



United States Nuclear Regulatory Commission

Protecting People and the Environment

**PUBLIC MEETING TO DISCUSS THE UNISTAR
TOPICAL REPORT FOR THE USE OF HIGH-
DENSITY POLYETHYLENE (HDPE) PIPE,
UN-TR-10-001-NP**

Tanya Ford

Project Manager

Office of New Reactors/Division of New Reactor Licensing

December 8, 2010

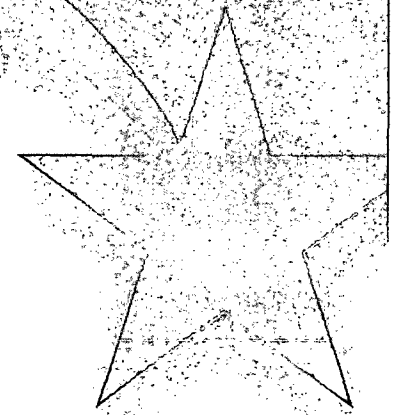
AGENDA

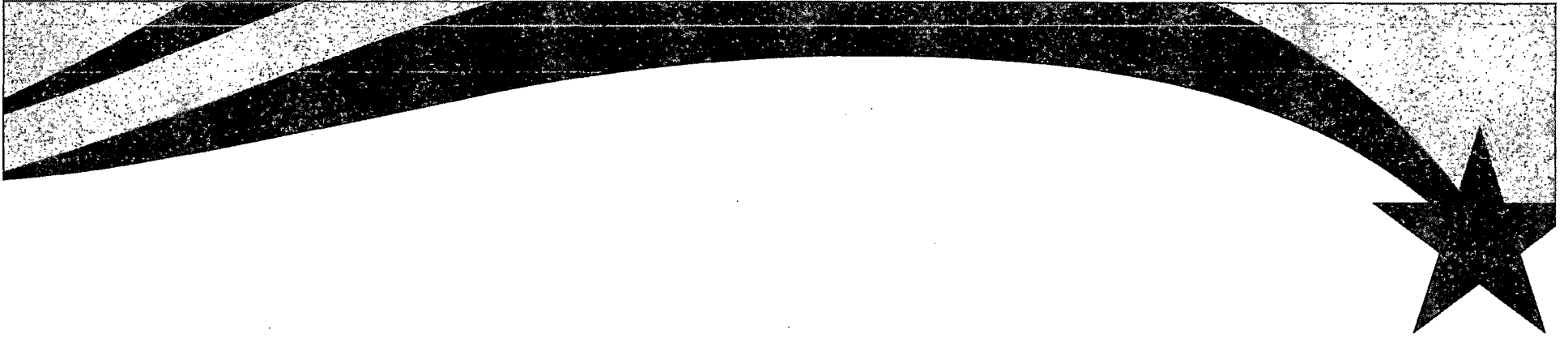
- **Welcome/Introductions**
- **Overview of Staff's Preliminary Review Findings**
- **Discussion of Technical Issues**
- **Comments**



Topical Report Post Submittal Meeting
High Density Polyethylene Pipe (HDPE) in
US EPR ASME Class 3 Buried Piping

