



EPRI

ELECTRIC POWER
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EPRI **Buried/Underground Piping** **Activities Update**

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Program Manager-Balance of Plant Corrosion

NRC/Industry Meeting on Buried Pipe

October 20, 2011 White Flint, MD

Today's Discussion

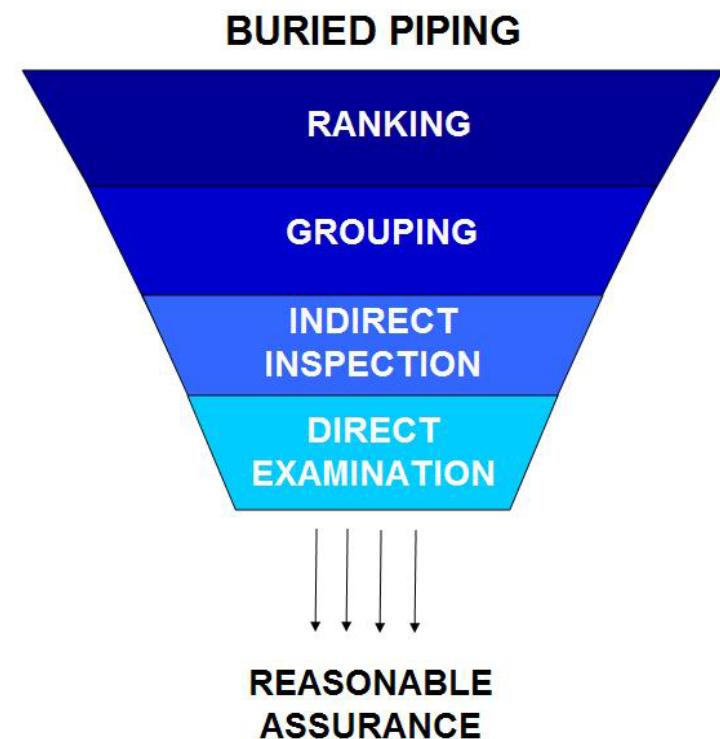
- NEI Inspection Planning Guidance or Reasonable Assurance Document Update
- EPRI Buried and Underground Piping Activities
 - Plant Engineering Activities
 - NDE Activities

Background-NEI-Inspection Planning Guidance

- Develop an approach to meet the intent of the Industry Initiative
- Reasonable Assurance Technical Advisory Group
- Approach had been developed by 2 Utilities
- Draft reviews, webcast and conference calls
- Several levels of review and approval

Inspection Planning- Overall Approach

- **Reasonable Assurance / Inspection Planning Guidance is a Graded Process that involves:**
 - Inventory and Risk Ranking
 - Create Line Groupings
 - Indirect inspection samples
 - Direct examinations
 - Feedback for overall program



**Effective use of resources through graded process,
focused and quality inspections**

Current Status and Future Plans

- Final Draft “Approved for Use” released April 2011
- Revise Guidance Document to incorporate underground piping and tanks
 - Review by NEI BPITF
 - Review by NEI BPIWG
- Provide clarifications as needed
- Issue as an Appendix to NEI 09-14

Buried Pipe Activities - Update

- Programmatic Support and Training
- Condition Assessment
- Analysis
- Mitigation and Arrest of Corrosion
- Repair and Replace

Buried Pipe Activities - Update

- **Programmatic Support and Training**
 - Buried Pipe Integrity Group (BPIG)
 - Cathodic Protection Users Group
 - Cathodic Protection Training
 - Job Targeted Cathodic Protection Training
 - Buried Piping Reference Document (Rev 1)
 - Buried Piping Recommendations Document (Rev 2)
 - Buried Piping Inspector Training Course
 - Buried Pipe Inspection Results Database**

Buried Pipe Inspection Results Database

- Industry database developed to leverage Inspection Results
- Collect affirmative as well as adverse inspection results
- Phase I is operational
- Match similar parameters
- Optimize inspections

Buried Pipe Activities - Update

- **Condition Assessment**

- Evaluation of Indirect Assessment Techniques for Coating Flaw Detection
- Guidance for the Evaluation of Buried Pipe in Concrete
- Use of Leak Detection for Providing Reasonable Assurance
- **Other NDE focused projects described in detail later**

Buried Pipe Activities - Update

- **Analysis**
 - **BPWORKS™ revision to include underground pipe and tanks**
 - Guidance on Corrosion Rates for buried piping
 - Support of ASME Code work for development of Design Rules and Fitness for Service code cases

