

## Madeira-Porto Santo very high water depth submarine cable feasibility study

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### ABSTRACT

The paper describes the results of the feasibility study for the electrical interconnection between the islands of Madeira and Porto Santo by means of a very high depth submarine cable link. In the area of interest for cable routing the sea depth is in the range 2200÷2500m; furthermore steep slopes up to 25° are expected near the shore of the two islands. The paper highlights that the installation of the cable at a sea depth up to 2500m and for the envisaged power level scenario (30,60 and 100MW) is today technically feasible, providing possible solutions for cable design and installation in consideration of selected voltage levels.

### KEYWORDS

Submarine cable link, high water depth, feasibility study, islands power interconnection.

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### INTRODUCTION

In the last 20 years cable laying water depth overcame 1000m with a substantial increase and has reached a maximum value of 1620m in 2006 with the SAPEI interconnection (HVDC link between Italy mainland and Sardinia Island) [1]. Such link has been considered as a very challenging project at that time, in consideration of the cable design and installation equipment. In Figure 1 the trend of maximum water depths reached by high voltage submarine power cable links is presented.

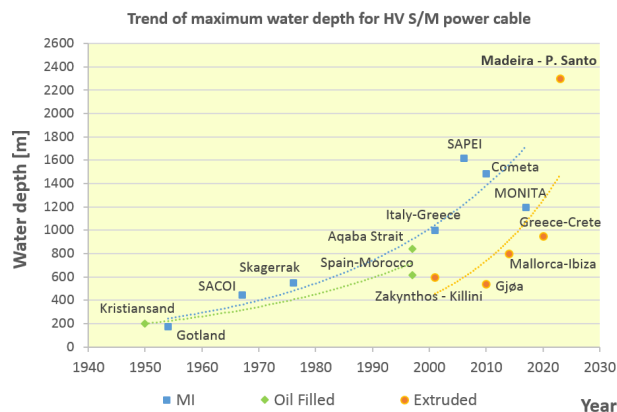


Figure 1: Trend of maximum water depths for HV S/M power cables

In the last years demand for very high-water depth power cables has increased due to the needs required by projects in areas characterized by water depths above 2000m. In

the specific case of Madeira-Porto Santo interconnection the maximum water depth foreseen is between 2200 and 2500 m as better described in next sections.

### AIM OF THE FEASIBILITY STUDY

The feasibility study for the new interconnection has been performed considering:

- Environmental/Cable Route Study, aimed at quantifying the presence of environmental constraints along the preliminary marine route.
- Technological Study: aimed at verifying the possibility to design, manufacture and install a submarine power cable system at a maximum depth up to 2500m.
- Power System Studies: in order to study the needs of the networks of the two islands considering the presence of the new cable link.
- Economic Assessment of the feasible solutions.
- Final screening analysis with the aim to collect all the information gathered in the other studies to define a ranking among the feasible solutions.

Furthermore, a preliminary marine survey has been performed to obtain geophysical and geotechnical information on the sea bed characteristics along a first tentative route of the submarine link. According to preliminary investigation performed by the local transmission system operator (EEM) the following power levels have been considered: 30, 60 and 100 MW, for a bidirectional power transit. At the time of the study (2017/2018) the highest voltage level of the system was 60 kVac on the island of Madeira and 30 kVac on the island of Porto Santo. The system configuration of the new assessed submarine link in the study is both AC or DC.

### PROJECT NEEDS

The new interconnection between the two islands has been considered for two main purposes:

1. to feed electrical energy to Porto Santo island from Madeira starting from 2020 (in a preferred scenario) to allow Porto Santo to become a 'green island' as requested from the Authorities. In this case the power to be transmitted is only a small part (less than 10 MW) in respect to the envisaged power levels under consideration for the link (30, 60 or 100 MW),
2. depending on cable carrying capacity, in a second step the link will be used also to import green energy from Porto-Santo, where new renewables installation is foreseen, to Madeira. In this case the transmitted power through the submarine connection could reach some tenths of MW.

### STUDY AREA

At the beginning of the study a first tentative route corridor for S/M interconnection between the Islands has been selected with the aim to: