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AN EXPERIMENTAL STUDY ON SECONDARY SODIUM SYSTEM BASED DECAY HEAT REMOVAL CIRCUIT OF A SODIUM COOLED FAST REACTOR

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Decay heat removal is an important safety function of a nuclear power plant and failure of the same needs to be practically eliminated. Various concepts for decay heat removal have been adopted in different designs of sodium cooled fast reactors (SFRs) depending upon the size and type of reactor. Some of the pool type designs adopt safety grade decay heat removal system (SGDHRS) which consists of three coupled natural convection loops. SGDHRS removes decay heat through immersed decay heat exchangers in the hot sodium pool and sodium to air heat exchanger kept at a higher elevation at the bottom of a tall stack. These systems are capable of functioning under possible extreme conditions affecting the plant. In order to improve reliability of the decay heat removal function, an additional decay heat removal system capable of functioning under emergency conditions which is connected to secondary sodium system may be considered. One typical design configuration for this system adopts a forced cooling type of sodium to air heat exchanger, operating in parallel to steam generators in the secondary sodium circuit of the reactor. The secondary sodium system based decay heat removal circuit could also be considered to function as a normal shutdown cooling system if its controllability under various operational conditions is established. Accordingly, the controllability of the system under varying decay power scenario and utilization of this system for long term maintenance of cold shutdown condition in the plant are some of the important aspects to be established. Towards this, experimental studies have been carried out using 2 MWt capacity sodium to air heat exchanger in the Steam Generator Test Facility (SGTF) at Indira Gandhi Centre for Atomic Research, Kalpakkam, India under varying heat source conditions (simulating the decay power evolution in the reactor core). These studies ensure controllability and operability of the system at desired operating conditions respecting various thermal hydraulic design constraints under various simulated transient conditions.

Keywords: sodium cooled fast reactors, safety grade decay heat removal system, secondary sodium system based decay heat removal system, steam generator test facility.

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