UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

ENCLOSURE

SAFETY EVALUATION REPORT
ON REQUEST FOR RELIEF FROM INSERVICE INSPECTION REQUIREMENTS

VIRGINIA ELECTRIC AND POWER COMPANY
SURRY POWER STATION UNITS 1 & 2
DOCKET NOS. 50-280 & 50-281

I. BACKGROUND

By letter dated June 23, 1986, Virginia Electric and Power Company (the licensee) requested relief from certain inservice examination requirements of the 1980 Edition through Winter 1980 Addenda of Section XI of the ASME Code at Surry Power Station Units 1 & 2 for the second ten-year inspection interval. Specifically, the request is for relief from the outside diameter (OD) surface examination of reactor vessel nozzle-to-safe end butt welds. The staff granted this relief for Surry Units 1 & 2 for the first ten-year inspection interval. However, the staff requested the licensee to demonstrate the effectiveness of the alternative examination if the same relief is to be requested for subsequent inspection intervals. On June 24, 1986, the licensee arranged with Westinghouse to demonstrate to the staff the effectiveness of the licensee's proposed alternative examination. The demonstration was held at the Westinghouse Waltz Mill Site in Pennsylvania. This report provides an evaluation of the licensee's request, supporting information, and alternative examinations or tests, as well as the staff's bases for granting or denying the request pursuant to 10 CFR 50.55a(g). The relief granted remains in effect for the second ten-year inspection interval unless revised or modified prior to the end of the interval. The relief request is evaluated below.

II. EVALUATION OF RELIEF REQUEST

Item B5.10, Category B-F: Reactor Vessel Nozzle-to-Safe End Butt Welds

Code Examination Requirement

Table IWB-2500-1 specifies that a volumetric examination of one-third of the volume at the inside diameter (ID) and a surface examination of the OD are required.

Code Relief Request

Relief is requested from performing the OD surface examination.

Licensee Basis for Relief

At the beginning of the recent Unit 1 outage, average radiation readings taken in the general area of the nozzle dissimilar metal welds were recorded at 1.5 R/hr and loop contact readings of 4.5 to 6 R/hr were also recorded. The OD surface examination would require a significant amount of time for the removal of interference and shielding materials, surface preparation, and examination. High radiation exposures would be expected should this examination be performed. Attachment 1 to the submittal describes the estimated radiation exposures that would be incurred to complete the ASME Section XI examination requirements.

Alternately it is requested that a full volumetric examination from the ID be accepted in lieu of the surface examination from the OD. During the recent Unit 1 refueling outage, a full volumetric examination from the ID of a Surry calibration block has demonstrated sensitivity adequate to resolve a 5% notch on the OD. Additionally, a flaw, which is an estimated eighty percent of the critical flaw as described in ASME Section XI IWB-3000 Acceptance Standard for Flaw Indications, has been induced into a mock-up block. This flaw has been

satisfactorily detected and distinguished from the bimetallic interface. Demonstration of both capabilities at the Westinghouse Waltz Mill Calibration Facility have been found acceptable by the Authorized Nuclear Inservice Inspector.

The licensee considers that the weld integrity has been adequately established by performance of the volumetric examination of the ID. The additional assurance of weld integrity derived from performing the surface examination of the OD is not commensurate with the projected high man-rem expenditure. For the above reasons, the licensee requests that the full volumetric examination from the ID be acceptable in lieu of the OD surface examination of the reactor vessel nozzles.

Licensee Proposed Alternative Test

A full volumetric examination from the ID will be performed.

Staff Evaluation and Conclusions

Surface examination of reactor vessel nozzle-to-safe end welds usually necessitates personnel exposure to relatively high levels of radiation. The licensee has estimated an exposure of 27.9 manrem is required to complete the examination. The surface examination requirement is intended to cover areas on the OD of the component where ultrasonic examination data may be difficult to interpret when the ultrasonic examination is performed from the ID. However, ultrasonic examination of the nozzle-to-safe end welds from the ID can provide assurance that OD flaws will be detected provided the instrument calibration for such flaws is incorporated in the examination procedure. Because the calibration and the examination procedure are affected, the staff is considering such a relief request on a plant specific basis. Thus, the staff requested the licensee to demonstrate the effectiveness of the proposed alternative examination as part of the relief request. Specifically, the staff requested the licensee to demonstrate that a notch, having a depth corresponding to 3% to 5% of wall thickness, machined on the OD surface of the basic calibration block could be detected.