12/08/10





UniStar Opening Remarks

Greg Gibson – Vice President Regulatory Affairs



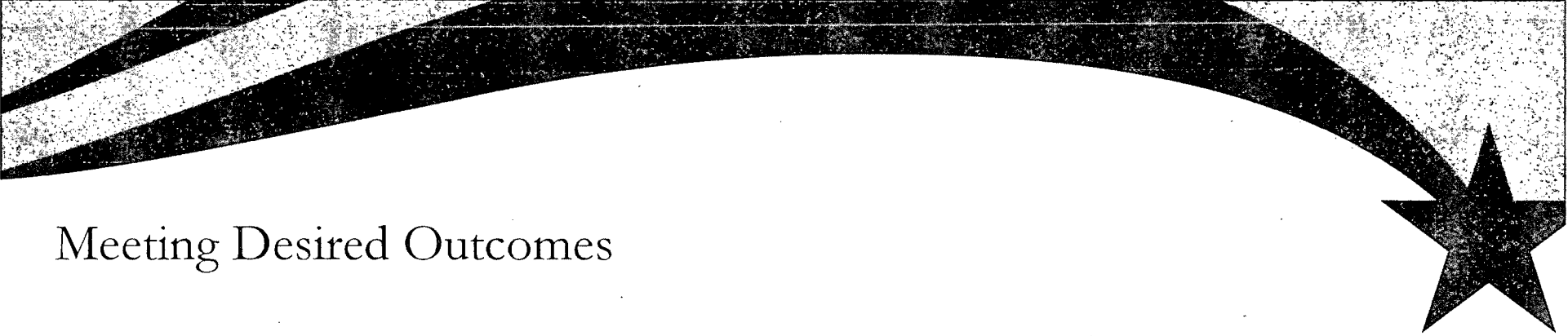
Topical Report Process Update

- UNE Sponsored Topical Report Pre-Submittal Meeting on January 28, 2010
 - Identified the intent to submit a Topical Report on HDPE in Safety Related applications
 - Discussed 4 NRC Topical Report Criteria and compliance
 - Reviewed proposed structure of Topical Report
- UNE has and will continue to monitor the ASME code activity and other industry initiatives related to HDPE
 - Although the industry is making continued progress on HDPE, revision to existing code is pending
- UNE submitted Topical Report UN-TR-10-001 for the use of HDPE on September 28, 2010.
 - Addresses NRC concerns regarding existing code
 - Reflects the latest industry efforts and knowledge regarding HDPE



Topical Report Structure

- Topical Report follows the development Code Case N755
- Topical Report incorporates, where appropriate, lessons learned from Callaway and Catawba Relief Requests previously approved by the NRC
- UNE Team has been monitoring Code Committee meetings and other industry initiatives for new developments.
- Where applicable, have used data or text from the Code Case as part of the TR, but have not referenced these items as ASME information
- When necessary to resolve an outstanding NRC concern we have deviated from criteria in the Code Case to provide a more conservative approach.
- In addition the TR has narrative explanations, references, and calculations that are not included in the Code Case
- The TR also covers topics not within the jurisdiction of the ASME B&PV Code (i.e. excavation and back fill, etc.).



Meeting Desired Outcomes

- Acceptance of UniStar HDPE Topical Report for review by the NRC
- Clear understanding of the NRC concerns / questions with the Topical Report
- Alignment on schedule for resolution of technical issues
- Alignment on schedule for review of the Topical Report



Results of NRC Staff's Acceptance Review of UniStar HDPE Topical Report

December 8, 2010

David Terao, Chief
Component Integrity, Performance and
Testing Branch 1
Office of New Reactors

Background

- In a letter dated September 28, 2010, UniStar submitted its HDPE Topical Report, UN-TR-10-001-NP, under NRC's topical report program.
- The TR provides alternative requirements for the materials selection, design, fabrication, installation, examination, testing, and procurement of HDPE piping material in lieu of meeting requirements in the ASME Code, Section III, Subsections NCA and ND that are incorporated by reference into 10 CFR 50.55a.
- NRC staff performed an acceptance review following the guidance in LIC-500, Rev. 4.

Topical Report Process

- Per LIC-500:
“A TR is a stand-alone report containing technical information about a nuclear power plant safety topic, **which meets the criteria contained in Section 4.1.1**, that can be submitted to the NRC for its review and approval. A TR improves the efficiency of the licensing process by allowing the staff to review a proposed methodology, design, operational requirements, or other safety-related subjects that will be used by multiple licensees following approval by referencing the approved TR. The TR provides the technical basis of a licensing action.”

LIC-500, Section 4.1.1 TR Criteria

- Criterion A: The report should deal with a specific safety-related subject regarding a nuclear power plant that requires a safety evaluation by the NRC staff.

The UniStar topical report meets this criterion because it deals with alternative requirements for the design, materials selection, fabrication, installation, examination and testing of buried piping that can be evaluated independently of a specific license application.

LIC-500, Section 4.1.1 TR Criteria

- Criterion B: The topical report is expected to be used by multiple licensees in a number of requests for licensing actions.

The UniStar topical report meets this criterion because it is expected that all combined license (COL) licensees referencing AREVA's U.S EPR certified plant design will use this topical report. In addition, the UniStar topical report does not preclude other plants, both operating and new reactors, from using this topical report.

LIC-500, Section 4.1.1 TR Criteria

- Criterion C: Consistent with the criteria in LIC-109, "Acceptance Review Procedures," the topical report contains complete and detailed information on the specific subject presented.

