# Stability FACTS + ESS for fast energy response in case of contingency

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## Abstract

Great effort is being made to integrate non-dispatchable energy sources, such as solar PV and wind energy, in the electrical system. This penetration requires more flexibility for the operation of the system, flexibility that could be provided by different technological solutions as flexible AC transmission systems (FACTS) or energy storage systems (ESS). However, these technologies typically require large and expensive facilities. To overcome this challenges, multiple services could be provided through new approaches, as it is been proposed in the Stability FACTS project (first stage named AMCOS project and partially funded by CDTI[1] with FEDER[2] funds under the Innterconecta Programme).

In this project a new cost-effective modular converter has been designed to act as both a STATCOM and an ESS, while at the same time being able to connect to the medium or high voltage grid. This project is being leaded by the Spanish TSO, Red Eléctrica de España, which is responsible of defining the technical requirements and to perform the electrical simulations to evaluate the impact of the device in the operation of the system. GPTech is responsible of developing the power electronics and control methods of the converter. Cobra is responsible of the test facilities for the development, protection and later integration of the prototype. In the project are also participating the University of Seville, the University of Las Palmas de Gran Canaria and Intradel engineering.

The modular approach of this development permits to combine different types of energy storage devices, as some modules may comprise supercapacitors while others comprise batteries. Supercapacitors may respond more quickly while batteries allow for longer responses. Not all modules need to comprise energy storage devices; they are designed to provide reactive power and increase the output voltage of the converter at the same time. This concept reduces the cost of the converter and allows for future expansions, since batteries and supercapacitors may be connected to these modules. Finally, the converter high-voltage output permits to largely reduce the transformation costs and losses as the transformer may be 1-to-1, or even not needed depending on the regulations.

So far a 7MVA and 2900V prototype is being built under a first stage AMCOS project. This prototype is 3-phase and comprises 3 H-bridge modules per phase. One module of each phase comprises supercapacitors which can be charged or discharged between 667V and 1026V for a total storage of 1.7kWh. The remaining modules comprise DC-Links of 1000V to increase the output voltage and provide reactive power. A second prototype with the same topology is expected be built, with 25MVAr, 10MW power and 9000V output voltage. This prototype will comprise a total of 48 H-bridge modules, 18 of them with supercapacitors capable of storing a total of 10.3kWh. Some of the remaining modules may comprise batteries in the future.

The final FACTS will be used in Canary Island's electrical system to increase the penetration of renewable energy resources and also provide a fast response for system stability in case of contingency.

[1] Centre for the Development of Industrial Technology
[2] European Regional Development Fund