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THE **SPAIN-FRANCE** UNDERGROUND
ELECTRICAL INTERCONNECTION
A WORLD-PIONEERING PROJECT



RED
ELÉCTRICA
DE ESPAÑA





RTE

Réseau de transport d'électricité



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1. Presentation

The new electrical interconnection between Spain and France is a project declared to be of European interest as per the agreement that, on 27 June 2008 in Zaragoza, was agreed to by the governments of the two countries. The execution of the project is the responsibility of Inelfe, a company founded by Red Eléctrica de España (REE) and Réseau de Transport d'Électricité (RTE).

Among the main objectives of this line of note are the increased security, stability and quality of the electricity systems of the respective territories. The line will enable the exchange of energy between the two countries, following, in this way, the guidelines of the European Union (EU) regarding the increase in the commercial exchange capacity amongst its member countries. Thus, it will enable the exchange capacity to be doubled from 1400 to 2800 megawatts, that is to say from the current level of 3 % of demand up to 6 %.

In addition, it will improve the quality of power supply to the towns in the Roussillon and Empordà regions and will guarantee the electrical power supply necessary for the correct operation of the high-speed train on the Spanish side.

In the future, the interconnection will also enable the use and consumption of electricity coming from renewable sources, mainly wind power. In this way, it will contribute to the target set by the EU so that 20 % of energy consumed in 2020 comes from renewable sources.

The interconnection line, which has a length of 64.5 kilometres, links the towns of Santa Llogaia, near Figueres, with Baixas, near Perpignan. The entire interconnection link is completely underground and has been housed in a concrete trench, except for the stretch that crosses the Pyrenees that runs through an 8.5 kilometre tunnel that runs parallel to the high-speed railway line.



2. The investment

The Spain-France interconnection represents an investment of 700 million euros. The project received a financial grant of 225 million euros from the European Union under the European Energy Programme for Recovery (EEPR). Additionally, it has received funding from the European Investment Bank through a loan of 350 million euros granted to REE and RTE.





3. The converter stations

The electrical interconnection has the distinctive feature of being in direct current, whilst the Spanish and French grids are in alternating current. Therefore, it has been necessary to construct two converter stations, one at each end of the interconnection link, located in Baixas and Santa Llogaia respectively, in order to convert alternating current to direct current and thus link the interconnection with the rest of the Spanish and French power grids. Each station has more than 5,400 power modules, which are responsible for converting alternating current to direct current (and vice versa). The construction and development of the converter stations was carried out by Siemens.

To make this possible, Inelfe has chosen the most advanced technology available today and which has already been the focus of attention of many experts around the world, due to the advantages it represents in electricity grid management.



Baixas converter station



4. The trench

The route of line of the electrical interconnection is buried underground in a trench system, except for the stretch that crosses the Pyrenees through the Albera massif that passes through a tunnel. This trench system involves a fully-underground concrete enclosure which houses the interconnection cables. In total, there are 250 kilometres of cable installed; bearing in mind that the interconnection consists of four cables, two per link. These cables will transport back and forth across the border 2,000 megawatts of direct current at 320 kilovolts, which is an all-time record amongst the underground interconnections in direct current.

On the Spanish side, the line crosses the Empordá region through the municipalities of Santa Llogaia, Vilafant, Figueres, Llers, Pont de Molins, Cabanes, Biure, Capmany, Darnius, Agullana and La Jonquera. For the most part, the route runs parallel to the AP-7 motorway and the high-speed train.

The route on the French side passes through the towns of Baixas, Baho, Villeneuve-la-Rivière, Le Soler, Toulouges, Canohès, Ponteilla, Trouillas, Villemolaque, Banyuls dels Aspres and Tresserre, and mostly follows the high-speed train route until the tunnel entrance in Montesquieu des Albères. After the tunnel it passes under the municipalities of Le Boulou, Les Cluses and Le Perthus.





5. The tunnel

The electrical interconnection crosses the Pyrenees through a tunnel of 8.5 kilometres in length and 3.5 metres in diameter. Of the total tunnel stretch of line, 7.5 kilometres run through French territory and 1 kilometre in Spanish territory. The tunnel runs parallel to the high-speed train tunnel and it also has its entrance and exit in the municipalities of La Jonquera in Spain and Montesquieu des Albères in France.

To construct the tunnel, two tunnel boring machines were used, both designed and manufactured especially for this project: 'Alberes' on the Spanish side and 'Canigó' on the French side. The tunnel boring machines began the drilling work in February 2012 and October 2012 respectively.