The UniStar topical report does not meet this criterion because the topical report does not contain sufficient technical information to commence with a detailed technical review and enable the staff to reach the necessary finding that the alternative to the regulations provides an acceptable level of quality and safety pursuant to 10 CFR 50.55a(a)(3)(i).

The failure to meet this criterion is discussed in more detail later.

LIC-500, Section 4.1.1 TR Criteria

- Criterion D: NRC approval of the report will increase the efficiency of the review process for applications that reference the report.

The UniStar topical report meets this criterion because NRC approval of the topical report will provide a consistent basis for authorizing an alternative to the regulations by demonstrating an acceptable level of quality and safety that is required to be submitted by each plant referencing the topical report pursuant to 10 CFR 50.55a(a)(3)(i).

Criterion C Issues

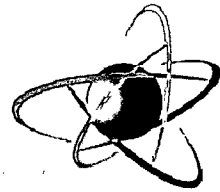
- UniStar TR provides alternative “construction” requirements in lieu of ASME Code, Section III, Subsections NCA and ND (2001 Edition/2003 Addenda)
- Once approved, each plant must request NRC authorization to use the TR by demonstrating that the alternative provides an acceptable level of quality and safety pursuant to 10 CFR 50.55a(a)(3)(i).
- Accordingly, the UniStar TR is to be evaluated by the NRC staff to enable specific plants requesting its use to demonstrate that an acceptable level of quality and safety has been provided by the TR.

Criterion C Issues (con't)

- The ASME Code, Section III currently does not contain requirements for use of HDPE material.
- The NRC staff is working with ASME Code to develop rules for HDPE piping.
- UniStar TR provides detailed alternative design, qualification, fabrication, installation, examination and testing methods and acceptance criteria for HDPE piping in lieu of meeting ASME Code rules for metallic piping.
- But, the TR does not explain why or how these methods and acceptance criteria provide an acceptable level of quality and safety.
- Although the TR references many established standards used for non-nuclear plastic pipe applications, the adequacy of those standards has not been demonstrated for the applications intended by the TR in nuclear plants.

What Additional Information is Needed?

- In order to commence its review of the UniStar TR, the NRC staff will need the technical bases (e.g., test data, technical justification) for these alternative methods and acceptance criteria that demonstrate that the alternative methods and criteria provide an acceptable level of quality and safety.



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UN-TR-10-001-NP**

Eric Reichelt

Senior Materials Engineer NRO/DE/CIB1

December 8, 2010

OVERVIEW

- Topical report provides alternative requirements for design, fabrication, installation, examination and testing for HDPE piping material in lieu of requirements in Section III, Subsection NCA and ND of the ASME Code 2001 Edition, up to and including 2003 Addenda.

PRELIMINARY FINDINGS

- Unistar topical report has not met Criterion C of LIC-500.
- Topical report does not contain sufficient technical information to commence with a detailed technical review and enable the staff to reach the necessary finding that the alternative to the regulations provides an acceptable level of quality and safety to 10 CFR 50.55a(a)(3)(i).

TECHNICAL ISSUES

- Topical Report does not provide the technical bases and supporting test data to justify methods and acceptance standards.
- Section 7.1.2 discusses visual examination requirements. There are no requirements in ASME Code for HDPE piping. Visual examination is not acceptable as a stand alone examination.
- TR states that fusion is performed with a minimum ambient temperature of 50F. Testing is currently being performed to identify material properties under different ambient temperatures.
- Section 8.1.1 A. states external surfaces shall be given a visual examination prior to installation. VE can not detect nonconformities within the material (i.e., shrinkage). Testing is currently being performed with UT for an additional test requirement.

TECHNICAL ISSUES (CONT.)

- Section 8.2.1 discusses UT examinations. There are currently no requirements in ASME for HDPE. Qualification requirements and mockups are currently being discussed in ASME Code. Appendix VIII type of testing is being considered.
- Section 8.2.3 discusses NDE examination procedures. Currently there is no UT examination method approved. In addition, types of tests, minimum flaw sizes and orientation have not been approved.
- Section 8.3.1: Visual examinations acceptance criteria of external surfaces of the butt fusion joints not endorsed by NRC or agreed upon in Code Committees. Additionally, testing has concluded that joints that appeared to be fully fused failed destructive testing due to brittle failure, and joints that appeared to be partially fused passed.

