

# Code Case N-871-1

## Status Update

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NRC Technical Exchange Meeting  
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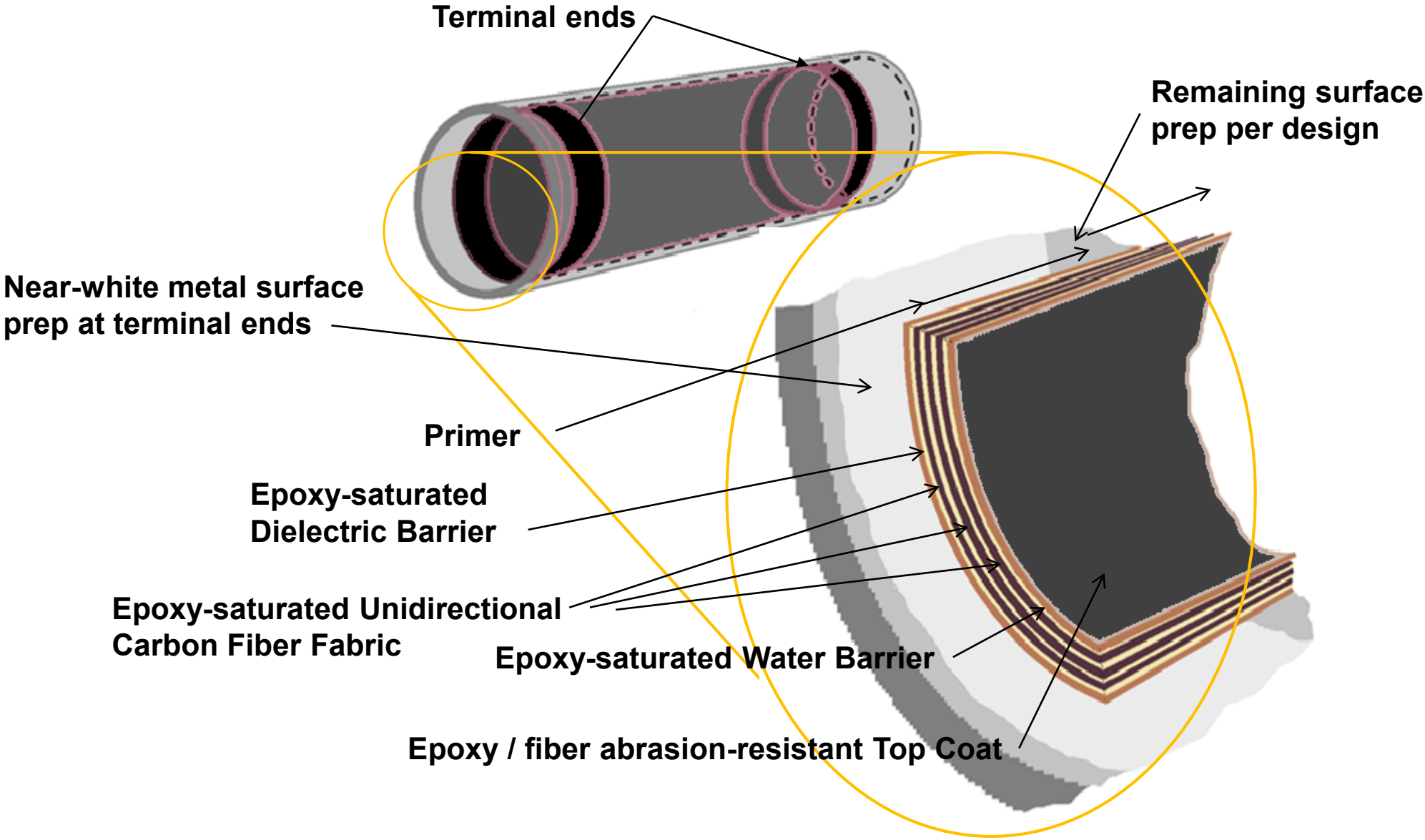


# Update on CFRC

## Code Case N-871, “Internal Repair of Class 2 & 3 Buried Piping Using Carbon Fiber Composite Materials”

- Scope of original Code Case:
  - Segments of hand lay-up carbon fiber reinforced polymer (CFRP) composite structurally replace the underlying degraded piping
  - Multiple in-process visual examinations to ensure structural integrity
  - Terminal ends of CFRP designed to provide complete structural load transfer to and from sound steel substrate
  - Volumetric examination of terminal ends required to verify soundness to ensure adequate load-transfer capability – acoustic tap method specified for examination of composite
  - Scope limited to internal application of CFRP composite for repair of degraded sections of large bore buried steel piping

# Update on CFRC



# Update on CFRC

## Code Case N-871-1, “Repair of Class 2 & 3 Piping Using Carbon Fiber Composite Materials”

- Scope of revision 1:
  - Volumetric examination of terminal ends – initially revised to allow acoustic tap or dynamic response spectroscopy method
  - Scope expanded to include:
    - internal or external application of CFRP for repair of degraded sections of buried metallic piping
    - Internal or external application of CFRP for repair of degraded sections of aboveground metallic piping

