NOW QUALIFIED: NEW WESTINGHOUSE SIGMA™ NUMBER ONE REACTOR COOLANT PUMP SEAL

Background

More than 30 years of successful operating experience and lessons learned, on more than 600 pumps globally, drove development of the internationally patented Westinghouse number one Sigma™ reactor coolant pump (RCP) seal.

As highlighted below, this innovative product has been designed and tested to deliver up to 12 years of continuous operation and reliable seal performance without maintenance, and within plants’ existing operating limits. The eight-inch diameter number one Sigma™ seal will be available in the fall of 2018, and the seven-inch diameter seal is planned for spring 2019 availability.

Benefits

- Drop-in number one seal replacement for Westinghouse RCP designs
- Projected long-term cost savings through reduced seal maintenance costs
- Step-change improvement in reliability and predictability resulting from a simplified assembly and enhanced thermal stability
- Minimized potential for seal installation issues
- Reduced probability of a forced outage due to seal performance
- Decreased outage dose attributed to seal maintenance

Number One SIGMA™ Seal Qualification Summary*

- Long-term endurance testing
- Transient testing for station blackout, seal injection restart, and fire events
- Secondary seal (double delta channel seal, or DDCS) endurance testing for wear and high temperature survivability
- Structural, fatigue, seismic, dynamic and station blackout analysis
- 10 CFR 50.59 Screen

Endurance Testing

- Endurance-tested for more than 4,000 hours
- Full-scale testing of the number one Sigma seal at normal seal operating conditions
- Stable leak rate of between 2 GPM (454 l/hr) and 3 GPM (681 l/hr) for the entire test at temperatures ranging from 120°F (49°C) to 190°F (88°C)
- Reliable startup and shutdown performance during all test segments
- Significant reduction in the secondary seal (DDCS) wear relative to the existing seal

Resulting from the post-endurance testing, see the significant difference in wear reduction between a standard seal DDCS (left) and the Westinghouse number one Sigma™ seal with improved DDCS (right).
Station Blackout Testing

- The complete Sigma seal assembly was tested for high-temperature station blackout conditions.
- Test conditions of 572°F (300°C) and 2250 psia (155 bar) for two hours followed by cool-down and depressurization to 425°F (218°C) and 900 psia (62 bar) for 24 hours.
- The resulting leak rate under test conditions was two- to three-times lower than the results of the same test performed on the existing number one seal design. Results were stable over 24 hours.
- No significant erosion, discoloration or seal face degradation was experienced.

Compatible with Westinghouse SHIELD®

The U.S. Nuclear Regulatory Commission approved the final safety evaluation for the Westinghouse SHIELD® seal, which can be integrated into your existing plant equipment. The number one Sigma™ seal is compatible with the Westinghouse SHIELD® passive thermal shutdown seal, offering a superior combination of high reliability and integrated passive safety.

More Information

Learn more about Westinghouse Sigma™ seal here on www.westinghousenuclear.com.

Cold Shock Testing

- Seal operation at 550°F (300°C) and 2,250 psia (155 bar), followed by injection of 40°F (4°C) at eight GPM (1,817 l/hr), producing a severe thermal shock.
- No cracking, warpage, O-ring extrusion or other damage to seal experienced.
- Provides supportive test data for plants with alternate seal injection systems.

Analysis and Documentation

- Structural evaluation including stress, fatigue, seismic, and vibration analysis.
- Station blackout leakage analysis.
- Licensing evaluation including applicability determination and 10 CFR 50.59 screen.

Number one Sigma™ reactor coolant pump seal (shown) after a station blackout test represents the latest Westinghouse cost-saving innovation. The number one seal is designed, and now qualified, for an extended lifespan.

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* Numbers two and three Sigma™ seals are planned to be qualified in 2019 and 2020, respectively.