Buried Pipe Activities - Update

- **Mitigation and Arrest of Corrosion**
 - Coating Replacement Options for Buried Pipe
 - Coating Aging Study of Coal Tar Epoxy and Coal Tar Enamel
 - Cathodic Protection System Design Specifications
 - Update NMAC Guide on Cathodic Protection

Buried Pipe Activities - Update

- **Repair and Replace**

- High Density Polyethylene (HDPE) Material Testing
- Repair of ASME Class 3 Metallic Buried Piping
- High Density Polyethylene Workshop with ASME
- NDE Assessment of Cold Fusion in High Density Polyethylene Joints
- Use of High Density Polyethylene for Above Ground Applications

Assessment & Development of Buried Pipe NDE Technology

Objective / Benefits

- Benchmark buried pipe NDE capabilities
- Constructed mock-ups to assess technology
- Resources for vendors to tweak technologies and procedures
- Facilitate vendors understanding of nuclear industry requirements
- Provide utility support in implementing technology



Assessment & Development of Buried Pipe NDE Technology

Mock-ups

- Built 4-in, 6-in, 8-in, 10-in, 16-in and 24-in diameter mock-ups
- Acquired field removed samples



Buried Pipe NDE Mock-ups



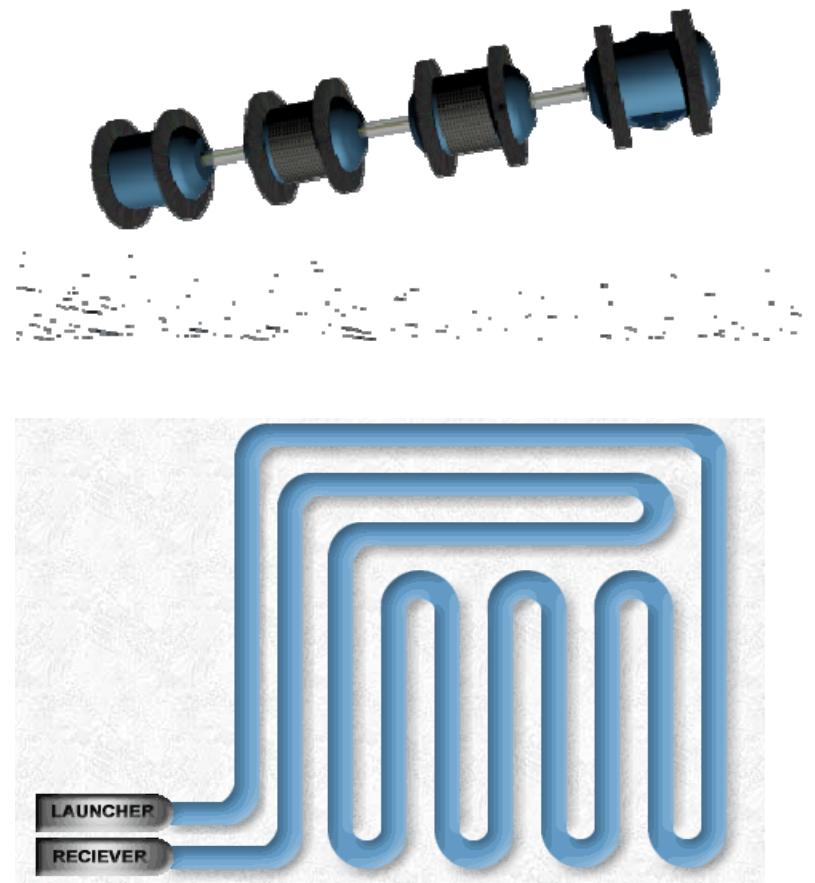
Buried Pipe Reference Guide Report

Buried Pipe NDE Reference Guide (EPRI Report 1021626)

