like sediment displacement. Less stable habitats (sandy bottoms) recover quicker than more stable habitats (mixed sediments, muddy sands and mud). Infaunal species are likely to re-establish themselves relatively quickly due to their adaptation to an environment that is subject to regular disturbance (wave action, storm events, …) while motile species are usually able to avoid the area during cable burial. Maximum impact occurs between 2 – 3 m on each side of the cable, but as already stated, the environment and its associated biodiversity will make a speedy recovery. Although sensitive species may show longer recovery periods, the overall environmental footprint on the seabed and associated biodiversity is usually small and most habitats are expected to recover in a short period.
Modern equipment and installation techniques though are able to avoid, reduce and/or mitigate the re-suspension of sediments during laying and burial activities (Table 2.4).

Table 2.3: Interaction of marine cable installation and operation with environmental receptors (Y= Direct interaction; I= Indirect interaction; N=No interaction; ?= Unknown)

Marine cable impacts	Inter/subtidal habitats	Offshore benthic habitats	Fish ecology	Commercial fisheries	Navigation and shipping
Seabed disturbance	Y	Y	Y	I	N
Potential contaminant release from sediment	Y	Y	Y	I	N
Artificial reef effects	Y	Y	I	Y	I
Electromagnetic fields	Y	Y	Y	I	N
Thermal radiation	Y	Y	Y	?	N
Underwater noise and disturbance from vessel and installation activity	N	N	Y	I	Y

Modern equipment and installation techniques though are able to mitigate and highly reduce the re-suspension of sediments during cable burial or removal (Table 2.4).

Table 2.4: Seabed disturbance caused by different cable burial tools

Burial tool	Type of sediment	Disturbance mechanism	Potential effects
Plough	Sand, silt, all types of clay, weak rock, hard rock/chalk/gravel beds	Displaces the sediment as the plough moves along the seabed. Usually followed by backfilling of the trench which limits the level of disturbance and particle mixing	Silt and chalk are the most concerning since they remain in suspension for days depending on hydrodynamics of the area
Jet	Sand and gravel (cohesion-less sediment)	Sediment can be liquefied or fluidized with water jets and pressures causing an increase in sediment volume. At high velocity/pressure sediment can be eroded or scoured, suspending and transporting particles away	Material may remain suspended in the water column for prolonged periods and transported over

Burial tool	Type of sediment	Disturbance mechanism	Potential effects
			longer distances than using ploughs
	Clays (cohesive sediment)	Localized erosion and scour enable the jets to begin to form cuts in the solid material. Dredging systems may be used to remove cut material	Material remains in the vicinity of the work area
	Weak rock (including chalk)	Very rare for a subsea jetting system to be deployed to attempt to cut trenches into a rocky seabed. If used, it is often accompanied by a dredge	
Dredge	Sand, silt and certain clays	Dredging removes sediments to create a trench by a process of suction. Works best with small size sediment particles. Often used in combination with a jetting system that fluidizes sediments prior to dredging. Once dredged, material can be deposited on a barge or dispersed into the sea away from the trench according to specific disposal norms and standards	Leads to higher sediment displacement than in the case of ploughing/jetting. The impact on marine life will depend on hydrodynamics and the adaptation ability of species to sediment deposition
Rock wheel cutter and chain excavators	Hard clays and rock. Sometimes used in sands and gravels.	Rocks are cut to form a narrow slot (of around 0.5 to 1 m) into which the cable is laid. The material is broken down into constituent components (i.e. sand for sandstone; silt for siltstone, etc.)	Loose material is suspended in the water column. The movement of the chain can fluidize the granular sediment in vicinity of the cutter and the disturbed material remains contained within the ground minimizing the amount of sediments dispersed.

2.4.1 Overall impacts of the project

The following Table provides a brief overview of the potential impacts induced by the Project on biodiversity.

Construction Phase	Operation Phase	Decommissioning Phase
• Seabed disturbance • Potential contaminant release from sediment • Artificial reef effects • Underwater noise	• Electromagnetic fields • Thermal radiation	No impact.

2.4.1.1 Definition of sensitivity

Sensitivity of marine fauna and flora has been deduced by expert opinion based on available grey literature and scientific publications.

2.4.1.2 Existing regulation and guidance

Some marine fauna and flora are regulated by international protocols and transboundary agreements. Therefore, "existing regulations and guidance" is classified as "Moderate".

2.4.1.3 Societal value

Even though a limited number of marine species are of social interest, the majority remain unknown and are not of importance. Therefore, "Societal value" is classified as "Moderate".

2.4.1.4 Vulnerability for change

Biodiversity has a great tendency to change and is vulnerable, this leads to classifying "Vulnerability for change" as "High".

2.4.1.5 Overall sensitivity

Given the above the overall sensitivity is classified as "Moderate".

Biodiversity				
Characteristics of sensitivity				Sensitivity
Existing Regulation and guidance	Societal Value	Vulnerability for change	→	
Moderate	Moderate	High	→	Moderate

2.4.2 Construction phase

2.4.2.1.1 Potential impacts

During the project construction, potential impacts on seabed are primarily related to the:

- Seabed disturbance
- Potential contaminant release from sediment
- Artificial reef effects

2.4.2.1.2 Seabed disturbance

Project works will impact a very narrow strip (approximately of 10 m) for a very short period of time for the burial of the cables using the ploughing and/or jetting technique.
Overall, the magnitude of impact is classified as ***Low***.

