Replacement Pressurizer

Background

The primary driver for pressurizer replacement is a plant's desire to reduce or eliminate downtime due to pressurizer heater sleeve leaks, two problems that have plagued the nuclear industry for some years. A number of plants already have made the decision to replace their pressurizers, while others are giving replacement serious consideration.

Replacement pressurizers (RPZRs) eliminate Alloy 600 nozzles, thereby eliminating downtime from leaks.

Two other drivers for pressurizer replacement are U.S. Nuclear Regulatory Commission (NRC) Bulletin 2004-1; and Westinghouse NSAL-04-5; which addresses pressurizer insurges and outsurges.

The NRC Bulletin 2004-1 requires plants with Alloys 82, 182 and 600 in their pressurizers to provide the NRC with a description of materials used in the penetrations and steam-space piping connections of their pressurizers and joint designs.

The bulletin further requires plants to provide the NRC with a description of the implemented inspection program for Alloys 82, 182 and 600, including the time and place of the supply inspections, the coverage achieved, the inspection methods and the results. Plants should also provide details offuture inspection programs, including proposed actions to address any leaks.

Plants are also required to provide verification that their inspection programs meet regulatory requirements. Within 60 days of restart following the next inspection of Alloys 82, 182 and 600, the plant must submit to the NRC a statement that the inspections were completed or a summary of the extent of inspections performed.

Westinghouse NSAL-04-5 documents the need to consider pressurizer insurges and outsurges. During an insurge, the temperature difference can exceed 300 F, subjecting the lower regions of the pressurizer and surge nozzle to significant and rapid temperature decrease. The inverse occurs if a significant outsurge follows a significant insurge. An additional fatigue usage factor will result, thus complicating the analysis of the heater sleeves.

Description

To address pressurizer heater sleeve leaks and regulatory concerns, plants must decide whether to perform complete pressurizer replacement or repair. The decision to replace or repair depends on a number of issues that a plant may encounter, including the following:

Heater sleeve material

When replacing a pressurizer, plants can consider both Alloy 690 and SS-316 for heater sleeve material. Some plants have switched to Alloy 690 because of the fatigue that results from the insurge and outsurge transients. Plants that have considered SS-316 instead of Alloy 690

tend to be concerned about inspection requirements that the NRC may announce in the future.

Insurge/outsurge transients

Westinghouse recommends that plants determine if insurge/outsurge transients have been addressed in structural analyses of the lower head. If they have not, plants must define actual insurge/outsurge transients. Plants can then

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base design-basis insurge/outsurge transients on actual pressurizer operation. These transients are needed to support the design of the RPZR.

Life extension

Many plants are seeking life extensions up to 60 years. RPZRs help address aging management issues.

Upratings

Large plant upratings may require larger pressurizer steam bubble volumes. RPZRs can be built with larger steam bubble volumes.

Design enhancements

A plant has many potential upgrades and improvements to consider when implementing an RPZR program, including:

- Reducing the number of heaters
- Reducing the risk of primary water system stress corrosion cracking with the selection of materials
- Improving access to the bottom through the support skirt
- Adding a small chemical injection and sampling nozzle in the water space
- Reducing the height of the heaters to provide a lower minimum water level
- Adding a reactor temperature detector nozzle to the lower head for future monitoring of insurges/outsurges
- Designing and locate lower-level instrument taps to minimize crud build-up
- Designing improved heater support
- Having forgings with integral nozzles
- Building a foreign material exclusion barrier into the manway
- Adding a specific vent path for reduced inventory operations

Reducing the number of heaters yields a number of benefits, including:

- Hardware price reduction
- Fewer penetrations needed for future inspections
- More room for maintenance under the pressurizer

Plants must consider a number of other factors with the reduced heater approach, including:

- More complicated licensing (10CFR50.59) and design change package
- Changes to the heater power supply cables and distribution

Benefits

Westinghouse distinguishes itself in the RPZR marketplace by working with one of several fabricators to get the best price to support each customer's preferences while developing plant-specific solutions.

Westinghouse also has strength and experience in design, engineering, project management, quality assurance and relationship maintenance with fabricators, allowing us to provide an RPZR on time and with the highest quality, long-term reliability and ease of licensing.

Deliverables

Westinghouse is able to provide engineering design and analysis, hardware fabrication and testing, delivery and installation of an RPZR.

Experience

Westinghouse performed design engineering for Omaha Public Power District's Fort Calhoun RPZR, and was the prime contractor for Entergy's Arkansas Nuclear One Unit 2 RPZR.

Westinghouse has vast experience as a result of our many years of successful completion of replacement steam generator and replacement reactor vessel closure head projects.

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