TECHNICAL ISSUES (CONT.)

- Section 8.4: Visual and UT procedures and personnel qualifications have not been agreed upon between NRC and ASME.
- Section 8.6: Identifies Plastic Pipe Institute procedures for fusion operators. Procedures are subjective and have not been endorsed by the NRC or ASME.
- Section 8.6.1: Identifies essential variables for fusion welding. Not currently agreed upon between NRC and ASME.
- Section 8.7.3: Specifies requirements for fusion procedure specifications are per PPI TR-33. NRC has stated that TR-33 is too subjective and NRC has not endorsed PPI TR-33.

TECHNICAL ISSUES (CONT.)

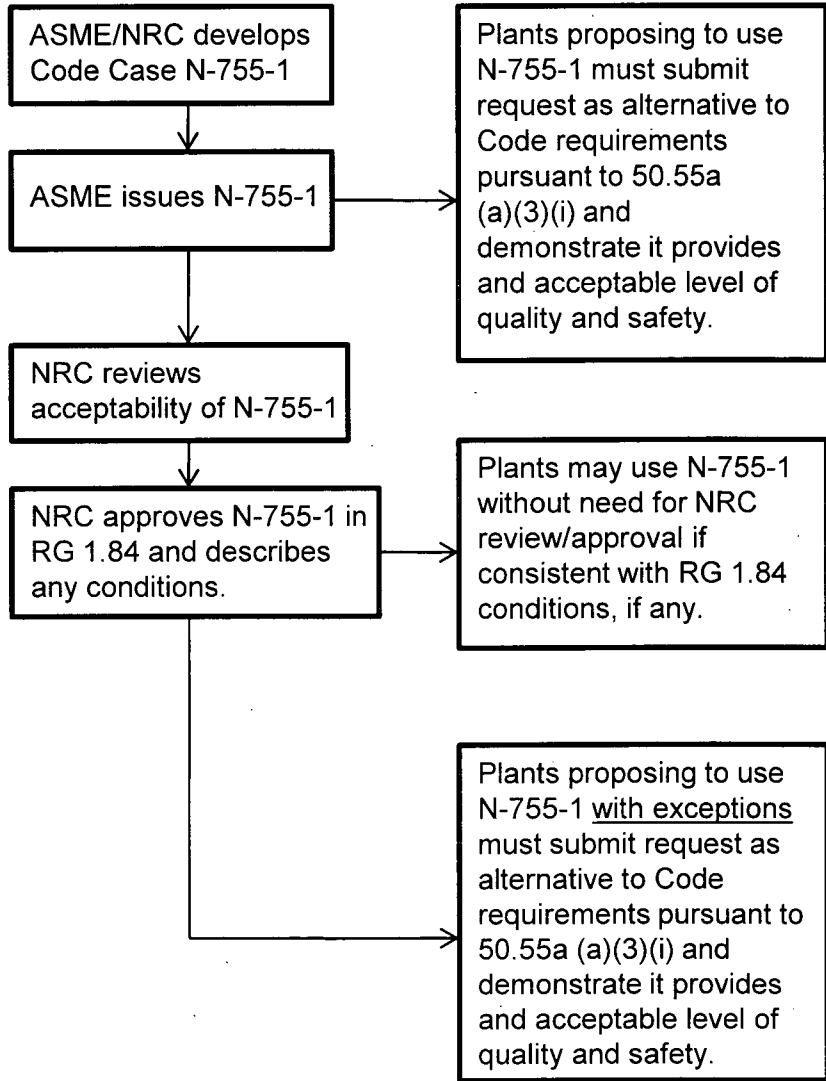
- Section 8.7.3: B-7 discusses bead size for different size pipe. Basis has not been provided to justify bead sizes are adequate. Testing is being performed to verify this variable by PPI.
- Section 8.7.3: D1 states that 8" DR 11 pipe size will be minimum pipe size for qualification of butt fusion joint. No basis or test data has been received to justify this requirement. NRC has stated that each diameter and material thickness is considered an essential variable and needs to be qualified.
- Section 8.8.3: A-1 states that one of the successful retests shall be used for mechanical testing. Test data has confirmed that areas of a pipe that passed UT failed tensile specimens by brittle failure, and pipe that failed UT passed tensile specimens.
- Section 8.8.4: A-1 specifies a range of pipe diameter. There is no test data or basis to support these ranges.

