CONCEPTUAL DESIGN FOR THE POOL-TYPE SODIUM-COOLED FAST REACTOR
(2) General plan for research and development

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The purpose of the conceptual design of the demonstration fast reactor is not only to determine the basic plant specifications but also to obtain the prospects for achievement of development goals and technical feasibilities. In the conceptual design of the demonstration fast reactor, in parallel with the design study, the promotion of research and development (R&D) is planned on the feasibility confirmation of the main technologies, the development of codes & standards and safety evaluation technologies. Baced on the design and licensing experience with “Joyo” and “Monju” and the results of subsequent research and development (R&D), R&D items to be conducted in the conceptual design phase were extracted and a development road map was formulated. This paper presents the results of organization of R&D items in the conceptual design phase and an outline of the development roadmap.

1. R&D ITEMS TO BE CONDUCTED IN THE CONCEPTUAL DESIGN PHASE

In identifying the R&D items, the functions of each piece of equipment in the plant to meet the development goals were organized, and it was confirmed that the R&D items necessary to achieve these functions were extracted.

An organized results of a reactor structure is shown in FIG. 1. Required functions are categorized into improvement of safety, improvement of seismic performance and improvement of economic efficiency. Required functions for improving safety include integrity of primary coolant boundary functions, prevention of core damages and mitigation of effects of core damages. The technical issues to be solved for achieving these functions were extracted, such as evaluation of coolant flow inside reactor vessel, development of a self-activating reactor shutdown mechanism and core catcher evaluation technology. Required functions for improving seismic performance include integrity of primary coolant boundary functions. The technical issues to be solved for achieving this function were extracted, such as development of sloshing evaluation method and improvement of core seismic evaluation method. Required functions for improving economic efficiency include shortening of refueling time, reduction of vessel diameter, feasibility of large reactor structure and improvement of maintainability/repairability (availability). The technical issues to be solved for achieving these functions were extracted, such as development of new refueling machine, technology for evaluating thermal hydraulics (e.g. cover gas) and inspection device for reactor vessel.

An organized results of reactor cooling systems is shown in FIG. 2. Required functions for improving safety include core cooling flow, detection of abnormal core cooling flow, early detection of sodium leakage, integrity of primary coolant boundary and early detection and mitigation of water leakage caused by SG tube failure. The technical issues to be solved for achieving these functions were extracted, such as feasibility of primary coolant pumps, reliability of immersed electromagnetic flowmeter, detectability of laser sodium leak detector, development of volume inspection technology for dissimilar joints, detectability of hydrogen detector and Sodium-water reaction evaluation method. Required functions for improving seismic performance include integrity of in-vessel heat exchanger. The technical issues to be solved for achieving this function were extracted, such as development of buckling evaluation method. Required functions for improving economic efficiency include Feasibility of large

heat exchanger. The technical issues to be solved for achieving this function were extracted, such as heat transfer of IHX and SG.