Seabed disturbance				
Characteristics of magnitude				Magnitude
Intensity and direction	Spatial extent	Duration	→	
Low	Negligible	Low	→	Low

2.4.2.1.3 Potential contaminant release from sediment

Project works will impact a very narrow strip (approximately of 10 m) for a very short period of time during burial of the cables using the ploughing and/or jetting technique. Very minimal potential release of contaminants is therefore expected.
Overall, the magnitude of impact is classified as ***Low***.

Potential contaminant release from sediment				
Characteristics of magnitude				Magnitude
Intensity and direction	Spatial extent	Duration	→	
Low	Low	Low	→	Low

2.4.2.1.4 Artificial reef effects

The current project does not foresee any cable protection since they will be buried, the magnitude of the impact is still being assessed in case the need for protection arises.
Overall, the magnitude of impact is classified as ***Moderate***.

Artificial reef effects				
Characteristics of magnitude				**Magnitude**
Intensity and direction	**Spatial extent**	**Duration**	→	
Low	Moderate	High	→	Moderate

2.4.2.1.5 Underwater noise

The current Project will generate underwater noise during its operation with limited spatial extent.
Overall, the magnitude of impact is classified as ***Moderate.***

Underwater noise and disturbance from vessel and installation activity				
Characteristics of magnitude				**Magnitude**
Intensity and direction	**Spatial extent**	**Duration**	→	
High	Moderate	Low	→	Moderate

2.4.2.1.6 Significance of impacts

Biodiversity – Construction Phase			
Impact Significance matrix			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Seabed disturbance	Moderate	Low	Low
Potential contaminant release from sediment	Moderate	Low	Low
Artificial reef effects	Moderate	High	Moderate
Underwater noise	Moderate	Moderate	Moderate

2.4.2.1.7 Mitigation Measures

At the current stage of project design, the following design measures and operational/management procedures for the avoidance, reduction and/or compensation of impacts during construction are anticipated:

- Procedure to avoid, reduce and/or mitigate potential seabed contamination during construction:
  - Avoiding areas with high sediment contamination.
  - Conducting works in the winter season when seawater temperatures are low to avoid/reduce eutrophication from nutrient loading (low productivity periods).
  - Applying technology that disturbs sediments to the minimum therefore reducing resuspension of contaminants from sediment disturbance.

- Procedures to avoid/reduce potential seabed disturbance during construction:
  - Selection of the marine cable route.
  - Burial technique.

- Procedures to avoid/reduce potential artificial reef effects during construction:
  - Using the minimum amount of artificial material for marine cable protection.

  - Using very smooth, artificial substrate to reduce the capacity of organisms to attach.

- Procedures to prevent potential underwater noise during construction:
  - Avoiding the use of installation techniques that generate substantial noise.
  - Using ploughing and/or jetting for marine cable installation (reduction).
  - Shortening to the maximum the duration of marine cable laying activities (reduction).
  - Choosing the best available technology that minimize acoustic related impacts (reduction).
  - Equipping ships and vessels with MMOs during cable laying operations to spot and identify sensitive species like cetaceans and marine turtles amongst others and to monitor on-board adherence to related environmental guidelines (avoidance/reduction).

2.4.3 Operation phase

2.4.3.1.1 Potential impacts

During the project construction, potential impacts on seabed are primarily related to the:

- Electromagnetic fields
- Thermal radiation

2.4.3.1.2 Electromagnetic fields

The current Project will continuously generate electromagnetic fields during its operation with limited spatial extent.
Overall, the magnitude of impact is classified as ***Moderate***.

Electromagnetic fields			
Characteristics of magnitude			**Magnitude**
Intensity and direction	**Spatial extent**	**Duration**	
Low	Moderate	High	→ Moderate

2.4.3.1.3 Thermal radiation

The current Project will continuously generate thermal radiation during its operation and during construction, repair and decommissioning phases, albeit at limited spatial extent.
Overall, the magnitude of impact is classified as ***Moderate***.

Thermal radiation			
Characteristics of magnitude			**Magnitude**
Intensity and direction	**Spatial extent**	**Duration**	
Low	Moderate	High	→ Moderate

2.4.3.1.4 Impact significance

Biodiversity – Operation Phase			
Impact Significance matrix			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Electromagnetic fields	Moderate	Moderate	Moderate
Thermal radiation	Moderate	Moderate	Moderate

2.4.3.1.5 Mitigation Measures

At the current stage of project design, the following design measures and operational/management procedures for the avoidance, reduction and/or mitigation of impacts during operation phase are anticipated:

- Procedure to avoid, reduce and/or mitigate potential electromagnetic fields during operation phase:
  - Burying the marine cable

- Procedure to avoid, reduce and/or mitigate potential thermal radiation during operation phase:
  - Burying the marine cable

2.4.4 Decommissioning phase

Decommissioning of the power plant is not expected to include removing of marine cables, as per current global industry practice. Removal would in fact lead to significant impacts on marine biodiversity, whereas leaving cables in place would not induce any significant disturbance; cables degradation will require hundreds of years.
The impact of this phase on the seabed can be estimated negligible.

