

START-UP OF AN OFFSHORE WIND POWER PLANT WITHOUT THE SUPPORT OF AN EXTERNAL POWER GRID

DESCRIPTION OF THE TECHNOLOGY

Researchers from the Universitat Jaume I and the Universitat Politècnica de València have developed a technological procedure that allows an offshore wind power plant to be black started, that is, to start up the plant without the support of an external power grid. Until now, this service, which is essential for restoring an electrical system in the event of a shutdown, has only been provided by conventional thermal or hydroelectric power stations.

However, with the reduction in the number of conventional plants and the increase in renewable energy plants, such as solar or wind power, these latter need to be able to restore the electricity system to operation in the event of a shutdown. This requirement is reflected in the new operating procedures drawn up by ENTSO-E (European Network of Transmission System Operators), which must be incorporated by the System Operators of each country.

The technology is applicable in the case where the offshore plant is connected to the land-based power grid via a high voltage direct current (HVDC) line or link with modular multilevel converters (MMC) that convert energy from alternating to direct current at source and from direct to alternating current at the endpoint.

For the wind power plant to start supplying power after a blackout, the capacitors of the MMC converters must be pre-charged and the DC link must be energised, using the onshore power grid. However, in the event of an outage in the land-based alternating current grid, it is not possible to supply the MMC converters and the HVDC line with power, which prevents the wind farm from being connected to the onshore power grid. This, in turn, aggravates the consequences of a blackout by reducing the number of plants that can restore an electrical system.

To date, several procedures have been proposed for the process of charging the capacitors; yet, in all cases an external power source is required, usually the terrestrial power grid itself. This prevents such plants from offering the start-up service without the support of an external power transmission grid.

The proposed method consists in using, with a specific control procedure, power from the plant itself, initially isolated from the onshore grid, to energise first the offshore MMC, then the HVDC line and finally the onshore MMC so as to then supply power to the onshore grid and contribute to its restoration in the event of an outage.

SECTORS FOR COMMERCIAL APPLICATION

The procedure is applicable to any power plant (wind or otherwise) that connects to the AC grid through an HVDC link using MMC converters in one of its converter stations or directly to HVDC grids.

TECHNICAL ADVANTAGES AND COMMERCIAL BENEFITS

Unlike the methods used or proposed to date, the procedure outlined here makes it possible to:

- Energise the MMC converters and the HVDC link using only power provided by the plant itself, i.e. without the need for an external power source (blackstart).
- Restore a power grid by an offshore wind farm or other type of plant connected by means of HVDC links.
- Charge the capacitors of the MMC converters without any auxiliary equipment (rectifiers, thyristors, auxiliary DC sources, pre-charge resistors, diesel generators, etc.).
- Control the charging currents at all times without the need for pre-charge resistors.

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- Charge the capacitors of the MMC converters which are HVDC-linked at constant current to the voltages of the capacitors under control.

STAGE OF DEVELOPMENT OF THE TECHNOLOGY

The start-up procedure has been satisfactorily validated in detail. The final phase of implementation in wind farms or other types of plants would require the development of specific controls for the converters in the plant and trials to test them in a pilot plant or simulated system.

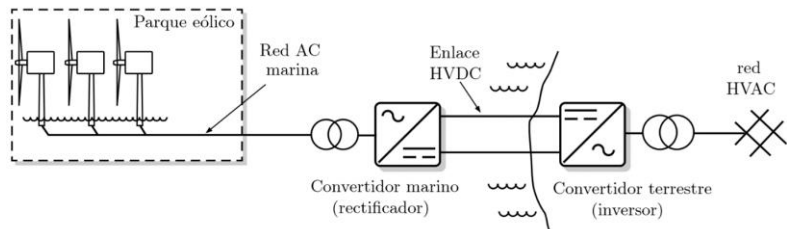
INDUSTRIAL AND INTELLECTUAL PROPERTY RIGHTS

Universitat Jaume I and Universitat Politècnica de València. This invention is protected by means of an application for a Spanish patent with reference P202030313 and application date 17/04/2020.

COLLABORATION SOUGHT

Adaptation of the technology to electric power plants through specific agreements and a subsequent licensing agreement.

RELATED IMAGES



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