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

October 1, 2020

MEMORANDUM TO: Anna Bradford, Director
Division of New and Renewed Licenses
Office of Nuclear Reactor Regulation

FROM: Jeremy Bowen, Deputy Director
Division of Engineering
Office of Nuclear Regulatory Research

Signed by Bowen, Jeremy on 10/01/20

SUBJECT: IMPENDING PUBLICATION OF TECHNICAL LETTER REPORT (TLR-RES/DE/CIB-2020-08) "SURVEY OF MODELING AND SIMULATION TECHNIQUES FOR ADVANCED MANUFACTURING TECHNOLOGIES, VOLUME 1: PREDICTING INITIAL MICROSTRUCTURES"

The Office of Nuclear Regulatory Research (RES) has completed a technical letter report (TLR) entitled "Survey of Modeling and Simulation Techniques for Advanced Manufacturing Technologies, Volume I: Predicting Initial Microstructures" (ADAMS Accession No. ML20269A331) under contract with Argonne National Laboratory. This TLR documents work performed under Subtask 1C "Modeling and Simulation of Microstructure and Properties" of the United States Nuclear Regulatory Commission Action Plan for Advanced Manufacturing Technologies, Revision 1, (Package ADAMS Accession No. ML19333B980).

The report is the first volume in a two-volume series. This first volume focuses on predicting initial microstructures for application to predict mechanical properties of material in components fabricated using advanced manufacturing technologies (AMTs). It also concentrates on AMTs of particular relevance to the design and manufacture of nuclear reactor components and concludes with a summary of gaps that may be of particular interest to the NRC when evaluating modeling and simulation methods for AMTs. The second volume discusses predicting material properties given the initial microstructure.

This survey attempts to encompass the current body of literature published on methods for predicting initial microstructures both for general materials and specific to AMTs. Included in this survey is a gap analysis describing the shortcomings of the various modeling and simulation methods identified and described in the report. Limited modeling techniques linking specific single processing parameters to general, high-level microstructural features are well developed and fairly robust even when applied to AMTs. However, comprehensive process models accounting for the effects of relevant processing parameters on microstructural evolution and end-state are not yet available. Such modeling frameworks will need to be developed and validated to increase confidence on modeling and simulation predictions without extensive experimental characterization of the final material. Automated length- and time-scale bridging and methods for multiphysics coupling are key barriers to the development of such frameworks. However, as described in this report, much recent progress has been made to overcome these barriers.

Staff representatives from the Division of New and Renewed Licenses in NRR reviewed a draft of this TLR, 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.

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 completing this short survey within the next 10 working days to present your office's views of the delivered RES product. If you cannot provide a rating of "Exceptional" in all areas of the survey, please reach out the RES/DE contact person prior to the completion of the survey and allow us the opportunity to address your concern.

If additional information is required, please contact Shah Malik of my staff at 301-415-2436 or Shah.Malik@nrc.gov.

CONTACT: Shah Malik, RES/DE/CIB
(301) 415-2436

Enclosure:

TLR-RES/DE/CIB-2020-08, "Survey of Modeling and Simulation Techniques for Advanced Manufacturing Technologies, Volume I: Predicting Initial Microstructures"

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