2.4.5 Avoidance, reduction and mitigation measures

Potential environmental impacts of marine cables should be anticipated prior to the installation phase by applying avoidance and reduction measures. Measures that represent Best Environmental Practices through the application of the Best Available Techniques as defined in Appendix 1 of the OSPAR Convention should be adopted during all phases of the project. The section on Best Available Techniques in Appendix 1 of the Convention specifies such measures as: “the latest stage of development (state of the art) of processes, of facilities or of methods of operation which indicate the practical suitability of a particular measure for limiting discharges, emissions and waste [...]”. Techniques “include both the technology used and the way in which the installation is designed, built, maintained, operated and dismantled.” Such measures should be used in conjunction with other mitigation measures to minimize the negative impacts to the local environment (Table 2.5). Where no suitable mitigation measures are available, compensation by means of nature conservation and landscape management should be considered. A possible form of compensation measures can consist of improving future engineering strategies through experimental studies of ecosystem functioning and resilience following disturbance. For example, test transplanting seagrasses located in the marine cable corridor to another barren place before burial.

Table 2.5: Available mitigation measures to minimize or avoid environmental impacts of various anthropogenic pressures due to marine cable laying and operation (I: important measure; LI: less important measure)

Marine cable impacts	Route selection	Construction window	Burial technique	Burial depth	Cable type
Seabed disturbance	I	I	I	I	LI
Increase in suspended sediment concentrations and deposition	I	I	I	LI	LI
Potential contaminant release from sediment	I	-	LI	LI	LI
Electromagnetic fields	-	-	-	I	I
Thermal radiation	LI	-	-	I	LI
Underwater noise and disturbance from vessel and installation activity	LI	LI	LI	-	-

In order to avoid, reduce and/or mitigate potential environmental disturbances caused by marine cabling activities, measures exist and should be applied, including the choice of an appropriate marine cable route and installation technique:

- Suitable technology for reducing the emission of electromagnetic fields and minimizing the emission of electric fields through adequate shielding should be used.
- Respect to the maximum extent possible the life cycles of species of concern (winter dormancy, migration, mating and/or spawning, etc.), and minimize disturbance.

- Prioritize burial depth appropriate to the substratum type to reduce exposure of species to electromagnetic fields and heat emission by burying marine cables as deep as possible. According to some models the electromagnetic field level at the water-sediment interface with a 2m burial depth would be approximately 25% less of its initial value versus 60% less for a 1m burial depth. Basically, the deeper the better.

2.4.5.1 Seabed disturbance

The main planning steps where avoidance, reduction and/or mitigation measures can be applied to reduce sediment disturbance are the selection of the marine cable route, burial technique and construction window. Due to lack of information, evaluation of avoidance, reduction and/or mitigation measures was carried-out based on a combination of expert opinion, grey literature and scientific publications while applying the precautionary principle.

Seabed disturbance	
Stressor	Avoidance, reduction and/or mitigation possibilities
Route selection	High
Burial Technique	Low
Construction window	Moderate
Classification	High

Based on the evaluation of the different mitigation measures of the main stressors related to “Seabed disturbance”, “Avoidance, reduction and/or mitigation possibilities” are classified as “High”.

2.4.5.1.1 Route selection

Selecting the route (including landfall) with the lowest environmental impact and highest resource efficiency is one of the most important steps towards realizing best environmental practices. The selected route should meet the following conditions:

- Avoid impacts on habitats and benthic species that are most sensitive to disturbance or are of special ecological interest (i.e. protected areas).
- Avoid highly contaminated landing zones and cable routes to prevent the re-mobilization of contaminants present in sediments.
- Plan in advance the anchoring locations of the marine cable laying ship avoiding sensitive habitats (might need to establish anchoring exclusion zones).
- Choose the shortest possible length based on sea bottom surveys (reduction).
- Install the marine cables in proximity to existing marine cables/pipelines where possible and safe (reduction).
- Use tenders to lift the anchors instead of dragging them on the sea floor therefore reducing sediment disturbance and suspension (reduction).

Seabed disturbance		
Stressor	Type of Mitigation	Avoidance, reduction and/or mitigation possibilities
Route selection	Avoid impacts on habitats and benthic species	Moderate
	Avoid highly contaminated landing zones and cable routes	High
	Choose the shortest possible length	High
	Install the marine cables in proximity to existing marine cables/pipelines	Moderate
	Plan in advance the anchoring locations	High
	Use tenders to lift the anchors	Moderate
Classification		High

2.4.5.1.2 Burial technique

The burial technique plays a major role in determining the burial depth of marine cables. From an environmental point of view, avoidance and reduction of sediment displacement and morphology changes are the most important.

- Avoidance of sediment and morphology changes: Morphological changes of the sediment may occur when laying marine cables in soft substrates. Marine cables should be buried to the deepest level possible to reduce the impacts of thermal radiation and electromagnetic fields. The burial technique applied should also reduce to the maximum the resuspension of sediments, use the removed sediments to backfill the trench and allow the trench to further fill naturally shortly after burial. In case the marine cable is buried in a trench that does not refill naturally, no berm next to the trench should be left, and the trench should be refilled to hasten species recovery while making sure that no spoils are left on the sea floor. It is highly recommended to avoid the trench dredging technique as it results in extensive sediment displacement and suspension.
- Reduction of sediment displacement: Applying the precautionary principle, it is imperative that the technique used results in the lowest release of sediments. Installation via jetting or ploughing involves the lowest environmental impacts (**Errore. L'origine riferimento non è stata trovata.Errore. L'origine riferimento non è stata trovata.**) with ploughing causing less sediment disturbance than jetting. Furthermore, the marine cable is best buried in a one-step instead of a two step-process further minimizing environmental impacts. In sallow and in landfall areas, the HDD technique is to be applied.

