

## Design studies for French submarine links

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### ABSTRACT

RTE is carrying out design studies in order to define optimal technical and economical features for future submarine links (AC or DC, number of circuits, voltage level, power rating, etc.).

From many engineering studies for these links, some of them being still going on, the authors enumerate and discuss numerous design criteria in this paper, with a special focus on:

- **The design criteria in regards to the state-of-the-art of the technologies of submarine cables.**

Technico-economical studies have been conducted to define the technological choice of each submarine link, taking into account the state-of-the-art of the HVAC and HVDC submarine cable technology. The present paper explains the different results obtained.

- **The design criteria at the landfall part, which is the bottleneck of the submarine links in terms of cable thermal design.**

The paper describes the main issues and how RTE imagines handling those, regarding thermal aspects and installation:

- ✓ Cable characteristics and calculation methods,
- ✓ Thermal resistivity of soil,
- ✓ Burial depth,
- ✓ Correlation with electro-technical studies (reactive power management for HVAC links for instance),
- ✓ Feasibility of the installation in open trench or HDD,
- ✓ Pulling efforts,
- ✓ Fault containment.

### KEYWORDS

Submarine cables, thermal design, design criteria, HVAC, HVDC, landfall.

### INTRODUCTION

In November 2012, the French Government launched a national and broad-ranging citizen debate about energy transition. In March 2015, a law was adopted by the Parliament, including the following targets:

- To reduce by 40% greenhouse gas emissions by 2030 compared to the reference 1990,
- To halve the energy consumption by 2050 compared to 2012,
- To cut by 30% of final energy consumption from fossil fuels by 2030 compared to 2012,

- To extend by in 2030, the share of energy from renewable sources to 32% of gross final energy consumption,
- To decrease by half the share of nuclear in electricity generation by 2025.

The development of the offshore wind generation is a major vector to reach the target of renewable energy. Two tenders (identified as Round 1 & 2 later in this paper) have planned six offshore wind farms (bullets in Fig.1). A third tender will be published in 2015.

On the other hand, In order to meet the challenges of the energy transition in Europe, RTE will operate numerous submarine links in the coming years, with different characteristics (AC/DC, interconnection/export, length, voltage level, current rating, etc.).

The following chart presents the different identified RTE subsea link projects.



Figure 1: Map of the future submarine links in France

### HVDC Projects:

- IFA 2: Interconnection between France and Great Britain - 1000 MW,
- Midi-Provence: RTE grid connection in the south of France - 1000 MW,
- FAB link: Interconnection between France and Great Britain through Alderney Island - 1400 MW,
- Celtic Interconnector: Interconnection between France and Ireland - 700 MW,