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Sketch Design of Fuel Sub-Assemblies for a SFR-150 MWe

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During the years 2018 and 2019 of the ASTRID program, a simulation program on SFRs has been prepared by the CEA and its industrial partners –EDF and Framatome –featuring sketch studies of a smaller-size SFR with extended experimental purposes. The power of the core has been reduced to 150 MWe to minimize investment costs while keeping the capacity to demonstrate the feasibility of Pu multi-recycling and to qualify designs and technologies expected for the future industrial SFRs.
These requirements led to an evolutive design for the core and the fuel sub-assemblies (S/A) over the reactor lifetime. At the beginning, the fuel pins will be similar to the one in former SuperPhénix SFR with UPuO2 fuel containing Pu from reprocessed PWR-UOX fuels. In the next step, Pu coming from reprocessed PWR-MOX fuels will be introduced. Then the concepts for the future industrial SFRs will be qualified: low void worth core, ASTRID-like large pin-small wire bundle, ODS cladding···
This paper presents sketch design studies of fuel S/A for a 150 MWe SFR at the end of 2019.
The hexagonal wrapper tube can host either a 169-SPX-type-pins bundle or 127-ASTRID-type-pins bundle. The thermomechanical behavior of the fuel bundle has been calculated with DOMAJEUR code. The lower gas plenum of the fuel pins has been reduced thanks simulations with GERMINAL fuel performance code, developed within the PLEIADES software environment, considering a nominal operation up to 87.5 dpa followed by an unprotected loss-of-flow transient. The upper neutron shielding is made of steel and B4C rings housed in a leaktight compartment to stay compatible with the washing process, while limiting the secondary sodium activation and the irradiation level of diversified absorber rods electromagnet. The overall S/A length of 4.20 m has been reduced by 30 cm compared to ASTRID-600 in the perspective of costs reduction.

Country/Int. organization

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