The staff attended a meeting at Westinghouse Waltz Mill Site on June 24, 1986 to observe a demonstration of the licensee's ultrasonic examination procedures of reactor vessel nozzle-to-safe end welds. The meeting was attended by personnel from the licensee, Westinghouse, and the staff.

The calibration blocks were in general fabricated from 37 inch diameter pipes with a wall thickness of 2.4 inch. The calibration blocks consisted of a carbon steel section with ID cladding and weld buttering before welding to a centrifugally casted stainless steel section. Three calibration blocks were available. The block designated VIR-45 was the basic calibration block and contained a notch having a depth corresponding to 5% of wall thickness. The notch was located at the center of the weld on the OD surface. Block VIR-45 also contained 3/16 inch diameter side-drilled holes at depths of 1/4, 1/2, and 3/4 of the wall thickness. The side-drilled holes were used to establish the distance amplitude correction (DAC) curves for calibration. The block designated VRA-022 contained an artificially induced mechanical fatigue crack having a depth corresponding to 80% of the maximum code (IWB-3514) allowed flaw size. The crack was in the carbon steel and was initiated from the OD surface at the interface between the carbon steel and the buttering. The crack depth ranged from 0.123 inch to 0.173 inch. The block designated 11231-H contained an artificially induced mechanical fatigue crack having a depth corresponding to 50% of the maximum code (IWB-3514) allowed flaw size. The crack was in the carbon steel and was initiated from the OD surface at the interface between the carbon steel and the buttering. The crack depth ranged from 0.020 inch to 0.103 inch (The block 11231-H had a 2 inch wall thickness and inconel buttering and weld). Also, uncracked blocks similar to VRA-022 and 11231-H were available as control specimens.

The licensee used the remotely operated reactor vessel inspection tool with 1-inch diameter and 1 MHz transducers. The ultrasonic equipment consisted of a Sonic model Mark VI. The examination was conducted in the water immersion mode with a 5 inch water path. The scanning speed was limited to less than 2 inches per second with a 3/8 inch scan increment. Three measurement techniques were attempted by the licensee. The techniques were 41° nominal refracted longitudinal, 41° nominal refracted longitudinal (zero null), and

45° nominal shear. The zero null method was attempted such that the scan sensitivity could be adjusted on site from the response of the bimetallic interface. The scan directions included both axial directions. The scan directions also included both circumferential directions for the 41° nominal refracted longitudinal examination. In performing the examination, each scan direction was monitored individually "in process." All interface/geometric responses were investigated "in process" by an ultrasonic inspector certified to Level III.

The licensee demonstrated the ultrasonic examination of the calibration blocks from the ID. The background noise level was generally between 15% and 20% full screen height. The shear wave examination generated a larger response from the bimetallic interface than the refracted longitudinal wave examination. The 5% wall thickness notch and the 80% code-allowed flaw were detected. When the response from the flaw was superposed on the response from the interface, the interface signal amplitude was approximately doubled. It was also possible to separate the responses from the flaw and the interface. The signal-to-noise ratio for the detection of the 80% code-allowed flaw was approximately 2 to 1.

The staff considers that the licensee has complied with the staff's request to demonstrate the detection of a 5% wall thickness notch on the OD surface. Furthermore, the licensee has demonstrated the possibility of detecting flaws exceeding the code allowable on the OD surface using the licensee's ultrasonic examination procedures from the ID. For all future examinations, the licensee will fully document all ultrasonic indications due to geometric reflectors as to position and signal amplitude. Hard copies of indications evaluated will be maintained by the licensee.

Based on the staff's evaluation and the discussion above, Code requirements are impractical. It is further concluded that the alternative examinations discussed above will provide necessary added assurance of the nozzles' structural reliability. Therefore, relief from the OD surface examination requirements of the nozzle-to-safe end butt welds may be granted as requested.