GE Hitachi
Nuclear Energy

Natural Circulation in ESBWR

fact sheet

Simplified Design and Improved Life Cycle Costs

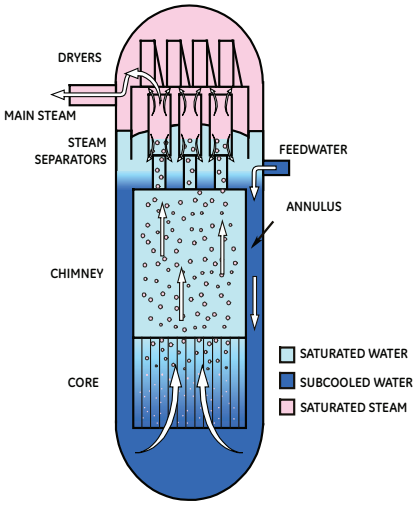
Through design simplification, natural circulation in GEH's ESBWR will decrease Operation and Maintenance (O&M) costs, reducing the overall cost of plant ownership. Natural circulation provides simplification over previous Boiling Water Reactor (BWR) and all Pressurized Water Reactor (PWR) designs that rely on forced circulation. This improvement is accomplished by the removal of recirculation pumps and associated motors, piping, valves, heat exchangers, controls, and electrical support systems that exist with forced circulation. Natural circulation in the ESBWR also eliminates the risk of flow disturbances resulting from recirculation pump anomalies.

Natural circulation is consistent with the key objectives of the ESBWR program: a passive safety design with simplification achieved by evolutionary enhancements. Most of the components in the ESBWR design are standard to BWRs and have been operating in the commercial nuclear energy fleet for years. The main differences between natural and forced circulation are the additions of:

- A partitioned chimney above the reactor core to stabilize and direct the steam and water flow above the core
- A correspondingly taller, open down-comer annulus that reduces flow resistance and provides additional driving head, pushing the water to the bottom of the core

Natural circulation is a proven technology. Valuable operating experience was gained from previously employed natural circulation BWR designs. Examples of plants using only natural circulation include the Humboldt Bay plant in California and the Dodewaard plant in the Netherlands, which operated for 13 and 30 years respectively.

Today, large (>1000 MW) BWRs can generate about 50% of rated power in natural circulation mode. The operating conditions in this mode—power, flow, stability, steam quality, void fraction, void coefficient, power density, and power distribution— are predicted by GEH calculation models that were calibrated against operating plant data from LaSalle, Leibstadt, Forsmark, Confrentes, Nine Mile Point 2, and Peach Bottom 2. The ESBWR utilizes proven natural circulation technology to operate a reactor with the size and performance characteristics customers need today at 100% of rated power.



Natural Circulation

Because hot water is less dense, it rises through the core while the cool water flows down to the bottom of the core. These natural differences in density create circulation.

Benefits

- Design and operation simplification
- Higher plant availability
- Contributes to 20% O&M cost advantage based on independent study
- Elimination of recirculation pumps decreases maintenance and associated personnel dose
- Very reliable passive Emergency Core Cooling System provides a large margin for loss of cooling accidents (LOCA)
- Passive operation system

Features

- Taller open down-comer and reduced core resistance
- Fine Motion Control Rod Drives instead of pump recirculation flow for core power change
- Taller down-comer provides circulation driving head, as well as large water inventory for Loss of Cooling Accident

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