UNITED STATES
NUCLEAR REGULATORY COMMISSION
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September 22, 2016

MEMORANDUM TO: John W. Lubinski, Director
Division of Engineering
Office of Nuclear Reactor Regulation

FROM: Brian E. Thomas, Director ***/RA/***
Division of Engineering
Office of Nuclear Regulatory Research

SUBJECT: IMPENDING PUBLICATION OF TECHNICAL LETTER REPORT, PNNL-25537, ENTITLED "CASS FERRITE AND GRAIN STRUCTURE RELATIONSHIP"

The Office of Nuclear Regulatory Research (RES) has completed Pacific Northwest National Laboratory (PNNL)-25537, a Technical Letter Report (TLR) entitled "Cast Austenitic Stainless Steel (CASS) Ferrite and Grain Structure Relationship," (ADAMS Accession ML16161A369). This report documents work performed under Task 5, Detection and Characterization of Flaws, in User Need Request NRR-2013-009 "Evaluating the Reliability of Nondestructive Examinations of Vessels and Piping." This user need request focuses on assessing the reliability and effectiveness of nondestructive examination methods used in nuclear power plants.

The American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code is currently developing performance demonstration requirements for the ultrasonic examination of CASS materials and weldments. Coarse-grained CASS materials and DMWs were used in the fabrication of primary coolant loop piping components, cladded components, overlay-repaired pipe joints, and Alloy 600/182/82 butt welds in light water reactors in the United States. Ultrasonic volumetric examinations are challenging in these materials because of the material microstructures, surface conditions, and geometries encountered in the field. The effects these factors have on ultrasonic propagation can be significant, often leading to inadequate and unreliable ultrasonic examinations. PNNL is conducting research to assess the capabilities of phased array ultrasonic testing to determine how reliable and effective it is in inspecting CASS.

This TLR provides a summary of a study that was conducted to determine whether, based on experimental measurements, a correlation existed between CASS grain structure and ferrite content. The motivation for this research lies in the fact that ultrasonic testing (UT) is strongly influenced by CASS grain structure; knowledge of this grain structure may help improve the ability to interpret UT responses, thereby improving the overall reliability of UT inspections of CASS components. This work showed that surface measurement techniques have limited capability to predict the volumetric variation of the grain structure of CASS. This work represents a sub-set of a multi-faceted program on the examination of CASS materials and welds; a final NUREG/CR summarizing all of PNNL's CASS work will be developed.

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The results of PNNL's research on inspection of CASS provides a basis for developing rulemaking such as the proposed rule to implement Code Case N-824: Alternate Requirements for Ultrasonic Examination of Cast Austenitic Piping Welds from the Outer Diameter (OD) Surface, Section XI, Division 1." This proposed rule was published in the Federal Register on September 18, 2015, FRN 56820, 10 CFR Part 50, Incorporation by Reference of American Society of Mechanical Engineers Codes and Code Cases; Proposed Rule. Further, the work will provide the basis for the staff to assess new Code requirements related to CASS such as ASME Code, Section XI, Supplement 9 for performance demonstration requirements for UT examination of CASS. The results documented in PNNL-25537 provide NRR with confidence that the conservatisms in the conditions placed on Code Case N-824 are appropriate given that it is not possible to know the grain structure of any given CASS component. Further, since this work thoroughly documents the limitations associated with predicting grain structure with surface measurements, NRR will not pursue rulemaking or Code actions to require industry to first determine a CASS component's grain structure prior to ultrasonic examination.

Staff representatives from the Divisions of Engineering in NRR reviewed a draft of this TLR, which was transmitted with a memorandum dated June 28, 2016 (ADAMS Accession Number ML16179A275), and the enclosed final TLR reflects the resolution of their comments. Nonetheless, please feel free to notify the responsible RES contact if you have any questions concerning the impending public release of this TLR.

If additional information is required, please contact Carol A. Nove of my staff at 301-415-2217 or can2@nrc.gov.

Enclosure:
As stated

The results of PNNL's research on inspection of CASS provides a basis for developing rulemaking such as the proposed rule to implement Code Case N-824: Alternate Requirements for Ultrasonic Examination of Cast Austenitic Piping Welds from the Outer Diameter (OD) Surface, Section XI, Division 1." This proposed rule was published in the Federal Register on September 18, 2015, FRN 56820, 10 CFR Part 50, Incorporation by Reference of American Society of Mechanical Engineers Codes and Code Cases; Proposed Rule. Further, the work will provide the basis for the staff to assess new Code requirements related to CASS such as ASME Code, Section XI, Supplement 9 for performance demonstration requirements for UT examination of CASS.

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