Seabed disturbance		
Stressor	Type of measure	Avoidance, reduction and/or mitigation possibilities
Burial Technique	Reduction of sediment displacement	Low
	Avoidance of sediment and morphology changes	Low
Classification		Low

2.4.5.1.3 Construction windows

Sediment disturbance can be further reduced by managing the timing of works. In shallow areas, works are best conducted at low tide, while further offshore, works should be completed as quickly as possible. In both cases, periods of migrations of birds, sea mammals and sea turtles through the marine cable route should be avoided.

Seabed Disturbance		
Stressor	Type of measure	Avoidance, reduction and/or mitigation possibilities
Construction window	Manage time of works	Moderate
Classification		Moderate

2.4.5.2 Potential contaminant release from sediment

Since contamination (chemicals, nutrient loading that may contribute to eutrophication, etc…) risk arises from seabed disturbance in heavily contaminated locations, avoiding, reduction and/or mitigating such impacts can be achieved by:

- Avoiding areas with high sediment contamination.
- Conducting works in the winter season when seawater temperatures are low to avoid/reduce eutrophication from nutrient loading (low productivity periods).

- Applying technology that disturbs sediments to the minimum therefore reducing resuspension of contaminants from sediment disturbance.

Due to lack of information, evaluation of mitigation measures was carried out based on a combination of expert opinion, grey literature and scientific publications while applying the precautionary principle.

Potential contaminant release from sediments	
Type of measure	Avoidance, reduction and/or mitigation possibilities
Avoid areas with high sediment contamination	High
Conduct works in the winter season	High
Apply technology that disturbs sediments to the minimum	Moderate
Classification	High

Based on the evaluation of the different mitigation measures related to “Potential contaminant release from sediments”, “Avoidance, reduction and/or mitigation possibilities” are classified as “High”.

2.4.5.3 Artificial reef effects.

In case the marine cable requires protection, hard substrates will be used providing attachment habitats for species. Impact reduction actions may involve:

- Use the minimum amount of artificial material for marine cable protection (reduction).
- Use very smooth, artificial substrate to reduce the capacity of organisms to attach (reduction).

Artificial reef effects	
Type of Mitigation	Mitigation and prevention possibilities
Use the minimum amount of artificial material	Moderate
Use very smooth, artificial substrate	High
Classification	High

Based on the evaluation of the different mitigation measures related to “Artificial reef effects”, “Avoidance, reduction and/or mitigation possibilities” are classified as “High”.

2.4.5.4 Electromagnetic fields

Electromagnetic fields produced by marine cables may alter natural electromagnetic cues with potential impacts on the ecological processes in electromagnetic-sensitive species. The evidence that artificial electromagnetic fields can affect overall fish migration is still inconclusive. The main avoidance, reduction and/or mitigation actions revolve around burying the marine cable as deep as possible as this has shown to eliminate/reduce the exposure of electromagnetically sensitive species to the fields.

Electromagnetic fields	
Type of measure	Avoidance, reduction and/or mitigation possibilities
Bury the marine cable as deep as possible	High
Classification	High

Based on the evaluation of the different mitigation measures related to “Electromagnetic fields”, “avoidance, reduction and/or mitigation possibilities” are classified as “High”.

2.4.5.5 Thermal radiation

Even though evidence exist that some marine organisms react sensitively to minor increase in ambient temperature, in-situ studies on heat related impacts of marine cables is almost non-existent. The main mitigation actions revolve around burying the marine cable as deep as possible as this has shown to eliminate/reduce the exposure of species to thermal radiation.

Thermal radiation	
Type of measure	Avoidance, reduction and/or mitigation possibilities
Bury the marine cable as deep as possible	High
Classification	High

Based on the evaluation of the different mitigation measures related to “Thermal radiation”, “Avoidance, reduction and/or mitigation possibilities” are classified as “High”.

2.4.5.6 Underwater noise and disturbance from vessel and installation activity

As previously stated, there is no clear evidence that noise caused by the installation of marine cables and associated vessels poses a high risk of harms marine fauna. Furthermore, information on burial techniques with the lowest noise emissions is currently not available. Nevertheless, burial techniques involving substantial noise generation should not be employed. As previously stated, ploughing and jetting are currently the least damaging and should be used by order of priority. If the substrate requires a different technique, blasting in rocky subsoil should be avoided. Main mitigation actions include:

- Avoiding the use of installation techniques that generate substantial noise.
- Using ploughing and/or jetting for marine cable installation (reduction).
- Shortening to the maximum the duration of marine cable laying activities (reduction).
- Choosing the best available technology that minimize acoustic related impacts (reduction).
- Equipping ships and vessels with MMO during cable laying operations to spot and identify sensitive species like cetaceans and marine turtles amongst others and to monitor on-board adherence to related environmental guidelines.