TECHNICAL ISSUES (CONT.)

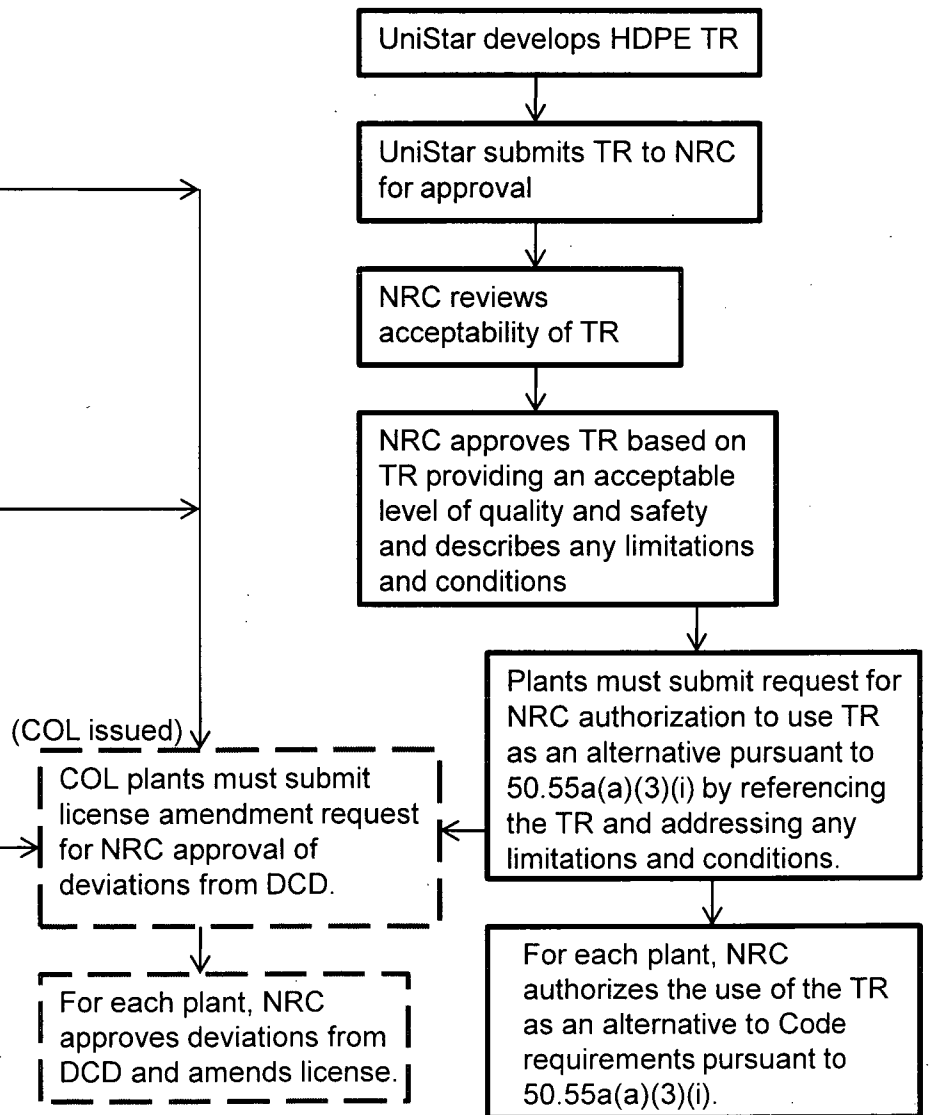
- No data has been provided that material properties are consistent throughout DR 6 pipe.
- Data has not been provided to demonstrate that variables such as temperature, pressure and hold times are consistent between thin and thick pipe.
- Data has not been provided that support a 60-year life at 140 °F, and what the allowable flaw size is for different thicknesses of pipe.
- Section 10.0: QA/QC requirements based on the requirements of Section NCA of the ASME Code. These requirements have not been endorsed by the NRC.

Comparison of Code Case vs. Topical Report Process

Code Case



Topical Report



(COL issued)

COL plants must submit license amendment request for NRC approval of deviations from DCD.

For each plant, NRC approves deviations from DCD and amends license.