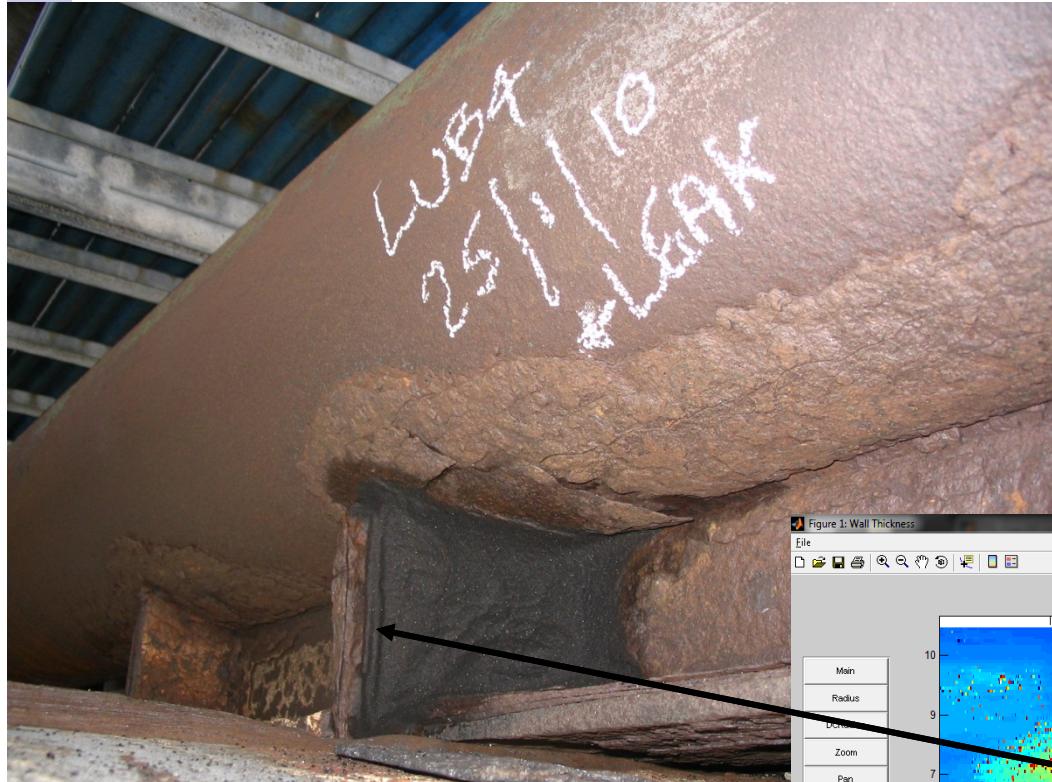
- Overview of available buried pipe NDE technologies
 - In-line and outside pipe application
 - Eleven NDE technologies
 - Identifies limiting conditions and configurations
- Guidance on technology selection
- Living Document – 2011 Revision to include
 - New technologies
 - Update on reported technologies
 - Overview of internal NDE tool launch and retrieval

Recent Internal Ultrasonic Tool Assessment

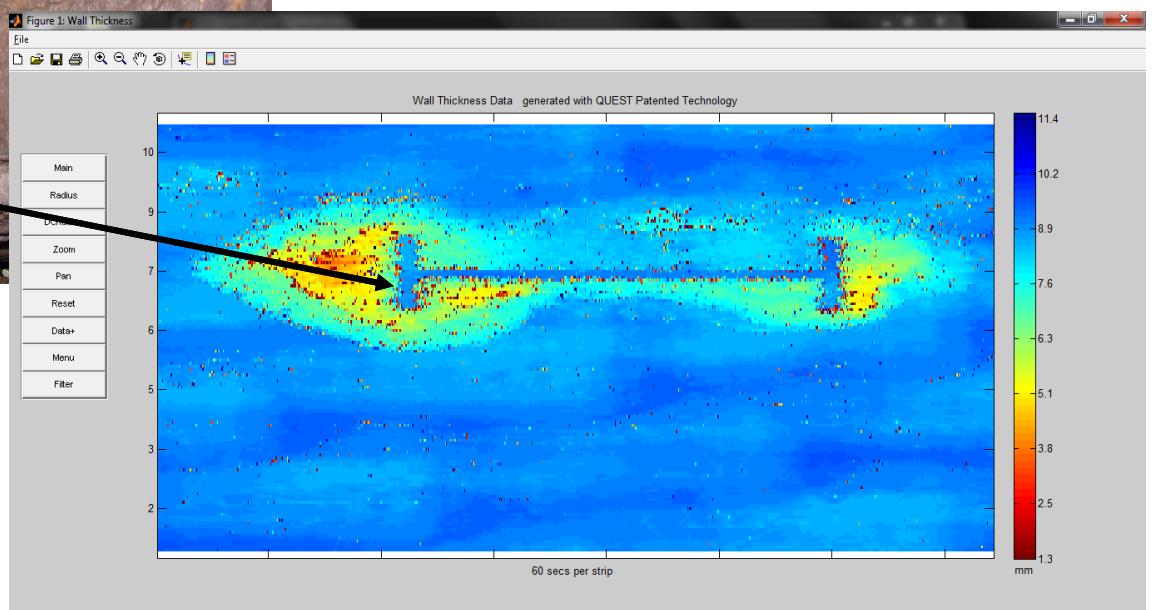
- Quest Integrity InVista™ Free Swimming internal ultrasonic
 - Widely used in other industries
 - Designed to navigate Short Radius - 1D - 180° bends
 - Transducer array provides 100% coverage
 - Imaging of ultrasonic data
 - On-board data collection
 - Not tethered