Underwater noise and disturbance from vessel and installation activity	
Type of measure	Avoidance, reduction and/or mitigation possibilities
Avoid the use of installation techniques that generate substantial noise	High
Use ploughing and/or jetting for marine cable installation	High
Shorten to the maximum the duration of marine cable laying activities	Moderate
Choose the best available technology that minimize acoustic related impacts	High
Equip ships and vessels with MMOs	High
Classification	High

Based on the evaluation of the different mitigation measures related to “Underwater noise and disturbance from vessel and installation activity”, “Avoidance, reduction and/or mitigation possibilities” are classified as “High”.

2.4.6 Impacts on sensitive groups and species

The IBAT report identified seven taxonomic groups either fully marine or with marine affinity listed on the IUCN Red list as either Critical (CR), Endangered (EN) or Vulnerable (VU) on Mediterranean level as follows:

- Actinopterygii (ray-finned fishes) with 16 species out of 346 listed as either CR, EN or VU.
- Chondrichthyes (cartilaginous fishes) with 43 species out of 346 listed as either CR, EN or VU.
- Aves (birds) with 5 species with marine affinity listed as either CR, EN or VU.
- Bivalvia (organisms having a shell composed of two valves) with 1 species out of 9 listed as either CR, EN or VU.
- Reptilia (marine reptiles) with 1 species, the green turtle *Chelonia mydas* listed as EN.
- Anthozoa (marine invertebrates) with 1 species out of 5, the Mediterranean Pillow *Cora Cladocora caespitosa* listed as EN.
- Mammalia (marine mammals) with 5 species listed as either CR, EN or VU.

Using the precautionary principle, it is assumed that the species identified as CR, EN or VU will occur in the area of works and that the Project will have different effects/impacts and magnitudes on the different taxonomic groups.
Furthermore, the nearshore surveys identified two main seagrass species, *Posidonia oceanica* and *Caulerpa sp.* in the marine environment of Kelibia, Tunisia.
The project will apply the HDD (Horizontal Directional Drilling) technique that involves drilling from land towards the sea for stretches generally up to 800m and down to 30m depth. This will avoid conducting works in the proximity of the shoreline, but cable burying is expected to occur in parts of the nearshore area (up to 40m depth) with potential effects/impacts on seagrasses.
Information related to potential contamination from sediments (Section 2.2) in the marine cable corridor is not available, and therefore the effects/impacts cannot be assessed on specific groups. Furthermore, the current project does not foresee any cable protection installations and therefore its effects/impacts (Section 2.3) are not assessed. Following is the assessment of the remaining effect/impacts of project activities within the corridor of cable burial as they relate to the different taxonomic groups.

2.4.6.1 Definition of sensitivity

2.4.6.1.1 Existing regulation and guidance

These are taxonomic groups with species at risk of extinction and therefore subject to protection measures. Therefore, "existing regulations and guidance" is classified as "Moderate".

2.4.6.1.2 Societal value

Some endangered species are important from a social point of view. Therefore, "societal value" is classified as "Moderate".

2.4.6.1.3 Vulnerability for change

Since these are species already at risk of extinction, they are extremely susceptible to changes. Therefore, "vulnerability for change" is classified as "High".

2.4.6.1.4 Overall sensitivity

Sensitive groups and species				
Characteristics of sensitivity				Sensitivity
Existing Regulation and guidance	**Societal Value**	**Vulnerability for change**	→	
Moderate	Moderate	High	→	Moderate

2.4.6.2 Actinopterygii and Chondrichthyes

Actinopterygii are the group of ray-finned fishes comprising 50% of living vertebrate species while Chondrichthyes represent the group of cartilaginous fishes. Many species of both taxonomic groups have been recorded to be electro-receptive. In addition, many members of both groups are affected/impacted by the different types of marine works taking into consideration that mobile species, including benthic species are able to avoid most disturbance.

2.4.6.2.1 Construction phase

2.4.6.2.1.1 Potential impacts

During the project construction, potential impacts on the seabed are primarily related to the:

- Seabed disturbance
- Underwater noise

2.4.6.2.1.2 Seabed disturbance

Project works will impact a very narrow strip (approximately of 10 m) for a very short period of time for the burial of the cables using the ploughing and/or jetting technique.
Overall, the magnitude of impact is classified as ***Low***.

Seabed disturbance		
Characteristics of magnitude		
Intensity and direction	**Spatial extent**	**Duration**
Low	Low	Low

Magnitude
Low

2.4.6.2.1.3 Underwater noise

The current Project will generate underwater noise during its construction with limited spatial extent.
Overall, the magnitude of impact is classified as ***Moderate.***

Underwater noise and disturbance from vessel and installation activity		
Characteristics of magnitude		
Intensity and direction	**Spatial extent**	**Duration**
High	Moderate	Low

Magnitude
Moderate

2.4.6.2.1.4 Significance of Impact

Actinopterygii and Chondrichthyes			
Impact Significance matrix			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Seabed disturbance	Moderate	Low	Low
Underwater noise	Moderate	Moderate	Moderate

2.4.6.2.2 Mitigation Measures

At the current stage of project design, the following design measures and operational/management procedures for the avoidance, reduction and/or mitigation of impacts during construction are anticipated:

- Procedures to avoid, reduce and/or mitigate potential seabed disturbance during construction:
    - Selection of the marine cable route.
    - Burial technique.