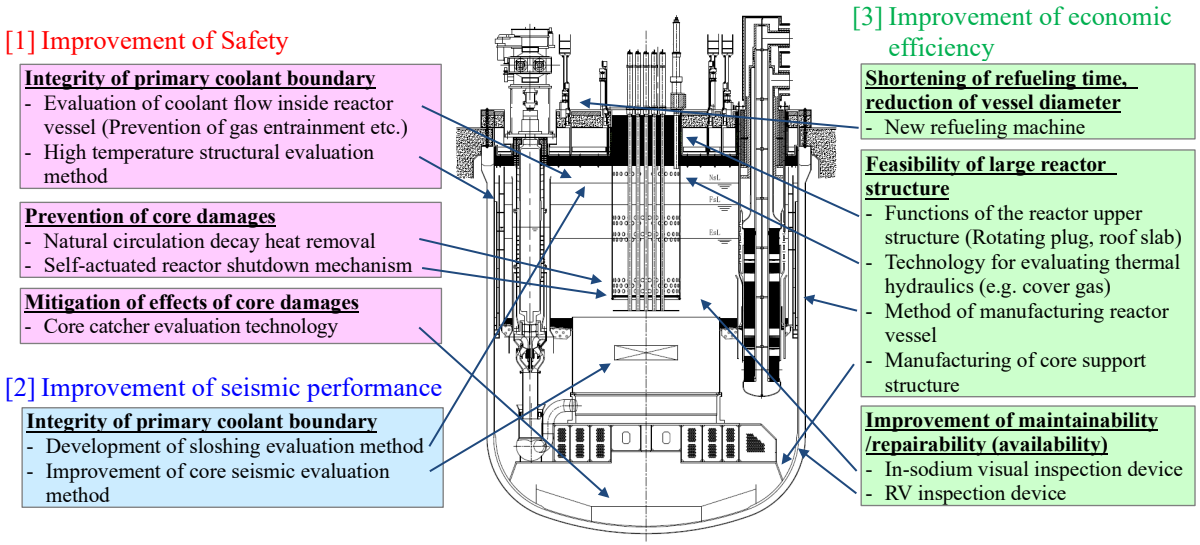

FIG. 1. Required functions and technical issues of the reactor structure

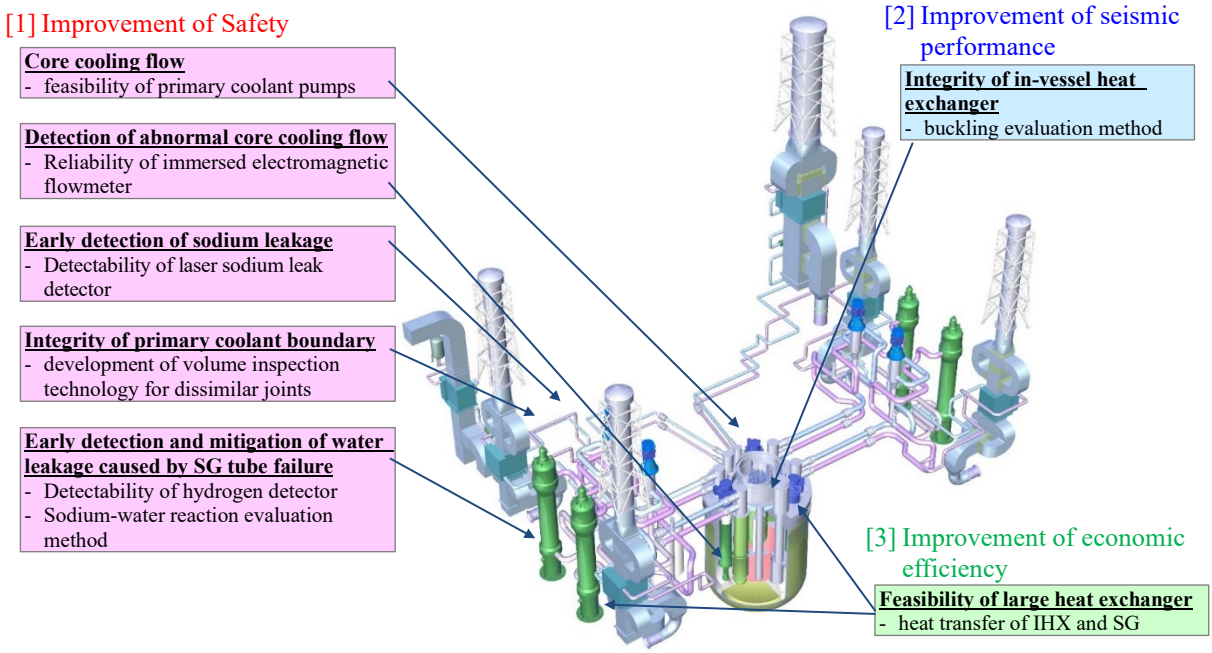

FIG. 2. Required functions and technical issues of the reactor cooling systems

Regarding the technical issues for the main equipment of the demonstration fast reactor, based on the design and licensing experience with "Joyo" and "Monju" and the subsequent R&D results, the issues of the technologies that are required to be developed due to the new technologies and the issues of the technologies to be applied to the pool-type reactor were organized.

