Background on MOU

• Concludes work performed under previous MOU

• Status of deliverables
  – Mockup measurements and round robin: complete
  – 3-D analyses and EWR: underway
  – WRS inputs for xLPR: complete
  – ASME Code practices for WRS: underway

• Expires December 2015

• No follow-on MOU currently planned
Program History

• 2008 to 2011 – Initial joint validation program effort
  – Measurement and modeling of small and full scale mockups as well as canceled plant components
  – Baseline study of variability between modelers and measurements
  – Documented in both NRC and EPRI documents

• 2012 to 2015 – New mockup and round robin study
  – Improve understanding of variability between modelers and measurement
  – Develop validation criteria
  – Incorporate WRS information into consensus standards
Progress Since June 2014

• Closed round robin in August 2014

• Round robin results made public
  – December 2014 NRC public meeting: ML14352A195
  – EPRI/NRC PVP paper: PVP2015-45636

• ASME Code Case development in Task Group Crack Growth Reference Curves

• EPRI-sponsored [UC Davis] research on uncertainty and validation criteria

• NRC-sponsored research [Sandia National Lab] on uncertainty and validation criteria
WRS Round Robin Mockup

34.625 in. [879.48 mm]

14.000 in. [355.6 mm]
WRS Round Robin Mockup

Measurement Data

Modeling Data–Isotropic Hardening

Modeling Data–Kinematic Hardening

Axial

Hoop
ASME Section XI Code Case Development

- Section XI Code Case governing WRS for DM welds
- Draft language in development

Analyses options include three level of analysis:
- Assume at yield strength through-wall
- Use bounding through-wall distributions developed for standard weld types
  - Proposed approach described in PVP2015 paper
- Use standard practice and conduct own analysis
  - Acceptance criteria discussion informed by modeler variability from 2014 Round Robin submissions
  - Jan and April 2015 ASME Code Week Meetings on 2014 Round Robin results used to develop Code Case approach regarding model acceptance
Excavate and Weld Repair

- EPRI shared EWR mockup information with NRC through the WRS MOU
- NRC developing finite element model
- Can be compared with measurements and other modeling efforts
- ASME Code Case currently under consideration
Challenges Moving Forward

- Identification and disposition of outliers
- Quantifying measurement uncertainty
- Quantifying modeling uncertainty
- Use engineering judgement to determine acceptance criteria
  - Criteria types (K, root-mean-square prediction error, etc.)
  - Acceptable numbers
- Use engineering judgement to formulate hardening law guidance