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*December 8, 2010
Rockville, MD*



Acknowledgments

- ***This work has been supported by the U.S. Nuclear Regulatory Commission (NRC)***
- ***NRC-RES Program Manager – Mr. Eric Focht***



Background Information on Technical Issues

- *ASME BPV approved Revision 0 of Code Case N-755 "Use of Polyethylene Pipe (PE) Plastic Pipe" in March 2007, and is currently balloting Rev 1; USNRC has NOT as yet approved Revision 0 of CC N-755*

- *Technical issues and NRC Concerns with use of HDPE Pipe in Safety-Related Class 3 Applications have been presented and discussed at*
 - ◆ *ASME BPV Section III and Section XI Meetings since 2006; presentations are available in the ASME SWG-PP minutes*
 - ◆ *Technical papers have been presented at various conferences – ICONE, ASME-PVP, Plastics Pipes XV, XIV, etc.*
 - ◆ *EPRI Workshop "NRC Issues Regarding the Use of HDPE Piping in Safety-Related Nuclear Applications," June 7-10, 2010*

- *Emc²'s efforts relate to "structural integrity" issues; NDE issues addressed elsewhere*



Technical Issues - Summary

- *Proposed Design Parameters in the Topical Report (perSection 1.0, 3.6, 3.9, 3.10.3, Table 3-4, and 10.4.1)*
 - *Pressure: up to 200 psig with a design factor DF =0.5*
 - *Maximum temperature: 140 F (with 160 F excursion for 30 days)*
 - *Wall thickness: up to DR 6 or 4.5 inches - whichever is smaller*
 - *Design service life: 40 years (up to 60 years)*
 - *Allowable flaw size: 10% of the wall thickness or 0.125 inches – whichever is smaller*
 - *Slow Crack Growth (SCG) Resistance: 2000 hours PENT*

- *The Topical Report (TR) does not provide experimental data and analysis to support the above design conditions (especially at the elevated temperature of 140 F)*
 - *to prevent premature failure due to SCG*
 - *to maintain structural integrity of fused butt joints which are known*
 - *to have greater susceptibility to SCG*



Technical Issues

- *Section 3.8 - hydrostatic design basis (stress) for 140 F and up to 160 F is based on ASTM D2837 and Rate Process Method (RPM) per PPI TN 16 - but this basis is developed using "unflawed pipe" test data - the TR does not provide experimental data on flawed piping even though an allowable flaw is defined.*
- *Section 3.9 - service life prediction based on PENT data at 80 C (or 176 F) is typically done for ambient/lower temperature service applications at 20 C (~68F) - the TR does not demonstrate how this method is applicable at 140 F.*
- *Section 3.10.3 - large diameter pipe with wall thicknesses of 4.5 inches are NOT commonly used - and can have significant gradient in properties. RPM data is developed on smaller diameter, thinner (2 inches or less typically) piping - the TR does not provide data to support the use of RPM for thicker wall piping.*



Technical Issues - Cont'd

- *Section 3.12.2 - the high thermal expansion coefficient, lower modulus, and poor thermal conductivity results in higher thermal gradients in thick walled PE piping - the TR does not explain how this is accounted for in the design.*
- *Section 3.14.1, Table 3-11 - Per PPI Handbook for PE materials the apparent modulus is a function of temperature, time and stress - the TR does not show how the effect of stress on modulus is accounted for in design.*



Technical Issues – Cont'd

- *Section 8.6.2 – defines the use of destructive mechanical tests for qualification of butt fused joints – the TR does not address failure of joints due to SCG under allowable longitudinal loads (per Section 3.11.1)*
- *Section 9.1/9.4 – the projected 60 year life is based on RPM which is developed using data on unflawed pipe – the TR does not provide data that shows the effect of the allowable flaw on the proposed service life conditions*



Closing Comments

- *The technical issues identified above are currently being discussed and resolved amongst the members of the Plastics Pipes Institute, the industry and NRC staff in various special working groups, task groups of the ASME BPV Code.*
- *Experimental data to address many of the above issues are being developed by EPRI and other projects.*



PUBLIC MEETING TO DISCUSS "UNISTAR TOPICAL REPORT FOR THE USE OF HIGH-DENSITY POLYETHYLENE (HDPE) PIPE IN ASME SECTION III, CLASS 3, SEISMIC CATEGORY I, SAFETY-RELATED BURIED WATER PIPE APPLICATIONS, UN-TR-10-001-NP"

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