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

July 23, 2020

MEMORANDUM TO: Raj M. Iyengar, Chief
Component Integrity Branch
Division of Engineering
Office of Nuclear Regulatory Research

FROM: Matthew J. Homiack, Materials Engineer ***/RA/***
Component Integrity Branch
Division of Engineering
Office of Nuclear Regulatory Research

SUBJECT: SUMMARY OF THE JULY 15, 2020, RES CATEGORY 3 PUBLIC MEETING WITH EPRI AND STAKEHOLDERS TO DISCUSS SETTING UP INPUTS IN THE XLPR PROBABILISTIC FRACTURE MECHANICS CODE

The U.S. Nuclear Regulatory Commission (NRC) staff from the Office of Nuclear Regulatory Research (RES) held a meeting on July 15, 2020, with representatives of the Electric Power Research Institute (EPRI) to provide information and guidance to new users on setting up inputs for the Extremely Low Probability of Rupture (xLPR) probabilistic fracture mechanics code.

The agenda for the meeting is available in the NRC's Agencywide Documents Access and Management System under Accession Number ML20181A202. Enclosed is a list of the meeting participants and the slide presentation. Additionally, a video recording of the meeting is available at www.youtube.com. A summary of the meeting discussions follows by agenda topic.

1. Introduction and Opening Remarks

   The NRC staff welcomed participants and covered administrative items for the meeting. It noted that xLPR Version 2.1 (V2.1) was made available to the public for request in early June 2020. An overview of the request process was given. The NRC staff also explained that the meeting was the second in a four-part technical seminar series on xLPR V2.1. The NRC staff indicated that a summary and video recording of the first seminar on models in the code are now available. The schedule for the remaining two technical seminars was also announced. A demonstration was then given on how to set up the various software components needed to begin using xLPR V2.1. Lastly, the NRC staff explained how users of the code could submit problem reports and requests for new code features or enhancements.

CONTACT: Matthew J. Homiack, RES/DE
301-415-2427

2. Resources for Inputs

   The NRC staff highlighted several resources that are pertinent to developing inputs for analyses performed using the code. Examples included in the xLPR V2.1 release package are the user and training manuals. The NRC staff also covered the available input databases, which provide inputs for different weld types, materials, and welding residual stresses (WRS). Other resources in the form of reports stemming from the xLPR V2.0 development effort were covered as well.

3. Review of the Input Set

   The NRC staff explained that the primary inputs interface for xLPR V2.1 is the Inputs Workbook, a Microsoft Excel file. The NRC staff described how the inputs in this file are organized across various spreadsheets. Simulation settings and other options for running the code are available on the first spreadsheet. The next spreadsheet is where the user can define various properties, such as the piping geometry, crack sizes, loads, and inservice inspection model parameters. The next four spreadsheets provide inputs related to material properties, such as the general mechanical properties and the crack initiation and crack growth model parameters. Following those are two spreadsheets where the user can enter WRS profiles. Thermal and mechanical transients for fatigue calculations are defined on the remaining two spreadsheets.

4. Input Uncertainties

   The NRC staff described how xLPR V2.1 accounts for uncertainties. Aspects of uncertainty include input variable uncertainty and model parameter uncertainty. Whereas input variable uncertainty characterizes the range in expected input values, model parameter uncertainty characterizes the calibration variability of the models in the code to specific sets of environmental conditions based on statistical analyses. In both cases, the NRC staff stated that the uncertainties are accounted for by the code sampling from the defined input distributions. The available distribution types available for user selection were described and the ones most commonly used were highlighted. In addition, due to the code's dual-loop sampling structure, the NRC staff explained that any uncertain inputs defined by distributions must be assigned to either the aleatory or epistemic sampling loops. Aleatory is appropriate for inputs where there is natural, unpredictable variation, whereas epistemic is appropriate for inputs where there is lack of knowledge. It was noted that, by assigning all the uncertain inputs to a single loop, a more classical Monte Carlo analysis could be performed. An additional aspect of uncertainty is model uncertainty, which refers to the fidelity with which various mathematical forms could be used to represent a physical behavior of interest. The inclusion of three primary water stress-corrosion cracking (PWSCC) initiation models in xLPR V2.1 was noted as one approach for addressing model uncertainty.

