

Design of secondary sodium based decay heat removal system for future fast breeder reactors

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Fast Breeder Reactor -1&2 (FBR-1&2) is a sodium cooled, pool type, Mixed Oxide (MOX) fuelled reactor with two sodium loops (primary and secondary). The design of this reactor is based on experience from Fast Breeder Test Reactor (FBTR) and prototype Fast Breeder Reactor (PFBR). Decay Heat Removal (DHR) system removes decay heat from the reactor after shutdown to ensure adequate cooling of core sub-assemblies. PFBR has two diverse paths for decay heat removal namely, Safety Grade Decay Heat Removal System (SGDHRS) and Operation Grade Decay Heat Removal System (OGDHRS).

OGDHR system requires at least one secondary loop, steam water circuits and off-site power supply for decay heat removal. SGDHR system is operated when OGDHR system is not available. In order to improve reliability of DHR system, it is planned to have an additional DHR system operating on secondary sodium, thus reducing the dependency on SGDHR system. The design of Secondary Sodium based Decay Heat Removal System (SSDHRS) for FBR-1&2 was carried out after, reviewing the design and operational experiences of BN 800, SUPERPHENIX and MONJU available in various forums.

SSDHRS is a part of Secondary Sodium Main Circuit (SSMC), it operates only during shutdown condition for decay heat removal. This system is designed for a heat removal capacity of 15MW. It is provided with an Air Heat Exchanger (AHX) with hot sodium flow in tube side by forced circulation using Secondary Sodium Pump (SSP) and air flow over the tubes by forced circulation using blower.

Heat removal capacity of the system with passive operational mode was also studied and found to be about 60% of the active capacity. System optimization was carried out to arrive at the sizing of various equipment of SSDHRS (Dimensions of AHX, blower capacity, height of stack and circuit design). Parametric studies have been carried out to analyse the effects of sodium temperature and flow rate on heat removal capacity of SSDHRS. SSDHR system is envisaged to cater to fuel handling and other maintenance conditions instead of relying on OGDHR system which requires external power supply, recirculation pumps, condenser cooling fans and steam generators to function.

Country/Int. organization

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