

Technology At Work

Ringhals Adopts EPRI Guidelines for Nuclear Safety

Swedish Utility Saves a Decade of Research Time

By Brent Barker

In the 1980s, Sweden decided to phase out nuclear power by 2010, but policy changed in 1999, allowing all but two nuclear plants to plan for operation beyond 40 years. Although reactor safety inspections had always been rigorous in Sweden, the nuclear utilities did not have aging management programs.

Swedish utility Ringhals AB is preparing for continued operation of its pressurized water reactor Units 3 and 4 as they approach the end of their 40-year licensing periods in 2021 and 2023, respectively.

“The Swedish nuclear regulator requires that we have an effective aging management structure, and we need to apply it fairly rapidly to meet the regulator’s deadlines,” said Pal Efsing, senior specialist in materials mechanics at Ringhals. “We got a late start and turned to EPRI for support.” Based on previous engagement with EPRI, Efsing suggested that Ringhals join EPRI’s Materials Reliability Program to gain access to more than 30 years of research on aging of materials and aging management.

“My view was that if we adopted the system built in the U.S. around the U.S. Nuclear Regulatory Commission’s Generic Aging Lessons Learned report and the associated EPRI guidelines to inform compliance, we should be able to meet our deadline,” said Efsing. “This would also make it easier for our regulators to benchmark our measures and discuss them with other regulatory bodies.”

Aging Management in the United States: An Approach Refined Over Many Years

In the United States, life extension had become a pressing concern by 2000. In 2009, the first of the pressurized water reactors would reach the end of its 40-year operating license, with others following in quick succession. Forty years of continuous irradiation and intense mechanical, thermal, and pressure loading takes a toll on components.

In 2001, the U.S. Nuclear Regulatory Commission (NRC) published the first version of the Generic Aging Lessons Learned report as the technical basis for license renewal. It called for a detailed aging management program backed by solid research and approved by the NRC for a 20-year renewal.

“From the outset, the U.S. regulators pointed to the aging issues that they were most concerned about for license renewal,” said EPRI Technical Executive Al Ahluwalia. “They required nuclear operators to prove that they will effectively manage the aging process during extended operations.”

EPRI served a key role in informing the industry’s response. “To begin, we assembled a team of world experts and said, ‘Here are the plants, the materials, and the exposures in different parts of the reactor. Tell us what can go wrong,’” said Ahluwalia. “The result was a comprehensive [Material Degradation Matrix](#).”

Then, EPRI worked with plant owners to identify those areas of greatest consequence in terms of safety and economics, and the resulting Issue Management Table had four areas of concentration:

- Reactor core internals (the biggest concern for aging management)
- Areas where the control rod drive mechanism penetrates the reactor’s upper head

- Areas where nozzles carry water in and out of the reactor vessel
- Bottom-mounted instrument nozzles that route instrumentation into the reactor core to measure radioactivity

“This table effectively became our bible, guiding us on where to focus our research,” said Ahluwalia.

Following years of research in these areas, EPRI published a series of Inspection and Evaluation Guidelines that operators can use to develop aging management programs and meet NRC requirements.

“These guidelines tell operators where, when, and how to inspect, laying out a rigorous schedule,” said Ahluwalia. “Following them in an aging management program covers 70–75% of compliance.”

Applying EPRI’s Guidelines in Sweden

U.S. reactors are on average about 10 years older than those in Sweden, and the timing of Ringhals’ access of EPRI’s guidelines was fortuitous.

“By implementing the EPRI way of aging management, we probably saved 8 to 10 years of our own research time,” said Efsing. “Further, we should be able to accelerate our safety review process by as much as 5 years and save at least \$5 million in avoided costs.”

For these efforts, EPRI’s Materials Reliability Program and Ringhals received a 2015 EPRI Technology Transfer Award.

Key EPRI Technical Experts

Al Ahluwalia