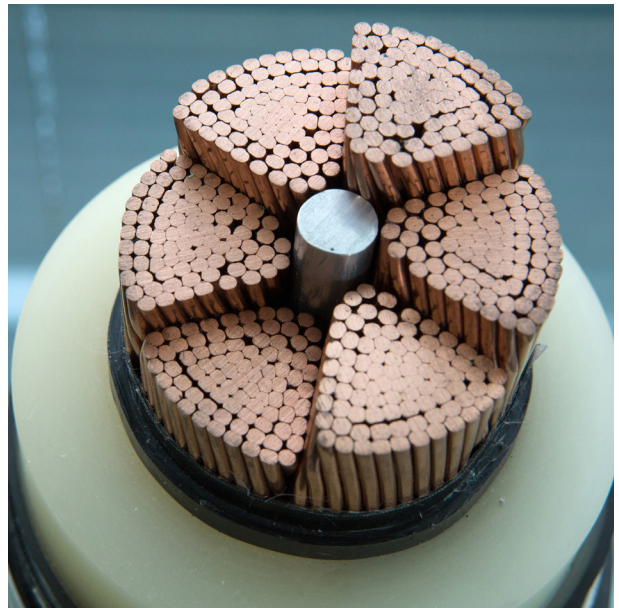
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6. Cutting-edge technology

This new electrical interconnection between Spain and France represents a milestone as it is the first time in Europe that Voltage Source Converter (VSC) technology has been used in an electrical link of this power capacity. It is a technology with the capability to quickly convert alternating current to direct current. The advantage of direct current is that it allows underground connections that run over long distances, such as this one of 64.5 kilometres between Spain and France.

In addition to the length of the underground line, the technology chosen also represents a major innovation in the manufacturing of the cables and the converter stations at these levels of voltage and power.



7. The environmental commitment

The electrical interconnection project required the adoption of a series of preventive and corrective measures so as to minimise the impact on the natural and social environment along its route.



In addition to backing the installation of a fully-underground line, one of the main criteria used in defining the route was to keep it as far as possible from towns and areas of higher population density, as well as natural spaces. Therefore, the interconnection, whenever possible, took advantage of existing infrastructure corridors such as the AP-7 motorway and high-speed train.

In order to reduce the visual and environmental impact, the line passes under motorways and railroads through a system of micro-tunnels, the same system that is used to cross beneath rivers with the aim of reducing the impact on river flows and water levels. In addition, the Company has fulfilled its commitment to use existing roads and paths during construction and for their restoration once the works concluded.

Both in Spain and France, monitoring committees were created to control and verify that all the established environmental nature measures were met.





8. Social commitment

In the social scope, Inelfe has maintained its commitment to the territory, both collaborating with leading cultural and sporting events, as well as creating direct and indirect job positions in the Roussillon and Empordà regions during the entire period the works were being executed.

In the cultural and social scope, this has resulted in a direct and ongoing collaboration with the 'Pau Casals' Music Festival in Prada, The Peralada Festival, the Figueres Acoustic Festival, the 'Temporada Alta' Festival in Girona, the Archipel theatre in Perpignan or the school of the USAP rugby club.





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9. Chronology of events

- **27 June 2008:** the governments of Spain and France sign the agreement in Zaragoza for the electrical interconnection between the two countries.
- **1 October 2008:** the Spanish company Red Eléctrica de España (REE) and the French company Réseau de Transport d'Électricité (RTE) create the company called Inelfe, a mixed-capital corporation, jointly-owned in equal shares, to construct the electrical interconnection.
- **13 December 2010:** REE obtains the environmental impact statement for the project.
- **16 December 2010:** Inelfe awards the construction of the electrical interconnection to Siemens and Prysmian.
- **1 February 2011:** Inelfe awards the construction of the tunnel for the electrical interconnection to the consortium led by Eiffage TP and Dragados.
- **6 October 2011:** The European Investment Bank signs a loan of 350 million euros with Inelfe, REE and RTE to finance the construction of the interconnection.
- **14 February 2012:** tunnel drilling commences on the Spanish side.
- **17 October 2012:** tunnel drilling commences on the French side.
- **22 April 2013:** tunnel boring works for the electrical interconnection completed.
- **January 2014:** the installation of the cables completed in the trench in the French section of the route.
- **February 2014:** installation of cables in the trench system starts on the Spanish side.
- **August 2014:** cable installation work commences in the interconnection tunnel.

- **December 2014:** conclusion of civil works for the interconnection and commencement of the technical testing phase with the aim of it being commissioned in mid-2015.





10. Project conclusion

It is foreseen that the electrical interconnection will be in operation in mid-2015. As with other international interconnections, its importance lies in guaranteeing the security of the electricity supply, enabling the export of energy at times of high production and low demand (as is the case of wind power energy at night). It also makes it possible to import electricity when there are sudden increases in demand or when a fault occurs in the electricity system.

The security of the electricity supply plays a key role in the social and economic development of the regions. The quality of the electricity supply is a critical factor for many companies who decided to establish themselves in the regions of Girona and Roussillon. The interconnection ensures a high level of quality, responding to power supply needs in the medium term, and represents a clear backing for the social growth of municipalities in both regions.



11. Key Data

€700 million

Overall budget

€350 million

European Investment Bank loan

€225 million

European Union financial grant

2,800 MW

Exchange capacity doubled from 1,400 to 2,800 MW

250 km

Kilometre of cable used

2x1,000 MW

Power transported through the cables in direct current at

64.5 km

Length of the interconnection link

8.5 km / 3.5 m

Tunnel dimensions: 8.5 km in length and 3.5 m in diameter

5,400

Number of power modules





Project declared of European Interest and
co-financed by the European Commission

February 2015