UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

April 8, 2022

MEMORANDUM TO: Brian Smith, Director
Division of New and Renewed Licenses
Office of Nuclear Reactor Regulation

FROM: Louise Lund, Director
Division of Engineering
Office of Nuclear Regulatory Research

Signed by Lund, Louise on 04/08/22

SUBJECT: IMPENDING PUBLICATION OF TECHNICAL LETTER REPORT ENTITLED "MODELING AND SIMULATION OF AUSTENITIC WELDS AND COURSE-GRAINED SPECIMENS: PART II" (PNNL-32702) (UNR NRR- 2020-002)

The Office of Nuclear Regulatory Research (RES) has completed a technical letter report entitled "Modeling and Simulation of Austenitic Welds and Course-Grained Specimens: Part II," (ADAMS Accession ML22087A127) under contract with Pacific Northwest National Laboratory (PNNL). This Technical Letter Report (TLR) documents work performed under User Need Request (UNR) NRR-2020-002, "Update of the User Need Request for Evaluating the Reliability of Nondestructive Examinations of Vessels and Piping." This UNR focused on assessing the reliability and effectiveness of nondestructive examination methods used in nuclear power plants. Task 1 on ultrasonic (UT) modeling and simulation requested that RES establish a standard method for evaluating UT modeling and simulation results for a variety of materials and degradation mechanisms.

The work documented in this TLR is part of a multi-phase effort at PNNL under Task 1 to evaluate UT modeling and simulation performance, reliability, and accuracy, and define best practices required for using computational models to simulate UT testing scenarios being conducted on nuclear power plant components. Simulation results from UT models can inform the design and qualification of inspection techniques and help interpret inspection results.

The focus of this TLR is to document the completion of work initiated in PNNL-29889, *Modeling and Simulation of Austenitic Welds and Course-grained Specimens* (ML20122A252), where CIVA was used to evaluate simulated flaw responses and ultrasonic beam models in austenitic welds, dissimilar metal welds, and cast austenitic stainless steel (CASS) materials. Additionally, this TLR addresses simulating acoustic noise and attenuation, particularly in models of CASS materials. This work will be used to provide guidance when establishing methods to perform and evaluate simulations for more standardized model implementation, simulation analysis, and interpretation of results.

The results of PNNL's studies showed that the 3D Voronoi models produce more realistic simulation results than the 2D specimen-based models when compared to empirical beam

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maps. In addition, results of the simulated sound fields for equiaxed and columnar grain CASS structures are measurably different. This is important to keep in mind when applying coarse-grained models to inservice inspection scenarios as the actual grain structure of the component will likely be unknown. Therefore, simulations with multiple specimen models are recommended in order to predict a range of flaw responses since the grain structure may have an impact on the flaw response.

Empirical UT scans of coarse-grained materials typically include coherent signal reflections from grain boundaries; such signals appear as structural noise. Attenuation is another key attribute of UT scans, and the severity of attenuation depends strongly on the material properties and probe frequency. This TLR documents PNNL's examination of the effects of adding noise and attenuation to the models.

Staff representatives from the Division of New and Renewed Licenses in the Office of Nuclear Reactor Regulation (NRR) reviewed a draft of this TLR and stated, "The NRR staff agrees with the conclusions of the report and the key findings. The TLR is of very high quality and is a good interim report on the research. The TLR shows the complexities involved in the use of ultrasonic modeling and provides detailed technical guidance for the use of modeling. The TLR contains sufficient detail and rigor to be used as a reference in rulemaking and in evaluating proposed alternatives."

RES has established an online quality survey to collect feedback from user offices on the usefulness of RES products and services. This survey can be found online at the hyperlink: RES Quality Survey. I would appreciate the responsible manager or supervisor completing this short survey within the next 10 working days to present your office's views of the delivered RES product.

If additional information is required, or there are any concerns with the impending public release of this TLR, please contact Carol A. Nove of my staff at 301-415-2217 or can2@nrc.gov.

Enclosure:
As stated

Modeling and Simulation o Austenitic Welds and Course-grained Specimens: Part II DATE April 8, 2022

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