Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

March 26, 1996

E. Harold Gray
US Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, PA 19406

Dear Harold:

Subject: JCN 2126, Task 4, Final Letter Report

This letter report contains a summary of the work performed on task 4 of JCN 2126. A summary of the technical findings resulting from the SAFT-UT inspections of cast stainless steel at the Seabrook Station and recommendations for enhanced capabilities in this area are presented in this letter report.

Field Exercise - Seabrook Station, Unit 2, Seabrook, New Hampshire:

During mid-January 1996, PNNL staff participated in a field exercise aimed at evaluating a low frequency, long wavelength inspection technique for examining thick section, coarse grained stainless steel components. The exercise was conducted in coordination with NRC Region I and Seabrook Station engineers.

The actual piping installed within the Unit 2 reactor consisted of 4 pressure vessel loops with a hot and cold leg elbow associated with each vessel. The actual elbows (most oriented vertically with 40° bends) were the only components available for inspection, and these were statically cast elbows, not centrifugally cast, and no CSS pipe-to-pipe or pipe-to-elbow sections existed. The surface geometries (on both the OD and ID) precluded PNNL staff from examining them with the large low frequency transducer, as the unit was too big to couple to the elbow surface without being de-coupled by a surface ridge, lip, weld crown, or other surface anomaly. These elbows provided very little surface area near the weld that was conducive for implementing any scanning at any angle (expect perhaps 0°) using the low frequency transducer. The radiographs that existed for loops 1, 2, and 4 were not useful, as there were no indications or flaws (besides a gouged out area near one weld) that existed in these loops. Our consultations with NRC Region 1 inspectors were invaluable, and our expectations of obtaining reliable information using

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industry standard transducers and inspection protocol for detection and sizing remained unchanged as the work was conducted. The degree of material variability was quite high from component to component as indicated by velocity data acquired as a function of position and incident angle in these materials.

<u>Technical Assessment:</u>

Analysis of the data while at Seabrook Station indicates that the low frequency/SAFT technique is more promising for detecting indications than the standard inspection protocol currently used by industry. A side by side comparison was conducted of transducers ranging from 350 KHz to 1.0 MHz as a function of material structure, flaw size and geometrical reflectors, frequency, beam processing angle, etc. A calibration block supplied by the utility was inspected, as were a number of Westinghouse Owner's Group (WOG) CCSS specimens. The low frequency/SAFT technique was the only method that provided good detection, localization and sizing data for a 10% deep, 1/8" thick, 1" long circumferential notch in the calibration block. Analysis of the data showed our length measurement of the notch as 1.05" and the depth measurement of the notch as 10%. This technique also identified the axial notch, and proved useful for detecting ¼-T and 3/4-T side drilled holes (1/8" diameter), as well as a continuous corner trap response over the width of the calibration block at all angles (30°, 45° and 60°).

The WOG specimens presented a variety of obstacles for the low frequency-SAFT method, due in large part to the size of the search unit. The search unit is 4.25" in length, 5.0" in width, and 3.5" in height. The surface geometries on the OD surface of the WOG specimens often precluded PNNL staff from examining the welds with the full contingent of incident angles, and on two occasions only a far-side inspection using a single angle of incidence could be performed. The transducer was too large to complete even a 1" path on some specimen surfaces without being de-coupled by a surface ridge, lip, weld crown, or other surface anomaly. Some data was acquired on the WOG specimens, and existing cracks were detected in most cases, however, depth information was poor in comparison to actual depths. More work is needed to fully assess the field utility of this technique.

<u>Recommendations:</u>

It became evident during data analysis, that CSS data interpreters should be trained using some set of consistent criteria for discriminating flaw indications from material structure or geometrical indications. Variability between interpreters using the same data set was evident. Low frequency data acquisition was limited due to ID and OD surface geometry constraints.

Immersion testing was implemented on-site as the problem of coupling the large transducer, under very cold conditions using ultragel, was insurmountable. A water tub was used to take data using the low frequency transducer. In order to carry out more conclusive evaluations using this technique, it is recommended that a blind test be performed using a search unit of smaller design, with similar characteristics. A blind test should utilize field representative pipe sections, with fabricated flaws that dimensionally approach critical flaw sizes in these components.

Sincerely,

George J. Schuster

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GJS:mb

cc: D. Naujock (NRC)