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ESFR-SMR Requirements to fit into the future EU electricity network

This study reports various factors modulating the characteristics of the future EU electricity grid and therefore establishing a basis for the European Sodium Fast Reactor (ESFR) - Small Modular Reactor (SMR) requirements, namely: i) policy plans and programs of the EU Commission for 2050, including EU Green Deal and national climate targets, ii) low-carbon technologies available to achieve net-zero target and iii) methods for providing stability to the grid and grid power balance.

The European Green Deal aims at transforming the EU into a modern, resource-efficient and competitive economy, ensuring no net emissions of GHG by 2050. The backbone of this transformation will be low-carbon technologies as well as large-scale European electrical network.

Conventional power plants directly connected to high-voltage transmission lines via synchronous-rotating-alternator contribute to system stability. This option is absent for Variable Renewable Energies(VRE), although they can supply or absorb reactive power. The large VRE integration will stress the problem of maintaining voltage stability and new solutions have to be implemented to enhance the response of power electronics inverters. Methods for providing grid stability and supporting the power balance, such as flexible power operation and other grid stabilizers (e.g.fast frequency response technologies, kinetic energy supply systems and energy storage systems) are therefore required to low-carbon technologies including ESFR-SMRs.

Existing requirements established for Nuclear Power Plants, both from the European Utilities Requirements association and Electric Power Research Institute as well as the best operational performance of currently designed advanced nuclear reactor systems are considered as reference for ESFR-SMR operational requirements. In order to be competitive, ESFR-SMRs have to offer load-following capabilities at least equivalent to conventional SMRs. The integration of a Thermal Energy Storage system enables ESFR-SMR to provide wider load-following capabilities, while maintaining safe reactor operation.

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