JSFR (JAEA, Japan)

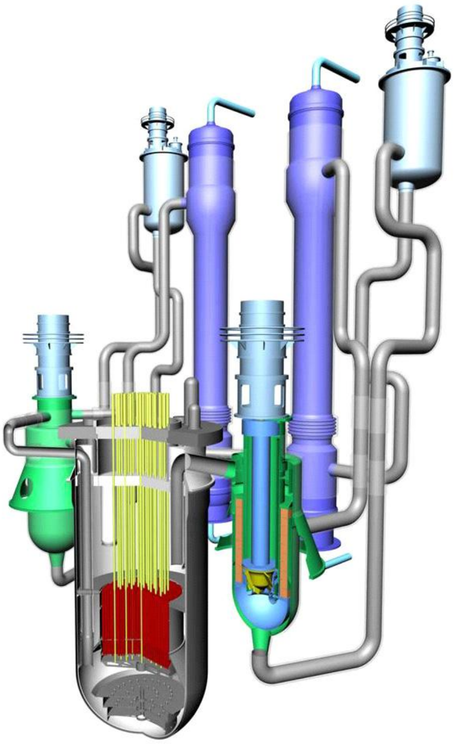

FIG. 8. Schematic Representation of JSFR.

Full name:	*Japan Sodium-cooled Fast Reactor*
Designer:	*Japan Atomic Energy Agency*
Reactor type:	*Sodium-cooled Fast Reactor*
Electrical capacity:	*750 MWe (medium scaled) 1500 MWe (large scaled)*
Thermal capacity:	*3530 MWth*
Coolant	*Sodium*
Primary Circulation	*Forced*
System Pressure:	*0.15 MPa (gage)*
System Temperature:	*550 °C*
Fuel Material:	*MOX*
Fuel Cycle:	*18-26 Months*
No. of safety trains*:	*3 trains*
Emergency safety systems:	*Primary and backup shutdown systems (2 active)* *Self-actuated shutdown system (SASS) (1 passive)*
Residual heat removal systems:	*DRACS+2PRACS (3 passive)* *AM decay heat removal system (1 or 2 active)*
Design Life:	*60 Years*
Design status:	*Conceptual Design*
Planned deployment/1st date of completion:	-
New/Distinguishing Features:	*FAIDUS, SASS, hot vessel, two loop, integrated IHX-pump*

*: Number of safety grade buses

Introduction

Japan Sodium-cooled Fast Reactor (JSFR) is a concept which has potential to achieve sustainable energy production, radioactive waste reduction, safety equal to the future light water reactor (LWR) and economic competitiveness against other future energy sources. In 1999, JAEA and utilities launched the "Feasibility Study on Commercialized Fast Reactor Cycle Systems (FS)" with domestic partners of vendors and universities. The FS targets aim at improved safety and economic competitiveness looking at other energy resources in the future including the future LWR. Those targets are consistent with the goals in Generation IV International forum (GIF).

Description of the Nuclear Systems

JSFR is expected to achieve the development targets of the FaCT (Fast Reactor Cycle Technology Development) project and the Generation IV reactor goals adopting following advanced key technologies:

- High burn-up core with oxide dispersion strengthened steel cladding material
- Safety enhancement with self-actuated shutdown system (SASS) and re-criticality free core
- Compact reactor system adopting a hot vessel and in-vessel fuel handling with a combination of an upper inner structure (slit UIS) with a slit and advanced fuel handling machine (FHM)
- Two-loop cooling system with large diameter piping made of Mod. 9Cr-1Mo steel
- Integrated intermediate heat exchanger (IHX)-pump component
- Reliable steam generator (SG) with double-walled straight tube
- Natural circulation decay heat removal system (DHRS)
- Simplified fuel handling system
- Steel plate reinforced concrete containment vessel (SCCV)
- Advanced seismic isolation system

Those technologies have been evaluated to be suitable for installation to the demonstration JSFR.

Description of the Safety Concept

For safety design, JSFR adopts the defence-in-depth (DiD) principle to the same extent as it has been in LWRs. Securing reactor shutdown, two independent reactor shutdown systems with independent/diversified signals are installed. For the fourth level of DiD, SASS is installed providing passive shutdown capability. The re-criticality free core concept has the great importance to ensure the in-vessel retention scenario against whole core disruptive accidents. The initiating phase energetics due to exceeding the prompt criticality has to be prevented by restricting the sodium void worth and the core height. The possibility of molten fuel compaction has to be eliminated by enhancing the fuel discharge from the core. The effectiveness of fuel assembly with inner duct structure (FAIDUS) has been confirmed by both in-pile and out-of-pile experiments. The JSFR decay heat removal system consists of a combination of one loop of direct reactor auxiliary cooling system (DRACS) and two loops of primary reactor auxiliary cooling system (PRACS) adopting full natural convection system.

Deployment Status and Planned Schedule

Even though the JSFR safety design already took into account measures against severe accident situations and passive safety features such as passive shutdown system and natural convection decay heat removal systems as 2010 design version, the Fukushima Dai-ichi nuclear power plant (1F) accident became aware importance of design measures against severe accidents and extreme external events. For further improvement on safety designs based on lessons learned from the 1F accident, Safety Design Criteria (SDC) is under discussion in the GIF framework aiming at global standards for sodium-cooled fast reactor safety designs.