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Development of steam-water cycle chemistry for steam generator of research reactor MBIR

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The compatibility of water chemistry with structural materials of steam-water cycle is most important condition for long-term operational reliability of steam generators. Limiting service life factor of the steam generators is usually corrosion damages of heat exchanger tubes from the steam-water side. In view of this the mostly proven in practice reference design and engineering solutions were used to ensure efficient, reliable and safe operation of the multipurpose fast research reactor MBIR under development in Russia by NIIAR (as an operator), NIKIET (as a chief designer), etc.
The reverse type steam generators for MBIR were developed by JSC "TASMO" and the Czech company ENERGOVÝZKUMO. The main design feature of reverse type steam generators is sodium coolant circulation within the tube bundle while the steam-water medium is going through the shell side. The design of these steam generators should ensure their reliable and safe operation during 200 thousand hours of service life. The above steam generators will provide both heat removal from the secondary sodium coolant loop to steam-water environment of the third coolant circuit and the generation of superheated steam for steam turbine.
The cutting research from reference steam generators has shown that corrosion damages of heat exchanger tubes were initiated and developed from the steam-water side under this environment. The main goal of water chemistry is the formation of the protective oxide films on heat exchanger tube surfaces which provides their low corrosion rate thanks to limitation of corrosion-active impurities in the steam-water environment (copper, chloride ion, sulfate ion, etc.). The main local corrosion mechanism of these tubes is crevice and pitting.
Neutral water chemistry was proposed for the steam generator of MBIR reactor due to a number of advantages over alternative options:
- Simple chemistry control and monitoring due to absence of any chemical reagent dosing into feed watert;
- Reduction of capital costs and the amount of waste due to absence of dosing system;
- The absence of hydrazine and ammonia dosing eliminates both toxicological hazards for personnel and ballast exchange capacity of ion exchangers in condensate polisher system
- Elimination of deposits from steam generator surfaces during operational transients.
Thus the proposed neutral chemistry mode for steam-water cycle of research reactor MBIR will reduce the capital and operating costs, improve environmental performance and ensure high reliability and design life of the steam generators.

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