

Chrome-plated Flux Thimbles

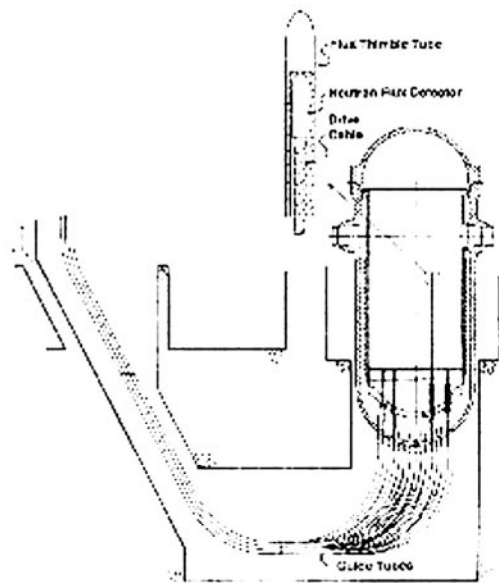
Background

Instances of flux thimble tube wear and leakage observed in operating reactors have been attributed to flow-induced vibrations in the lower internals support column area. As a result, the U.S. Nuclear Regulatory Commission (NRC) has issued Bulletin BL-88-09, Thimble Tube Thinning in Westinghouse Reactors, which instructs utilities to establish and implement inspection programs to periodically confirm thimble tube integrity. In response, Westinghouse has developed a thimble tube design upgrade, in addition to appropriate maintenance to increase thimble tube life and integrity during plant operation.

The design upgrade consists of applying a thin layer of chrome plating in the region that, because of flow-induced vibration, sustained the maximum wear. This region is located between the bottom nozzle of the fuel assembly and the bottom of the reactor vessel. The chrome-plated flux thimbles are available in a standard size of 0.313-inch outside diameter, which does not require expansion of the thimble tube at the seal table, or in the original design size. Installation of chrome-plated flux thimble tubes does not require any other plant modifications, including those to the incore detector or to the detector drive system.

Description

The flux thimble tube is chrome plated in the regions where the possible wear occurs. These regions are in the instrument support columns in the reactor internals and in the fuel assembly bottom nozzles. The starting point of chrome plating is at the bottom fuel nozzle and will extend down to the entrance of the instrument support column, which is near the bottom of the reactor vessel. The chrome-plating material is pure chrome with low cobalt content.



General Arrangement of Bottom-mounted Instrumentation

Benefits

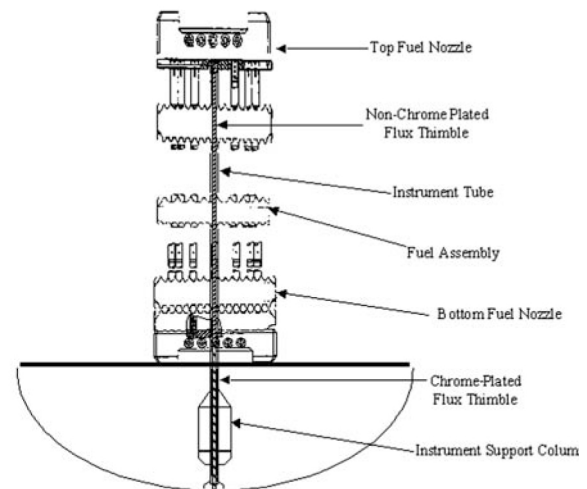
Reduces wear and extends the life of flux thimble tubes by at least a factor of two compared with conventional flux thimble tubes

- Extends the interval of eddy current inspection from the conventional flux thimble, which occurs at least every other or every third refueling outage
- Reduces maintenance costs with a longer thimble replacement interval
- Saves an as-low-as-is-reasonably-achievable dose with a longer interval of flux thimble tube inspection and replacement
- Saves space in the spent fuel pool due to reduced flux thimble replacement

Experience

The following Westinghouse plants have installed chrome-plated flux thimbles, either fully or partially:

- Farley Unit 1
- D.C. Cook Units 1 & 2
- South Texas Units 1 & 2
- Wolf Creek Unit 1
- R. E. Ginna
- Angra Unit 1
- Ascó Units 1 & 2
- Almaraz Units 1 & 2
- Diablo Canyon Units 1 & 2
- Millstone Unit 3 (NEU)
- Watts Bar Unit 1



Location of Chrome Plating on the Flux Thimble