- Procedures to avoid, reduce and/or mitigate potential underwater noise during construction:

- Avoiding the use of installation techniques that generate substantial noise.
- Using ploughing and/or jetting for marine cable installation (reduction).
- Shortening to the maximum the duration of marine cable laying activities (reduction).
- Choosing the best available technology that minimize acoustic related impacts (reduction).
- Equipping ships and vessels with an MMO during cable laying operations to spot and identify sensitive species like cetaceans and marine turtles amongst others and to monitor on-board adherence to related environmental guidelines (avoidance/reduction).

2.4.6.2.3 Operation phase

2.4.6.2.3.1 Potential impacts

During the project construction, potential impacts on the seabed are primarily related to the:

- Electromagnetic fields
- Thermal radiation

2.4.6.2.3.2 Electromagnetic fields

The current Project will continuously generate electromagnetic fields during its operation with limited spatial extent.
Overall, the magnitude of impact is classified as ***Moderate***.

Electromagnetic fields			→	**Magnitude**
Characteristics of magnitude				
Intensity and direction	**Spatial extent**	**Duration**		
Low	Low	High	→	Moderate

2.4.6.2.3.3 Thermal radiation

The current Project will continuously generate thermal radiation during its operation and during construction, repair and decommissioning phases, albeit at limited spatial extent.
Overall, the magnitude of impact is classified as ***Low***.

Thermal radiation			→	**Magnitude**
Characteristics of magnitude				
Intensity and direction	**Spatial extent**	**Duration**		
Low	Low	Moderate	→	Low

2.4.6.2.3.4 Significance of Impact

Actinopterygii and Chondrichthyes			
Impact Significance matrix			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Electromagnetic fields	Moderate	Moderate	Moderate
Thermal radiation	Moderate	Low	Low

2.4.6.2.4 Mitigation Measures

At the current stage of project design, the following design measures and operational/management procedures for the avoidance, reduction and/or mitigation of impacts during operation phase are anticipated:

- Procedure to avoid, reduce and/or mitigate potential electromagnetic fields during operation phase:
  - Burial technique.

- Procedure to avoid, reduce and/or mitigate potential thermal radiation during operation phase:
  - Burial technique.

2.4.6.2.5 Decommissioning phase

Decommissioning is not expected to include removing of marine cables, as per current global industry practice. Removal would in fact lead to significant impacts on marine biodiversity, whereas leaving cables in place would not induce any significant disturbance; cables degradation will require hundreds of years.
The impact of this phase on the seabed can be estimated negligible.

2.4.6.3 Aves

Aves are the group of birds with many species of marine affinity. Species in this taxonomic group are mostly expected to be affected by the disturbance from vessel activities.

2.4.6.3.1 Construction phase

2.4.6.3.1.1 Potential impacts

During the project construction, potential impacts on the seabed are primarily related to the disturbance form vessel and installation activity.

2.4.6.3.1.2 Disturbance from vessel and installation activity

Disturbance from vessel and installation activity		
Characteristics of magnitude		
Intensity and direction	Spatial extent	Duration
Low	Low	Low

→

Magnitude
Low

2.4.6.3.1.3 Significance of the Impact

Aves			
Impact Significance matrix			
Impact	Sensitivity	Magnitude	Significance
Underwater noise	Moderate	Low	Low

2.4.6.3.2 Mitigation Measures

At the current stage of project design, the following measures and operational/management procedures for the avoidance, reduction and/or mitigation of impacts during construction are anticipated:

- Procedures to avoid, reduce and/or mitigate potential underwater noise during construction:
  - Avoiding the use of installation techniques that generate substantial noise.
  - Using ploughing and/or jetting for marine cable installation.
  - Shortening to the maximum the duration of marine cable laying activities.
  - Choosing the best available technology that minimize acoustic related impacts.
  - Equipping ships and vessels should with MMO during cable laying operations to spot and identify sensitive species like cetaceans and marine turtles amongst others and to monitor on-board adherence to related environmental guidelines.

2.4.6.3.3 Operation phase

No impact on this taxonomic group is expected during the operational phase.

2.4.6.3.4 Decommissioning phase

Decommissioning is not expected to include removing of marine cables, as per current global industry practice. Removal would in fact lead to significant impacts on marine biodiversity, whereas leaving cables in place would not induce any significant disturbance; cables degradation will require hundreds of years.

The impact of this phase on the seabed can be estimated as negligible.

2.4.6.4 Bivalvia and Anthozoa

Bivalve are organisms having a shell composed of two valves and encompass large number of species of clams, oysters, mussels, scallops, and other members of the phylum Mollusca, while Anthozoa are a group of marine invertebrates represented by corals, anemones, sea pens and sea fans amongst others. Species of both taxonomic groups are expected to be affected in the same manner form cable laying activities.

2.4.6.4.1 Construction phase

2.4.6.4.1.1 Potential impacts

During the project construction, potential impacts on the seabed are primarily related to the seabed disturbance.