2. R&D ROAD MAP

A development road map for each R&D item has been formulated, assuming that the basic design will be conducted from 2029 and the safety review will begin in the 2030s. In the conceptual design phase, R&D on feasibility will be conducted for resolving design issues for individual component, and with the R&D reflected in the conceptual design as appropriate, the basic specifications for the demonstration reactor will be determined. In the basic design phase, system performance such as operability will be verified and confirmed in preparation for the safety review, and the detailed specifications for the demonstration reactor will be determined.

The R&D roadmap of the reactor structure is shown in FIG. 3 and that of the reactor cooling systems is shown in FIG. 4. For each technical issue, the targets of the conceptual design phase were set. And then, the contents already implemented and the contents to be implemented in the conceptual design phase were arranged.

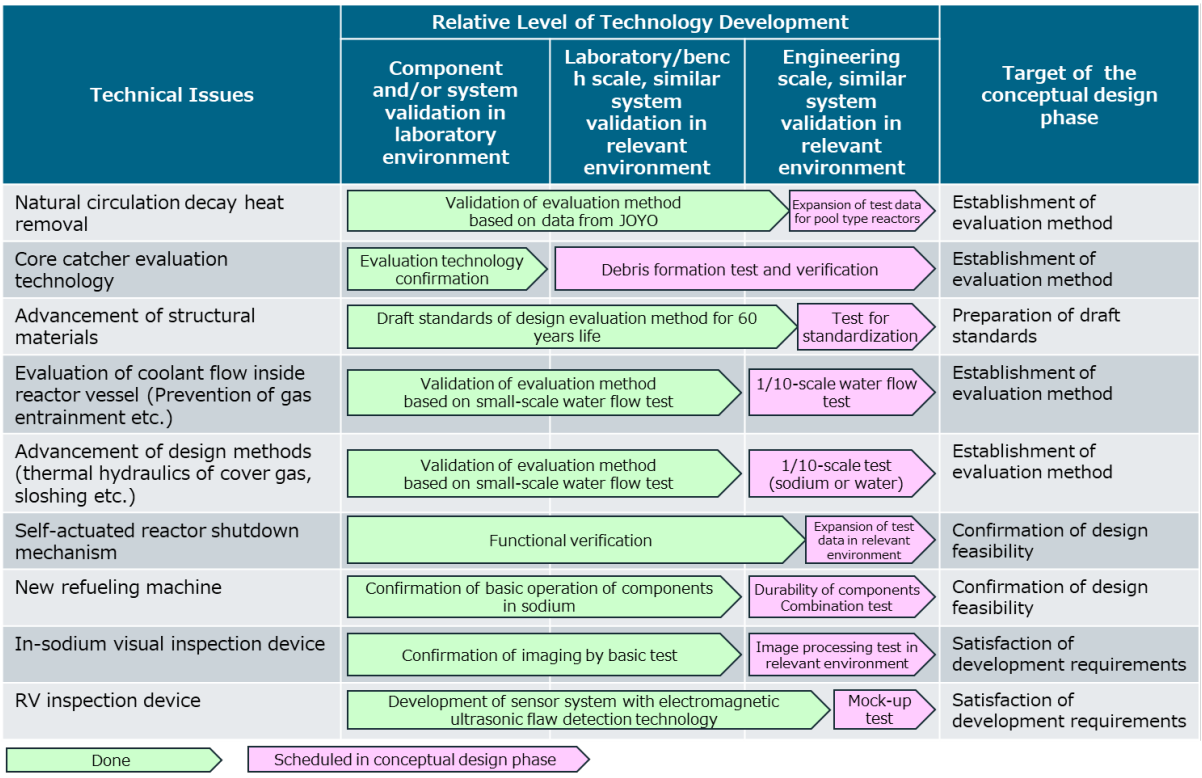

FIG. 3. R&D roadmap of the reactor structure

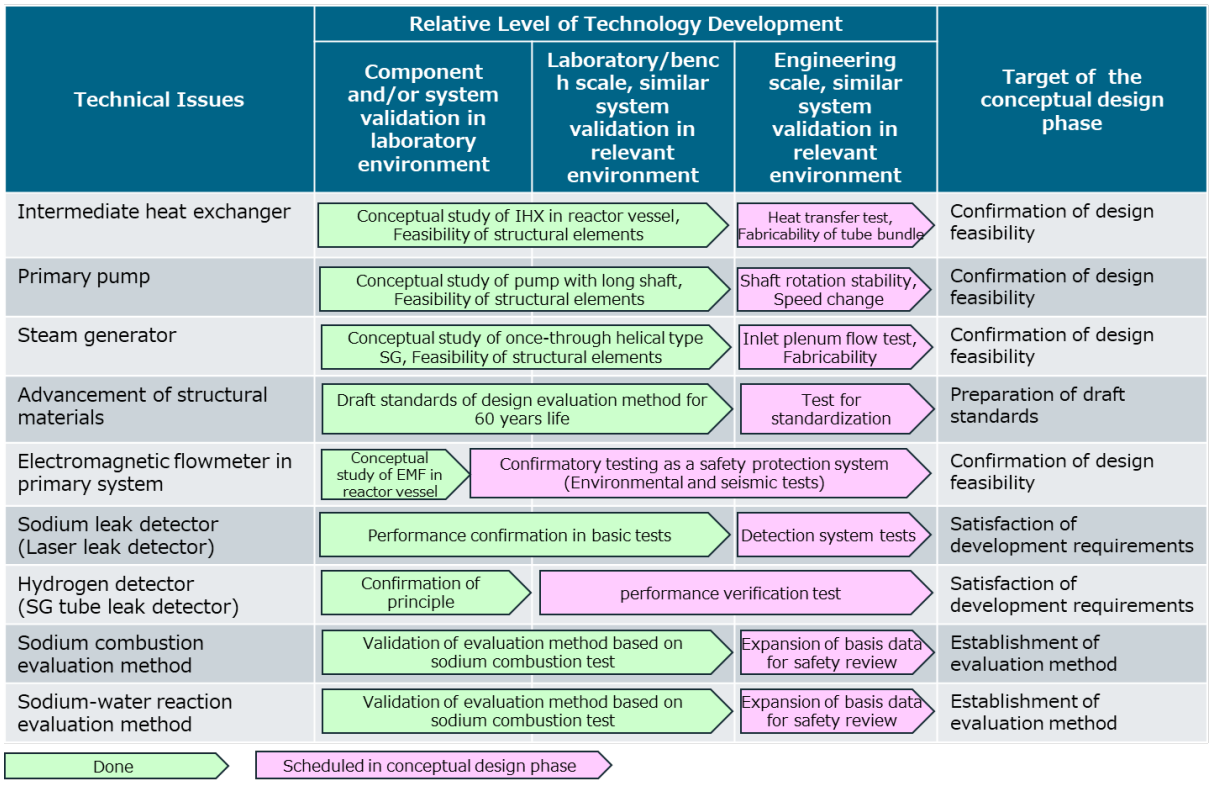

FIG. 4. R&D roadmap of the reactor cooling systems

3. CONCLUSION

For the conceptual design of the demonstration fast reactor starting in 2024, it is planned to promote the design study and R&D while utilizing the technological knowledge accumulated to date, aiming to start operation sometime in the middle of this century.

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