Replacement Pressurizer

Engineering Services

Background

The primary driver for pressurizer replacement is a plant's desire to reduce or eliminate downtime due to pressurizer heater sleeve leaks or other Alloy 600 leaks that have plagued the industry for some time. A number of plants have already made the decision to replace their pressurizers; others are giving replacement serious consideration. Replacement pressurizers (RPZRs) eliminate Alloy 600 nozzles, thereby eliminating the downtime.

Two other drivers for pressurizer replacement are NRC Bulletin 2004-1 and Westinghouse NSAL-04-5, which address pressurizer insurges and outsurges.

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

Plants must also 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, the results, etc. Plants should provide details of future inspection programs, including the proposed action to address leaks.

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

Westinghouse NSAL-04-5 discusses 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 insurge is followed by a significant outsurge. Additional fatigue usage factor (UF) will result, which complicates justifiying the use of SS-316 for heater sleeves.

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For more information, call your local Westinghouse Electric Company sales representative.

Westinghouse

Benefits

Westinghouse differentiates 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 the strength and experience in design, engineering, project management, quality assurance, and relationships with fabricators to provide an RPZR on time, with the highest quality, long-term reliability, and ease of licensing.

Description

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

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 resulting from the insurge and outsurge transients. Plants that have looked at SS-316 instead of Alloy 690 are concerned about inspection requirements that may be dictated by the NRC 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 not, the actual insurge-outsurge transients must be defined. Design-basis insurge-outsurge transients can then be based on actual pressurizer operation. These transients are needed to support the design of the RPZR.

Life Extension

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

There are a number of potential upgrades and improvements that a plant can consider when implementing an RPZR program. They are:

- Reduce the number of heaters
- Reduce the risk of primary water system stress corrosion cracking (PWSCC) with selection of materials
- Improve access to the bottom through the support skirt
- Add small chemical injection and sampling nozzle in the water space
- Reduce height of the heaters to provide a lower minimum water level
- Add a reactor temperature detector (RTD) nozzle to lower head for future monitoring of insurges/out surges
- Design and locate lower level instrument taps to minimize crud build-up
- Design improved heater support
- Have forgings with integral nozzles
- Build foreign material exclusion (FME) barrier into the manway
- Add specific vent path for reduced inventory operations

Reducing the number of heaters yields the following benefits:

- Reduction of hardware price
- Fewer penetrations needed for future inspections
- More room for maintenance under the pressurizer

Other factors to consider with the reduced heater approach:

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

Deliverables

Westinghouse has the capability 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 is the prime contractor for Entergy Operations Inc.'s Arkansas Nuclear One (ANO) Unit 2 RPZR.

Westinghouse also utilizes its experience from many years of successful completion of replacement steam generator and replacement reactor vessel closure head projects.

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