Chubu Electric Safely Manages Reactor Seawater Intrusion Event with EPRI Support

Rapid-response technical expertise related to water chemistry management helps Japanese utility ensure safe shutdown and minimize damage.

During the process of putting the Hamaoka-5 Advanced Boiling Water Reactor into cold shutdown in May 2011, debris from the failure of feedwater pump piping within the main condenser led to the failure of some condenser tubing, enabling seawater to enter the reactor water system. To cope with this event, Chubu Electric Power Company worked with EPRI experts to successfully diagnose and manage water chemistry issues. The collaboration helped ensure safe shutdown and minimize damage to reactor components.

Japan’s prime minister ordered Hamaoka-5 to shut down in May 2011 as a precautionary measure in the wake of the devastating tsunami that damaged the Fukushima Daiichi nuclear complex. The shutdown was proceeding normally until a recirculation piping end cap failed from fatigue due to a manufacturing defect. The dislodged end cap struck and damaged condenser tubes, allowing seawater used for cooling to rapidly enter the reactor. The intruding seawater raised the levels of chloride and other impurities in the reactor, which needed to be reduced as quickly as possible to avoid corrosion damage to reactor internal components.

At the time of the end cap failure, EPRI staff happened to be visiting Hamaoka to review their post-Fukushima safety enhancements. Chubu requested EPRI’s assistance in evaluating technical options for responding to the seawater intrusion. Information from the Hamaoka event was sent back to the United States that evening and a preliminary response was received less than 15 hours later addressing potential impacts on fuel, materials and water chemistry.

EPRI provided recommendations for operation of cleanup water filter demineralizers (CUW F/Ds) and resin mixtures to reduce reactor water chloride levels below 100 parts per billion, per the BWR Water Chemistry Guidelines. When chloride levels increased again, EPRI identified the source as the residual heat removal/shutdown cooling system, whose piping contained some salt water from the suppression pool. Combining these recommendations with its own findings, Chubu was able to implement countermeasures to prevent further seawater inputs to the reactor.

To reduce the levels of corrosion products (crud) in the reactor coolant, EPRI recommended using optimized resin mixtures that had been applied successfully for shutdown crud cleanup at U.S. nuclear plants experiencing seawater intrusions. EPRI also recommended that the CUW F/D system remain in service to clean up impurities in the reactor water and to gradually clean up the crud in the reactor coolant.

As a result of these and other actions, Chubu successfully reduced the reactor water impurity levels to levels within the chemistry specifications. “The seawater intrusion at Hamaoka-5 was unprecedented in Japanese nuclear history,” said Yoshihiro Ichikawa, general manager of the operations and maintenance group at Chubu. “EPRI’s rapid response helped us collect the
necessary information so we could organize and implement appropriate countermeasures. Among other things, EPRI’s practical recommendations on cleanup of chloride and other impurities in the reactor water were instrumental in verifying the relevance of our cleanup strategy."

For more information, contact Susan Garcia at 650.855.2239 or sgarcia@epri.com.