2.4.6.4.1.2 Seabed disturbance

Project works will impact a very narrow strip (approximately of 10 m) for a very short period of time for the burial of the cables using the ploughing and/or jetting technique.
Overall, the magnitude of impact is classified as ***Low***.

Seabed disturbance				
Characteristics of magnitude				**Magnitude**
Intensity and direction	**Spatial extent**	**Duration**	→	
Low	Low	Low	→	Low

2.4.6.4.1.3 Significance of Impact

Bivalvia and Anthozoa			
Impact Significance matrix			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Seabed disturbance	Moderate	Low	Low

2.4.6.4.2 Mitigation Measures

At the current stage of project design, the following design measures and operational/management procedures for the avoidance, reduction and/or mitigation of impacts during construction are anticipated:

- Procedures to avoid, reduce and/or mitigate potential seabed disturbance during construction:
  - Selection of the marine cable route.
  - Burial technique.

2.4.6.4.3 Operation phase

No impact on the component is expected during the operational phase.

2.4.6.4.4 Decommissioning phase

Decommissioning is not expected to include removing of marine cables, as per current global industry practice. Removal would in fact lead to significant impacts on marine biodiversity, whereas leaving cables in place would not induce any significant disturbance; cables degradation will require hundreds of years.
The impact of this phase on the seabed can be estimated as negligible.

2.4.6.5 Marine Reptilia

Marine reptiles are represented only by sea turtles in the Mediterranean with one the green turtle *Chelonia mydas* listed as EN on the IUCN Red list. Marine reptiles are expected to be impacted by several activities of the Project.

2.4.6.5.1 Construction phase

2.4.6.5.1.1 Potential impacts

During the project construction, potential impacts on seabed are primarily related to the:

- Seabed disturbance
- Underwater noise

2.4.6.5.1.2 Seabed disturbance

Project works will impact a very narrow strip (approximately of 10 m) for a very short period of time for the burial of the cables using the ploughing and/or jetting technique.
Overall, the magnitude of impact is classified as ***Negligible***.

Seabed disturbance				
Characteristics of magnitude				
Intensity and direction	**Spatial extent**	**Duration**	→	**Magnitude**
Negligible	Low	Negligible	→	Negligible

2.4.6.5.1.3 Underwater noise

The current Project will generate underwater noise during its operation with limited spatial extent.
Overall, the magnitude of impact is classified as ***Moderate.***

Underwater noise and disturbance from vessel and installation activity				
Characteristics of magnitude				
Intensity and direction	**Spatial extent**	**Duration**	→	**Magnitude**
High	Moderate	Low	→	Moderate

2.4.6.5.1.4 Significance of Impact

Marine reptilia			
Impact Significance matrix			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Seabed disturbance	Moderate	Negligible	Negligible
Underwater noise	Moderate	Moderate	Moderate

2.4.6.5.2 Mitigation Measures

At the current stage of project design, the following design measures and operational/management procedures for the avoidance, reduction and/or mitigation of impacts during construction are anticipated:

- Procedures to avoid, reduce and/or mitigate potential seabed disturbance during construction:
  - Selection of the marine cable route.
  - Burial technique.

- Procedures to avoid, reduce and/or mitigate potential underwater noise during construction:
  - Avoiding the use of installation techniques that generate substantial noise.
  - Using ploughing and/or jetting for marine cable installation.
  - Shortening to the maximum the duration of marine cable laying activities.
  - Choosing the best available technology that minimize acoustic related impacts.
  - Equipping ships and vessels should with MMO during cable laying operations to spot and identify sensitive species like cetaceans and marine turtles amongst others and to monitor on-board adherence to related environmental guidelines.

2.4.6.5.3 Operation phase

2.4.6.5.3.1 Potential impacts

During the project construction, potential impacts on seabed are primarily related to the Electromagnetic fields.

2.4.6.5.3.2 Electromagnetic fields

The current Project will continuously generate electromagnetic fields during its operation with limited spatial extent.
Overall, the magnitude of impact is classified as ***Negligible***.

Electromagnetic fields				
Characteristics of magnitude				Magnitude
Intensity and direction	**Spatial extent**	**Duration**	→	
Negligible	Low	High	→	Negligible

2.4.6.5.3.3 Significance of Impact

Marine reptilia			
Impact Significance matrix			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Electromagnetic fields	Moderate	Negligible	Negligible

2.4.6.5.4 Mitigation Measures

At the current stage of project design, the following design measures and operational/management procedures for the avoidance, reduction and/or mitigation of impacts during operation phase are anticipated:

- Procedure to avoid, reduce and/or mitigate potential electromagnetic fields during operation phase:
  - Burial technique.

2.4.6.5.5 Decommissioning phase

Decommissioning of the power plant is not expected to include removing of marine cables, as per current global industry practice. Removal would in fact lead to significant impacts on marine biodiversity, whereas leaving cables in place would not induce any significant disturbance; cables degradation will require hundreds of years.
The impact of this phase on the seabed can be estimated as negligible.

2.4.6.6 Marine Mammalia

Marine mammals are classified into four different taxonomic groups: cetaceans (whales, dolphins, and porpoises), pinnipeds (seals, sea lions, and walruses), sirenians (manatees and dugongs), and marine fissipeds (polar bears and sea otters). In the Mediterranean houses a large number of cetaceans and pinnipeds that have and continue to receive high attention in terms of protection.

