

# Alternate Reactor Coolant Makeup System

## Background

Station blackout (SBO) is defined as the loss of all AC power at the generating station — a loss of off-site power with a failure of the on-site emergency generators to run. If an SBO event occurs, some nuclear steam supply system designs could respond with a loss of reactor coolant pump (RCP) seal injection and thermal barrier cooling. For some RCP shaft seal designs, this condition may cause a deterioration of the seal's pliable material parts, resulting in leakage from the shaft/pump casing interface.

Many plants have successfully addressed postulated SBO conditions for as long as 12 hours. If an SBO condition happens over an extended time frame, RCP and general reactor coolant system (RCS) leakage can result in a significant primary system leakage (equivalent to a small-break loss-of-coolant accident). With no ability to recover, primary system inventory will decrease, resulting in loss of cooling through the steam generators and eventual core exposure. Independent of the RCS conditions, an extended SBO may leave the spent fuel pool without heat removal capabilities and lead to consequential loss of inventory through a boil-off condition.

## Description

The Westinghouse alternate reactor coolant makeup system (ARCMS) automatically supplies makeup reactor coolant inventory via RCP seal injection flow paths. The system is actuated when a low-voltage condition is detected on the essential electrical supply buses. The ARCMS is a single-train, nonsafety-related system consisting of one reciprocating positive displacement pump and associated valves and piping. The system design maximizes use of existing

components. The suction side of the pump connects to the emergency core cooling system piping from the refueling water storage tank. The discharge side of the pump connects to the chemical and volume control system supply to the RCP seals. This arrangement provides direct injection to the RCS while providing cooling flow to components of the RCP shaft seal, helping preserve its integrity over the duration of the SBO. Also, by virtue of an optional alternate injection alignment, the system can provide a nominal amount of coolant for makeup to the spent fuel pool.

The Westinghouse ARCMS:

- Self-actuates when necessary due to a robust logic design.
- Operates in an automatic mode, thus eliminating dependency on operator action.
- Operates for extended periods, independent of station power (duration specified by the utility).
- Maximizes use of existing plant equipment.
- Complies with U.S. Nuclear Regulatory Commission 10CFR50.63 requirements.
- Provides both RCS and spent fuel pool inventory makeup through custom design.

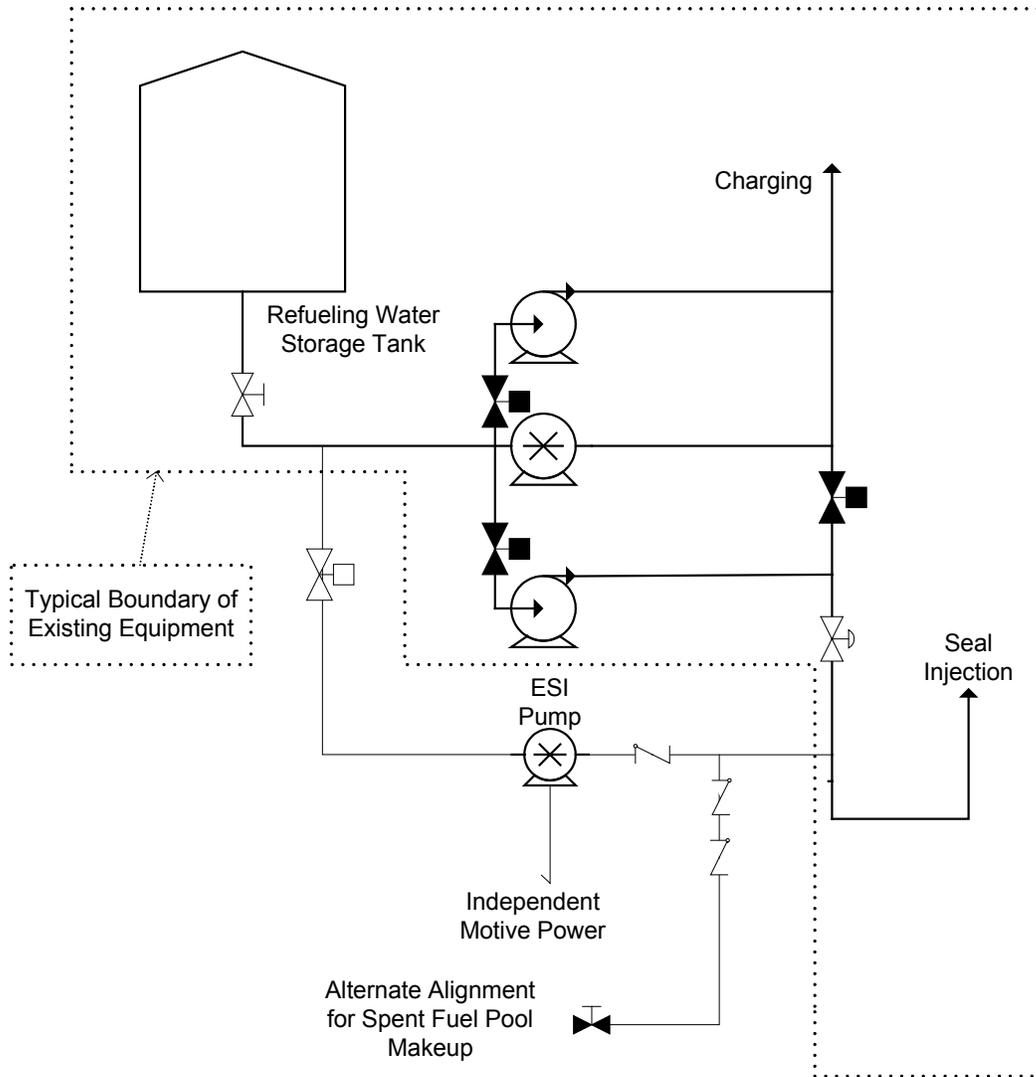
## Benefits

The principal benefit of this system is the reduction of core damage frequency due to the initiating event. It also is:

- Built and designed to support an extended SBO condition.
- Capable of supporting multiple inventory makeup conditions.

## Experience

Westinghouse has experience in designing and installing the ARCMS at several pressurized water reactors.



Alternate RCS makeup and seal injection