



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

May 22, 2017

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

Robert K. Caldwell, Acting Director  
Division of Engineering and Infrastructure  
Office of New Reactors

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

SUBJECT: IMPENDING PUBLICATION OF TECHNICAL LETTER REPORT,  
PNNL-26370, ENTITLED "EVALUATION OF ULTRASONIC  
PHASED-ARRAY DETECTION IN HIGH-DENSITY  
POLYETHYLENE (HDPE) BUTT FUSION JOINTS"

The Office of Nuclear Regulatory Research (RES) has completed Pacific Northwest National Laboratory (PNNL) - 26370, a Technical Letter Report (TLR) entitled "Evaluation of Ultrasonic Phased-Array Examination for Fabrication Flaw Detection in High Density Polyethylene (HDPE) Butt Fusion Joints," (ADAMS Accession ML17003A106). This report documents work performed under a joint User Need Request (UNR) from the Office of Nuclear Reactor Regulation (NRR) and the Office of New Reactors (NRO) entitled "User Need Request for Nondestructive Examination of Polyethylene Piping and Fittings." Task 2 of this UNR directed RES to assess the current state-of-the-art nondestructive examination (NDE) methods examining extruded products, fused joints, and fabricated configurations.

The attached TLR provides an assessment of phased-array ultrasonic (PAUT) examination for detection of planar flaws (represented by stainless steel discs) as well as particulate contamination and attempted cold fusion in HDPE thermal butt fusion joints. The HDPE materials used in the research were 30.5 cm (12 inch) diameter, DR 11 PE4710 pipe, manufactured with Code-conforming resins fused in accordance with standard fusing procedures specified in the American Society of Mechanical Engineers (ASME) Code. In addition to assessing PAUT, this research used outer-diameter beam profiling to assess the potential of visual testing to detect some of the conditions introduced into the fusion joints. The key results of the study show that PAUT is able to detect coarse particulate contamination, but it is not able to detect fine particulate contamination. The minimum concentration of particulate contamination required for detection was not established in this work.

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In terms of planar flaws this work showed that, the ability of PAUT to detect and size these flaws is dependent on the aperture of the probe, with detection and sizing ability improving with increasing aperture size. Further, the probability of detecting a planar flaw improved when examinations were performed from both sides of the fusion joint; however, for flaws near the outer diameter, detection was limited due to the blind spot caused by access limitations from the weld bead.

At the time the HDPE UNR was developed, the U.S. nuclear industry had begun to use HDPE in a variety of applications for repair and replacement at existing plants, and in new-plant construction. The ASME Code was, and still is, developing rules for the use of this material through the development of Code Case N-755, "Use of Polyethylene (PE) Plastic Pipe Section III, Division I and Section XI." Code Case N-755 has not yet been approved by the NRC; however, it is referenced by two licensees requesting the use of HDPE pipe for replacement of steel service water systems. The NRC Staff will use the results of the PNNL research described in the attached TLR to inform their evaluation of revisions to Code Case N-755, as well as to evaluate future relief requests from licensees looking to use HDPE in their plants.

Staff representatives from the Division of Engineering in NRR reviewed a draft of this TLR, which was transmitted with a email dated February 16, 2017 (ADAMS Accession Number ML17003A191), and the enclosed final TLR reflects the resolution of their comments. Since NRO was not directly involved in this project, the cognizant NRO staff deferred the review to NRR. 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](mailto:can2@nrc.gov).

Enclosure:  
As stated

J. Lubinski

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