2.4.6.6.1 Construction phase

2.4.6.6.1.1 Potential impacts

During the project construction, potential impacts on the seabed are primarily related to the underwater noise.

2.4.6.6.1.2 Underwater noise

The current Project will generate underwater noise during its operation with limited spatial extent.
Overall, the magnitude of impact is classified as ***Moderate.***

Underwater noise and disturbance from vessel and installation activity				**Magnitude**
Characteristics of magnitude				
Intensity and direction	**Spatial extent**	**Duration**	→	
High	Moderate	Low	→	Moderate

2.4.6.6.1.3 Significance of the Impact

Marine mammalia			
Impact Significance matrix			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Underwater noise	Moderate	Moderate	Moderate

2.4.6.6.2 Mitigation Measures

At the current stage of project design, the following design measures and operational/management procedures for the avoidance, reduction and/or mitigation of impacts during construction are anticipated:

- Procedures to avoid, reduce and/or mitigate potential underwater noise during construction:
  - Avoiding the use of installation techniques that generate substantial noise.
  - Using ploughing and/or jetting for marine cable installation (reduction).
  - Shortening to the maximum the duration of marine cable laying activities (reduction).
  - Choosing the best available technology that minimize acoustic related impacts (reduction).
  - Equipping ships and vessels with MMO during cable laying operations to spot and identify sensitive species like cetaceans and marine turtles amongst others and to monitor on-board adherence to related environmental guidelines (avoidance/reduction).

2.4.6.6.3 Operation phase

2.4.6.6.3.1 Potential impacts

During the project construction, potential impacts on seabed are primarily related to the Electromagnetic fields.

2.4.6.6.3.2 Electromagnetic fields

The current Project will continuously generate electromagnetic fields during its operation with limited spatial extent.
Overall, the magnitude of impact is classified as ***Moderate***.

Electromagnetic fields				**Magnitude**
Characteristics of magnitude				
Intensity and direction	**Spatial extent**	**Duration**	→	
Low	Low	High	→	Moderate

2.4.6.6.3.3 Significance of Impact

Marine mammalia			
Impact Significance matrix			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Electromagnetic fields	Moderate	Moderate	Moderate

2.4.6.6.4 Mitigation Measures

At the current stage of project design, the following design measures and operational/management procedures for the avoidance, reduction and/or mitigation of impacts during the operation phase are anticipated:

- Procedure to avoid, reduce and/or mitigate potential electromagnetic fields during operation phase:
    - Burial technique.

2.4.6.6.5 Decommissioning phase

Decommissioning is not expected to include removing of marine cables, as per current global industry practice. Removal would in fact lead to significant impacts on marine biodiversity, whereas leaving cables in place would not induce any significant disturbance; cables degradation will require hundreds of years.
The impact of this phase on the seabed can be estimated negligible.

2.4.6.7 Seagrasses

The project will apply the HDD (Horizontal Directional Drilling) technique that involves drilling from land towards the sea for stretches generally up to 800m and down to 30m depth. This will avoid conducting works in the proximity of the shoreline, but cable burying is expected to occur in the remaining stretch of the nearshore, by either using the ploughing or the jetting technique with minimal impact on the seagrasses in the area where burial of the cable will take place.

2.4.6.7.1.1 Potential impacts

During the project construction, potential impacts on seabed are primarily related to the seabed disturbance.

2.4.6.7.1.2 Seabed disturbance

Project works will impact a very narrow strip (approximately of 10 m) for a very short period of time for the burial of the cables using the ploughing and/or jetting technique.
Overall, the magnitude of impact is classified as ***Low***.

Seabed disturbance		
Characteristics of magnitude		
Intensity and direction	**Spatial extent**	**Duration**
Low	Low	Low

Magnitude
Low

2.4.6.7.1.3 Significance of Impact

Seagrasses			
Impact Significance matrix			
Impact	**Sensitivity**	**Magnitude**	**Significance**
Seabed disturbance	Moderate	Low	Low

2.4.6.7.2 Mitigation Measures

At the current stage of project design, the following design measures and operational/management procedures for the avoidance, reduction and/or mitigation of impacts during construction are anticipated:

- Procedures to avoid, reduce and/or mitigate potential seabed disturbance during construction:
    - Selection of the marine cable route.
    - Burial technique.
    - Timing

Regarding works that disturb *Posidonia*, two windows represent themselves that allow reducing impacts to the minimum by order of priority: 1) Summer season from beginning August until the end of September; and 2) the Winter season between the beginning of December and the end of February.
Visual inspection that the plants have shed all their fruits if works are to be conducted in the summer should determine the beginning of works while visual inspection about the stage of the developing fruits and length of the leaves is also important for winter works (leaves are usually still sprouting and if fruits started to develop, they are not too ripe).
For Caulerpa, works are recommended to take place between the month of December and June.

2.4.6.7.3 Operation phase

No impact on seagrasses is expected during the operational phase.

2.4.6.7.4 Decommissioning phase

Decommissioning of the power plant is not expected to include removing of marine cables, as per current global industry practice. Removal would in fact lead to significant impacts on marine biodiversity, whereas leaving cables in place would not induce any significant disturbance; cables degradation will require hundreds of years.
The impact of this phase on the seabed can be estimated negligible.