Megasolar – Integrated outdoor conversion platform for the interface controlled, coordinated and optimised for the network of renewable sources and storage

Summary

Scope – It was expected that in 2050, photovoltaic solar would be the second most used energy source (just after wind power) and that it would represent a quarter of the produced energy. To sustain the pursuit of this growth rate, the need to address various challenges associated with different aspects is envisaged, such as the need for the evolution of existing equipment, in order to increase the efficiency and integration capacity of photovoltaic solar energy (and other renewable sources) in the electricity grid, promoting a higher level of competitiveness, in order to reduce the cost of installing and operating this type of power plant compared to others, called conventional generation, which are typically more polluting.

Main objectives

Increased competitiveness in the field of photovoltaic inverters, with the main focus on increasing the power of the equipment and introducing a modular approach, in order to sustain business growth in the segment of power plants above 50 MW and respond to a set of requirements more demanding in interconnection, as well as promoting the integration of new paradigms, such as the capacity to accommodate an energy storage component, in a distributed concept.

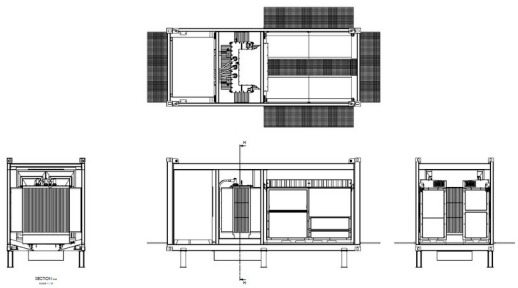

Figure 1. Side view and sections of the overall solution.

Project activities

Activity 1 – Preliminary studies

This activity intended to consolidate the state of the art with regard to existing technologies, legislation and recommendations applicable within the scope of the project.

Activity 2 – Technical specification

Identification of the overall system requirements based on the following main sub-areas:

- The regulatory provisions and technical codes of the target markets, as well as the regulatory and certification requirements that must be met for the various equipment – Transformer, Switchgear, grid connection, structure;
- The requirements to be imposed on technological solutions for control, automation and security, whether from the point of view of the efficiency of the overall operation of the system or in terms of integration into the public electricity network;
- The requirements and differentiating characteristics for products and integrated solutions already on the market;
- The technical requirements and functional requirements that should be considered for the development of the solution's cooling system, including converter, transformer and switchgear, enabling its application in extreme exploitation environments: panels, coatings or other innovative solutions that allow refrigeration without the use of filters and which promote the reduction of the thermal effect of solar radiation on the panels/equipment, in order to allow the correct cooling of the equipment, even when applied in extreme exploitation environments;
- Development of innovative cooling or heat exchange concepts applicable to power semiconductors, which were specific according to the semiconductor technology to be adopted, with the topology of each converter (dc/ac inverter and dc/dc bidirectional converter) and with the physical structure of the power electronics system;
- Environmental sustainability requirements, in order to enhance the use of more sustainable materials and technologies;
- Minimisation of the system's overall electrical losses (through the use of emerging technologies of power electronics and dedicated control algorithms, flexible depending on the different modes of operation and network conditions), both in production periods and also in periods of non-production (P=0), as well as periods of battery charge/discharge, resulting in an increase in overall system efficiency

CERIS : Civil Engineering Research and Innovation for Sustainability

Mega Solar

Project Reference

POCI-01-0247-FEDER-047220

Leading Institution

EFACEC – Energia, Máquinas e Equipamentos Eléctricos (Portugal)

Partners

EFACEC – Engenharia e Sistemas (Portugal), Itecons – Instituto de Investigação e Desenvolvimento Tecnológico para a Construção, Energia, Ambiente e Sustentabilidade (Portugal), UMinho – Universidade do Minho (Portugal)

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CERIS

Coimbra Hub: 270 076.65€

Project Website

https://projects.efacec.com/megasolar/

- Minimisation of the sound power of the main active components and consequently of the overall solution, even in periods when the application is operating at nominal power.

Activity 3 – Concept and design of the solution

This activity involved the detailed development of the different elements of the platform: power module; inverter (c.c./c.a.) for the interface between the grid and the primary energy sources (photovoltaic field); converter (c.c. / c.c.) for the interface between the storage system and the dc-link (common to the inverter and the photovoltaic field); transformer and switchgear; support structure and modules for sensing, communication, data processing and control.

Activity 4 – Component integration and laboratory testing

This activity aimed to verify the technological feasibility of the studied systems.

Activity 5 – Proof of concept and demonstration

The proof-of-concept and demonstration activity made it possible to establish, with the joint participation of all partners involved in the project, a program for the manufacture and integration of prototypes in the global solution proposed under this project, followed by a comprehensive test plan with the objective to characterise, in an integrated way, the performance of the various equipment/solutions developed and to highlight the significant impacts that the proposed solution brings to the integration, operation and maintenance of this type of systems.

Activity 6 – Dissemination of results

This activity intended to organise the results of the MEGASOLAR project and prepare technical and scientific content for dissemination to the public and the market.

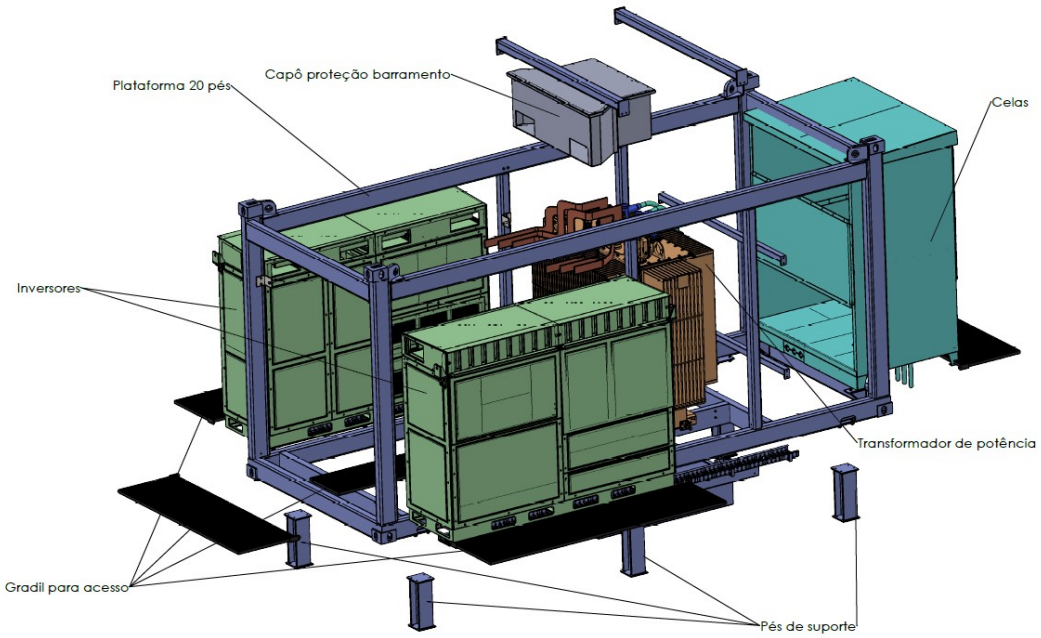

Figure 2. Exploded view of the main components.