# Update on CFRC

## Code Case N-871-1: Repair of Class 2 & 3 Metallic Piping using CFRC

- Recent Letter Ballot comments resulted in many improvements to the Code Case. These include:
  - Clarified how to evaluate degradation relative to design life.
  - Relocated inspection and examination acceptance criteria to Section 5000.
  - Revised installation and inservice examination to permit any equivalent volumetric technique that can qualify to the CC.
  - Refined volumetric demonstration and recording requirements.
  - Added requirement that Level III, SME and examination personnel experience be approved by the Owner.

# Update on CFRC

## Code Case N-871-1: Repair of Class 2 & 3 Metallic Piping using CFRC

- Improvements (cont'd):
  - Identified the rigor required for volumetric examination procedure qualification as defined by ASME Section V.
  - Added generic descriptions of required volumetric examination procedure essential variables.
  - Added background noise in decibels as essential variable for qualification of acoustic tap examination personnel.
  - Clarified mandatory training requirements for inspection and NDE personnel.

# Update on CFRC

## Code Case N-871-1: Repair of Class 2 & 3 Metallic Piping using CFRC

- Improvements (cont'd):
  - Clarified various CFRP Repair Procedure qualification requirements.
  - Clarified that users may set their own upper-bound test limits to broaden the potential applicability for a series of tests.
  - Changed acoustic tap and dynamic response spectroscopy examination mandatory appendices to nonmandatory.
  - Multiple changes in terminology for consistency and clarity throughout the Code Case.

# Update on CFRC

## Code Case N-871-1: Repair of Class 2 & 3 Metallic Piping using CFRC

- Some comments still require further discussion:

### *Design Related Comments*

- 3131(c) (2) - Are there data available to show that properties between Room Temperature and 125 F are reasonably close?
  - Third party testing currently underway
- 3131 (e) – Need to verify this equation provides a conservative estimation for ultimate strength of multi-ply laminate.
  - Third party testing currently underway



# Update on CFRC

## *Design Related Comments (cont'd)*

- 3131 (e) - 10 samples are not sufficient to provide the characteristic value; 50 samples are needed per ASTM D7290.
  - Third party testing currently underway
- Maximum operating temperature should be based on Material Adjustment Factor testing above 140 F
  - Third party testing currently underway
- Is the Miner's Rule approach applicable to unidirectional CFRP laminates?
  - Task Group is evaluating

# Update on CFRC

## *Design Related Comments (cont'd)*

- 3300 (c) - Some guidance or a reference is needed for evaluating strains in CFRP materials.
  - Task Group is evaluating
- Misalignment of 5 degrees may have a considerable effect in reducing the ultimate strength of CFRP repair.
  - Third party testing currently underway
- Need verification that provisions for testing to establish stress intensification factors for CFRC fittings are adequate.
  - Prototype testing is being considered by EPRI

# Update on CFRC

## *NDE Related Comments:*

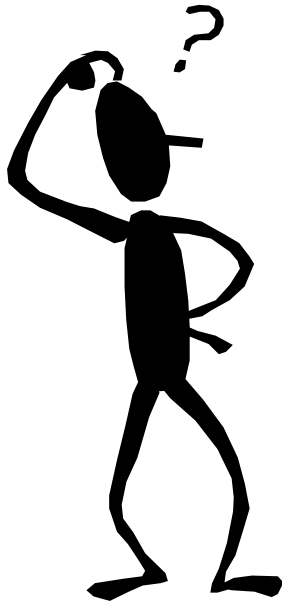
- 5212 addresses layer-by-layer visual exam, 5213 addresses final visual exam, but if you do the layer-by-layer, do you need a final?
  - The final visual includes the top coat and serves as preservice baseline examination.
- 5300 - The technical criteria for flaw acceptance is based on carbon fiber wrap of reinforced structural concrete – not piping.
  - AWWA C305 (2018), CFRP Renewal of Precast Concrete Cylinder Pipe invokes the same acceptance criteria.
- 5410(e) term “representative of the configuration to be examined” needs clarification relative to demonstration test panels.
  - Means maximum composite thickness and same substrate diameter to NPS 24

# Update on CFRC

## *NDE Related Comments (cont'd):*

- 5410(h) need to identify retention requirements for NDE demonstration panels.
  - Open for discussion
- 5420 minimum essential variables (f), (g) and (h) relate to any variables that could affect signal transmission, receipt of signal response or evaluation of signal response... seems too broad.
  - intended to be generic to apply to any examination method that is used.
- 5450(a)(3) optional in-process acoustic tap examinations, including optional personnel qualification method, should be removed.
  - Basic criteria: visual during installation, volumetric NDE of terminal ends

# Questions or Comments?



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