

Replacement Steam Generator Axial Flow Preheater Design

Background

Replacement steam generators (RSGs) have proven their economic and operational advantages to a large number of plant operators. Advanced RSG designs and materials result in reduced outage times, lower maintenance costs and smaller dose rates. With minimal plant modifications, RSGs often can be justified based on their ability to meet uprate power levels alone. Westinghouse is the premier supplier of reliable, advanced replacement steam generators customized to meet each plant operator's needs.

Description

Preheater original steam generator application

When replacing original preheat-type steam generators that have the main feedwater nozzle located on the lower shell, a key advantage of the AXP RSG is that relocation of plant feedwater piping is not required. The AXP design has been proven to be reliable and offers simplified startup and operation as compared to other preheat units.

Tube material and tube bundle assembly

Westinghouse expertise in the preparation of thermally treated Alloy 690 tubing specifications, its experience in working with all major tubing suppliers and its knowledge of tubing manufacturing processes provide a critical advantage in RSG supply. In the more than 20 years that Westinghouse has used thermally treated Alloy 690 tubing in RSGs, there have been no reported indications of tube corrosion.

Advanced channel head design

The Westinghouse RSG channel head design provides enhanced peripheral tube access and complete channel head drainage. The tubesheet is forged with an integral cylindrical extension, or "upstand," on the primary side.

The upstand provides additional vertical clearance within the channel head, which affords greater access underneath the peripheral tubes.

Design enhancements

- Selection of materials to minimize the risk of primary water stress corrosion cracking, corrosion and erosion
- Enhanced access to internals for maintenance, tooling, and foreign object search and retrieval coverage
- Recirculation nozzles and associated piping and spargers for use during wet layup and cleaning
- Increase in span of narrow-range water-level taps to reduce the potential of reactor trips and provide increased availability of a viable water-level indication during and following upset conditions and certain accident scenarios
- Electropolished divider plate and channel head to reduce personnel exposure
- Integrally forged primary nozzles and manways to reduce required in-service inspections
- Alloy 690 gasket seating surfaces to minimize corrosion and extend life of seating surfaces
- Sludge collector option to reduce sludge accumulation on the secondary face of the tubesheet and tube bundle surfaces
- Integral channel head drains to drain primary fluid into reactor coolant system piping
- High-capacity, secondary fluid blowdown system, integral with the tubesheet blowdown lane, which eliminates the need for a separate internal blowdown pipe
- Loose-parts traps in both the main (preheater) feedwater distributor and the auxiliary (downcomer) feedwater sparger and clean-out ports



Proven licensable design

All Westinghouse-designed RSGs have proved to be compatible with U.S. Nuclear Regulatory Commission plant licensing requirements. Since 1979, Westinghouse RSGs have been licensed successfully at more than 20 plants.

Benefits

Westinghouse experience provides the advantage in the supply of replacement steam generators. With proven RSG design, engineering, licensing and project management expertise gained from its more than 20 domestic and international plant projects, Westinghouse continues to be the premier supplier of RSGs worldwide. Selecting from our range of laboratory- and field-proven design features, we are uniquely able to customize RSGs to economically meet each operator's requirements.

The Westinghouse axial flow preheater (AXP) design offers reliability along with enhanced thermal performance. In the AXP, feedwater is introduced into the secondary-side lower cold leg region, distributed at a temperature of over 180 F into the bundle and directed axially along the cold leg side of the tube bundle. The increased temperature differential in the preheater convection zone enables higher overall heat transfer so that less heat transfer surface is required with the AXP design. The AXP typically uses laser-cut, bi-level advanced tube support grids, an RSG design option that reduces tube-to-tube support contact length, and unitized upper bundle supports that permit opening the tube pitch in the U-bend region of the tube bundle. The open tube pitch results in higher circulation ratios and lower steam quality in the upper hot side of the tube bundle. Several types of fieldproven and tested moisture separator options are available.

Experience

Westinghouse is the leading supplier of steam generators worldwide. In the United States, Westinghouse has supplied four AXP steam generators for Westinghouse plants and six AXP steam generators for CE-type plants. Internationally, Westinghouse has designed 28 AXP steam generators for new plants, of which 16 are in operation and 12 under construction.

