

Flux Thimble Tube Eddy Current Inspection System

Background

Flow-induced wear-through of three flux thimble tubes occurred at an operating plant in the early 1980s. Since then, wear-through has occurred in other plants. The U.S. Nuclear Regulatory Commission (NRC) issued Bulletin 88-09, which requires utilities to establish and implement a flux thimble inspection program. The program must be performed at a frequency that is technically justifiable, using a methodology that can detect flux thimble wear.

Westinghouse has developed, tested and qualified an eddy current inspection system that can help utilities satisfy these NRC requirements.

The system has many advantages, including enhanced data treatments (mixing), greater dynamic range and reliability, and compatibility with future system upgrades.

Description

When developing an inspection system to detect flaws in tubing, a good representation of the expected flaw geometry is imperative. The Westinghouse eddy current inspection system was developed using conditions based on actual observed flaws on thimble tubes that have been removed from operating plants. Final geometry was chosen so that measurements of wall loss would be conservatively estimated. This flaw geometry is also incorporated on calibration standards used by Westinghouse for inspections at plant sites.

Using the chosen standard flaw, a probe was designed that would detect flaws as accurately as possible, given the limitations of the small thimble inside diameter. The probe and delivery system provide an accurate real-time indication of position along the length of the tube thimble.

The eddy current inspection frequencies provide a primary frequency relatively independent of nearby external structures such as reactor vessel penetrations, lower internals and fuel assembly bottom nozzles with two auxiliary frequencies for data treatment.

Benefits

Westinghouse experience in eddy current testing, as well as a variety of other bottom-mounted instrumentation (BMI) services, provides utilities with the advantage of having one vendor capable to perform any required BMI service, including inspection of highpressure seal assemblies and thimble repositioning or replacement, if needed.

Deliverables

Before leaving the site, a preliminary inspection report is provided, which includes:

- Thimble tube identification
- Percent of wall loss
- Axial location of flaw
- Axial length of flaw