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GE-Hitachi Nuclear Energy

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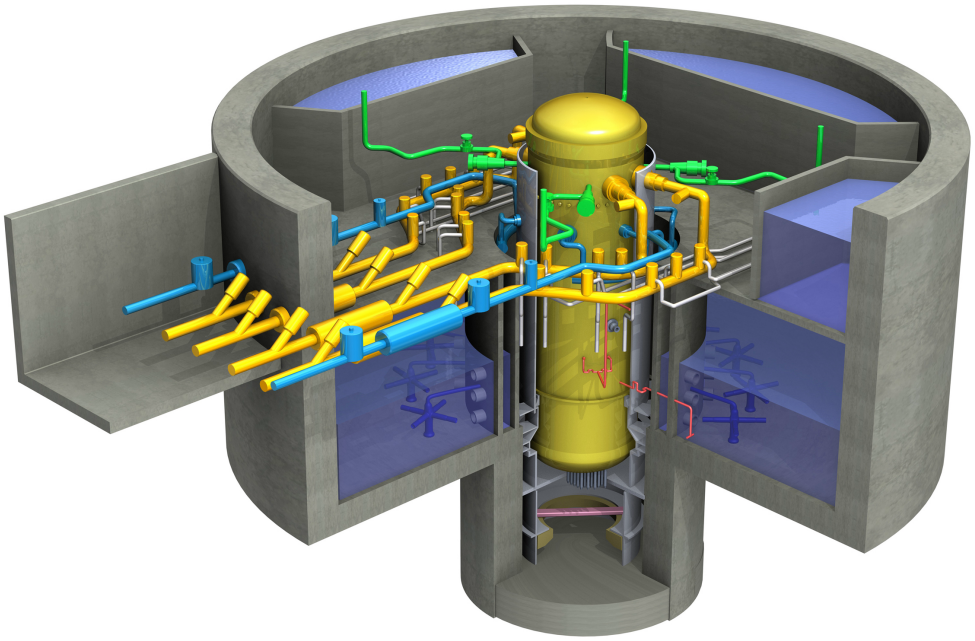

ESBWR Design Control Document
Tier 2

Chapter 1
Introduction and General Description of Plant
Sections 1.1 – 1.11

pumps take suction from the feedwater tank and discharge through high-pressure feedwater heaters to the reactor. Turbine extraction steam is used for multiple stages of feedwater heating. The drains from each stage of the low-pressure feedwater heaters are cascaded through successively lower pressure feedwater heaters to the main condenser. The drains for each stage of the high pressure feedwater heaters are cascaded to the feedwater tank.

The C&FS does not serve or support any safety function and has no safety design basis. Failure of this system cannot compromise any safety-related systems or prevent safe shutdown.

Portions of the system that are radioactive during operation are shielded with access control for inspections. Leakage is minimized with welded construction used wherever practicable. Relief discharges and operating vents are channeled through closed systems.

The C&FS piping is located in the steam tunnel and the turbine building. The feedwater system piping is designed such that waterhammer loads that could potentially result from anticipated flow transients are below the reactor pressure vessel design limits.

The C&FS has alarms and parameter displays in the main control room.

1.2.2.11.3 Condensate Purification System

The Condensate Purification System (CPS) continuously purifies and treats the condensate as required to maintain reactor feedwater purity, using filtration to remove solid corrosion products and ion exchange to remove condenser leakage and other dissolved impurities.

The CPS does not perform or support any safety-related function, and thus, has no safety design basis. No failure within the CPS could prevent safe shutdown.

Wastes from the CPS are collected in controlled areas and sent to the radwaste system for treatment and/or disposal.

The CPS is located in the turbine building.

The CPS has alarms and display for effluent conductivity in the main control room.

1.2.2.11.4 Main Turbine

The main turbine for the ESBWR Standard Plant has one high-pressure (HP) turbine and three low-pressure (LP) turbines. Other turbine configurations may be selected for plant-specific applications in order to obtain optimal thermal performance of the turbine plant at the site-specific conditions. The steam passes through sets of moisture separator reheaters (MSRs) prior to entering the LP turbines. Steam exhausted from the LP turbines is condensed and degassed in the condenser. Steam is bled off from each turbine and is used to heat the feedwater.

The control system for the main turbine provides control and monitoring of turbine speed, load, and steam flow for startup, normal operation and shutdown by operating the main steam turbine stop valves, control valves, and combined intermediate valves. The main turbine system includes supervisory instrumentation that is provided for startup and shutdown monitoring, operational analysis and malfunction diagnosis.

The Main Turbine is equipped with a single-speed, electric motor-driven turning gear, which is used to rotate the turbine generator shafts slowly and continuously if needed when the main

turbine is not in service, and especially during startup and shutdown periods when turbine rotor temperature changes occur.

The turbine-generator (TG) system is enclosed within the turbine building. The turbine generator is orientated within the turbine building to be inline with the reactor building to minimize the potential for any high energy TG system generated missiles damaging any safety-related equipment or structures.

1.2.2.11.5 Turbine Gland Seal System

The Turbine Gland Seal System (TGSS) provides steam, prevents the escape of radioactive steam from the turbine shaft/casing penetrations and valve stems and prevents air in-leakage through subatmospheric turbine glands.

The TGSS consists of a sealing steam pressure regulator, a sealing steam header, a gland steam condenser, two full capacity exhaust blowers and associated piping, valves and instrumentation.

The TGSS is a nonsafety-related system.

The HP turbine shaft seals must accommodate a range of turbine shell pressures. The LP turbines shaft seals operate against a vacuum at all times. The gland seal outer portion steam air mixture is exhausted to the gland steam condenser via the seal vent annulus (i.e., end glands), which is maintained at a slight vacuum. The radioactive content of the sealing steam, which eventually exhausts to the plant vent and the atmosphere, makes a negligible contribution to overall plant radiation release. In addition, the auxiliary steam system is designed to provide a 100% backup to the normal gland seal process steam supply, if available. A full capacity gland steam condenser is provided and equipped with two 100% capacity blowers.

A radiation monitor that is dedicated to the TGSS and installed on the gland steam condenser exhaust blower discharge monitors the TGSS effluents. High monitor readings are alarmed in the MCR. The system effluents are then discharged to the Turbine Building Compartment Exhaust system and the plant vent stack, where further effluent radiation monitoring is performed.

1.2.2.11.6 Turbine Bypass System

The Turbine Bypass System (TBS) can pass steam directly to the main condenser under the control of the Steam Bypass and Pressure Control (SB&PC) system. Steam is bypassed to the condenser whenever the reactor steaming rate exceeds the load permitted to pass to the turbine generator. The TBS in the ESBWR Standard Plant has the design capability to shed 110% of rated steam flow, which facilitates shedding of 100% of the turbine generator rated load without reactor trip or operation of the SRVs. The SB&PC system provides main turbine control valve and bypass valve flow demands, to maintain a nearly constant reactor pressure during normal plant operation.

The TBS, which does not perform or ensure any safety-related function, is classified as nonsafety-related. No failure within the TBS could prevent safe shutdown. However, the TBS is used to mitigate anticipated operational occurrences (which per 10 CFR 50, Appendix A, are defined as part of normal operations), and is analyzed to demonstrate structural integrity under the safe shutdown earthquake (SSE) loading conditions.