PRISM (GE-Hitachi, USA)

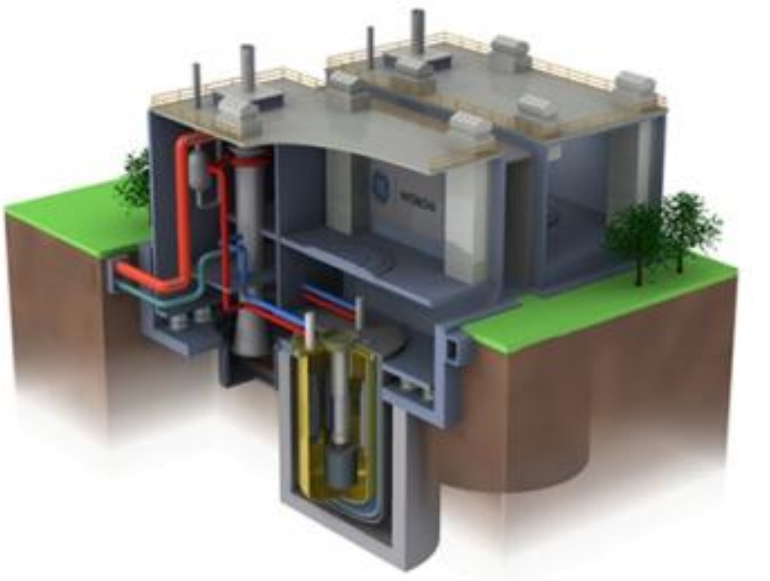

FIG. 12. Schematic View of PRISM

Reactor type:	*Liquid metal cooled fast breeder reactor*
Electrical capacity:	*311 MWe*
Thermal capacity:	*840 MWt*
Coolant:	*Sodium*
Primary Circulation:	*Forced circulation*
System Pressure:	*Low pressure operation*
Core Outlet Temperature:	*485°C*
Thermodynamic Cycle:	*Indirect Rankine Cycle*
Fuel Material:	*U-Pu-Zr*
Fuel Enrichment:	*26% Pu,10% Zr*
Fuel Cycle:	*18 months*
Reactivity Control:	*Rod insertion*
No. of safety trains:	*N/A*
Emergency safety systems:	*Passive*
RHRS:	*Passive reactor vessel auxiliary cooling system*
Design Life:	*N/A*
Design Status:	*Detailed design*
Seismic Design:	*N/A*
Predicted CDF:	*1E-6/reactor year*
Planned deployment:	*N/A*
Distinguishing Features:	*Underground containment on seismic isolators with a passive air cooling ultimate heat sink; part of the advanced recycling centre for spent nuclear fuel*

Introduction

The PRISM design uses a modular, pool type, liquid sodium cooled reactor. The reactor fuel element design most commonly used is a metal alloy comprised of uranium, plutonium and zirconium. The reactor employs passive shutdown and decay heat removal features.

Description of the nuclear systems

The PRISM reactor core is designed to meet several objectives:

- To increase fuel burnup;
- To limit the burnup reactivity swing; and
- To provide an 18 to 24 month refuelling interval.

The reactor is designed to use a heterogeneous metal alloy core. The core consists of 198 fuel assemblies, 114 reflector assemblies, 66 radial shield assemblies, 10 control and 3 shutdown assemblies. The PRISM fuel and core can be tailored to specific missions ranging from plutonium disposition to the maximization of fuel efficiency.

The primary heat transport system is contained entirely within the reactor vessel. The flow path goes from the hot sodium pool above the reactor core through the intermediate heat exchangers (IHXs), where heat is transferred to the intermediate heat transport system (IHTS); the sodium exits the IHX at its base and enters the cold pool. Four electromagnetic pumps take suction from the cold pool and discharge into the high pressure core inlet plenum. The sodium is then heated as it flows upward through the reactor core and back into the hot pool.

Heat from the IHTS is transferred to a steam generator where superheated steam is produced. This high pressure, high temperature steam drives the turbine-generator to produce electricity.

Description of the safety concept

The passive shutdown characteristics of the reactor core provide diverse and independent means of shutdown in addition to the control rod scram. The passive features comprise several reactivity feedback properties including: the Doppler effect, sodium density and void, axial fuel expansion, radial expansion, bowing, control rod drive line expansion and reactor vessel expansion. The negative feedbacks maintain the reactor in a safe, stable condition.

The passive Reactor Vessel Auxiliary Cooling System (RVACS) provides primary cooling during all design basis accident conditions and Anticipated Transients without Scram (ATWS). This passive system operates effectively without electricity or operator intervention for an unlimited amount of time. Heat is transferred from the reactor vessel to the containment vessel by thermal radiation and then to the surrounding atmospheric air by natural convection. Redundant decay heat removal is provided by the Auxiliary Cooling System (ACS), which consists of natural circulation of air past the shell side of the steam generator. The combination of systems allows for reduced plant outages for inspections and maintenance.

Deployment Status and Planned Schedule

The PRISM design was commenced in 1981 with support from several U.S. Government development programs. The design incorporates test data and operating experience from previous U.S. sodium reactors such as GE's Southwest Experimental Fast Oxide Reactor, and Experimental Breeder Reactor II. PRISM was reviewed by the U.S.'s Nuclear Regulatory Commission from 1987 to 1994 as part of a pre-application licensing review. GEH envisages PRISM most commonly deployed with integral used fuel recycling in areas interested in improving disposal strategies for used nuclear fuel. Also, due to PRISM's affinity for use of low-cost, plutonium bearing fuel, GEH is currently pursuing the use of PRISM to address the UK government's plans to dispose of plutonium via reuse in power reactors. In 2012, the UK's Nuclear Decommission Authority contracted GEH to carry out feasibility work in a number of key areas including the proposed commercial structure, the disposability of the fuel, the risk transfer model, the costs, and the ability to license in the UK.