5. Inputs Group Report Overview

   The NRC staff provided an overview of the Inputs Group Report, which is one of the key resources on inputs from the xLPR V2.0 development effort. The report describes the development of inputs for 11 scenarios for three separate study cases. The three study cases cover common large-diameter dissimilar metal weld locations that are likely to be susceptible to PWSCC. The 11 scenarios address a range of expected failure probabilities under a given set of circumstances for crack initiation, orientation, and

growth. Mechanical mitigation, chemical mitigation, or both are considered in some of the scenarios. The NRC staff provided an overview of the various sources used to develop these inputs. Then, following a recap of the Inputs Group's recommendations, the NRC staff demonstrated how a prospective value for a given xLPR V2.1 input could be determined and how the basis could be found in the Inputs Group Report.

6. Sim Editor

   An EPRI representative provided an overview of the Sim Editor, which is a tool included in the xLPR V2.1 release package to help users populate the Inputs Workbook. It was explained that the Sim Editor has two modes: simulation mode and database mode. Simulation mode is used for creating and modifying an Inputs Workbook. Database mode is used for creating and modifying data sets for material properties, WRS profiles, and weld types. The EPRI representative provided a review of the features and basic operation of each mode. Useful hints and tips for successful operation of the Sim Editor were also provided.

7. Demonstrations

   The presentation portion of the agenda was concluded with two demonstrations. The demonstrations showed how to set-up the inputs for one of the challenge problems available in the training materials provided in the xLPR V2.1 release package. The NRC staff provided the first demonstration, which showed how to set-up the inputs for the challenge problem by directly editing the Inputs Workbook. An EPRI representative demonstrated the same set-up using the Sim Editor. The presenters noted the advantages and disadvantages of each approach and provided useful hints and tips.

8. Questions and Answers

   As an NRC Category 3 public meeting, stakeholders had the opportunity to participate by providing comments and asking questions throughout the meeting. This participation was facilitated through the electronic submission of questions and comments using the question and answer feature of the virtual platform used to host the meeting. Clarifications were provided in response to a few attendee questions about the differences between aleatory and epistemic uncertainties and how they should be modeled using xLPR V2.1. All questions were answered over the course of the meeting.

9. Closing Remarks

   The NRC staff concluded the meeting by providing a recap of the presentations. Participants were thanked for their time and encouraged to submit any future questions or comments to the NRC staff at xlpr@nrc.gov and to EPRI at xlpr@epri.com. The NRC staff also invited the participants to attend the remaining two technical seminars. To prepare for the next seminar on running the simulation and retrieving results, the NRC staff suggested that attendees review certain sections of the user manual.

The NRC staff provided EPRI with an opportunity to review a draft of this meeting summary. EPRI comments were incorporated as appropriate.

Enclosures:
As stated

SUBJECT: SUMMARY OF THE JULY 15, 2020, RES CATEGORY 3 PUBLIC MEETING WITH EPRI AND STAKEHOLDERS TO DISCUSS SETTING UP INPUTS IN THE XLPR PROBABILISTIC FRACTURE MECHANICS CODE

DISTRIBUTION:
DE/RES
CIB/DE/RES
CMB/DE/RES
NPHP/DNRL/NRR
NVIB/DNRL/NRR
DRudland, NRR
RKalikian, NRR
RTregoning, RES
JBowen, RES
GFacco, RES

ADAMS Package Accession Number: ML20205L399 ***via email**

OFFICE	RES/DE/CIB
NAME	MHomiack*
DATE	7/23/2020

OFFICIAL RECORD COPY