Recent Internal Ultrasonic Tool Assessment



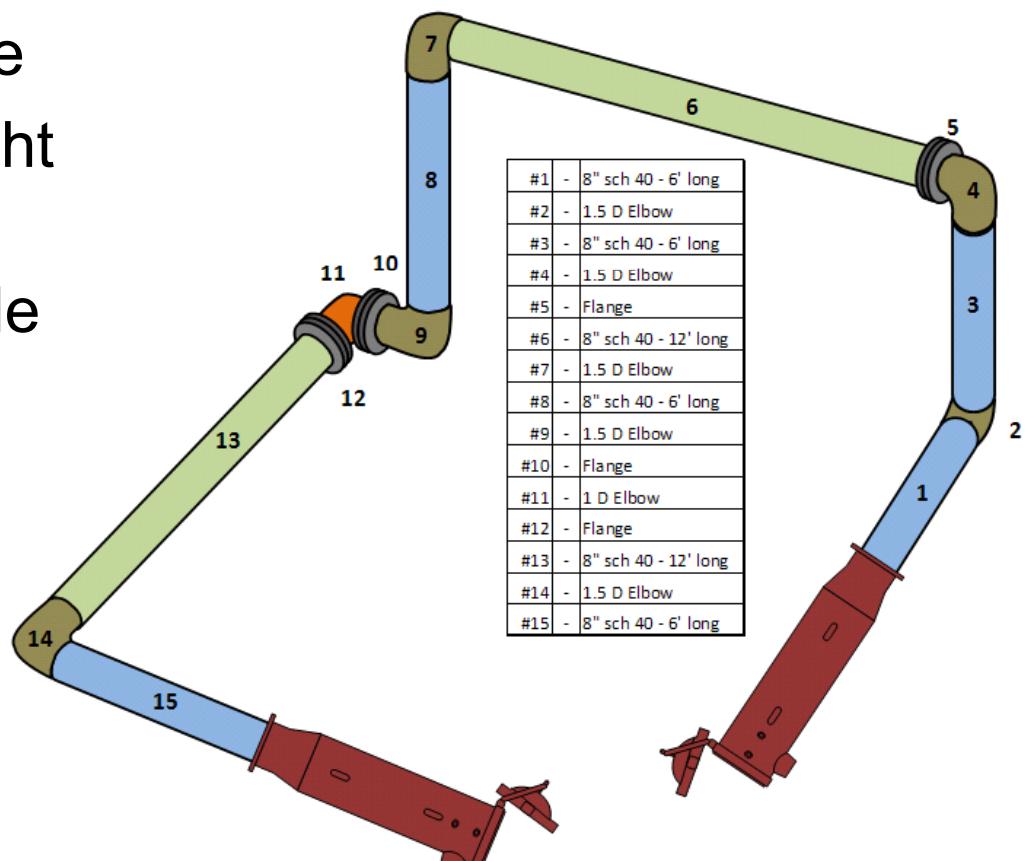
Example of corrosion damage around pipe support. (Courtesy Quest Integrity)



Recent Internal Ultrasonic Tool Assessment

Assessment Conducted on 60-ft long 8-in Diameter EPRI Mock-up

- Examined in <1 minute
- Full coverage of straight pipe sections
- Identified inside outside surface connected discontinuities



New Technologies

Phased array probes

- Advantages
 - Rapid scanning
 - Greater sensitivity to sharp flaws such as pitting
 - Improved depth and extent sizing
 - Provides depth imaging
 - Permanent data storage
- Status
 - Identified technology in aerospace industry
 - Vendor demonstrated on EPRI mock-up
 - Purchasing probe



2-in wide array of 64 ultrasonic elements

Standardization of Guided Wave Pipe Procedures Guidance

Successful application of NDE typically based on codes, standards or EPRI guidance. Guided wave lacks such protocol.

- Utility and guided wave service providers requested EPRI procedure guidance to obtain:
 - Consistent technology application
 - Repeatable results
 - Uniform expectations
- Status
 - EPRI has identified essential variables
 - Developing guidance
 - To meet with utility and service providers to gain consensus
- Guidance to be added to the EPRI 1019116: *Buried Pipe Guided Wave Examination Reference Document*

Development of Guided Wave Personnel Qualifications

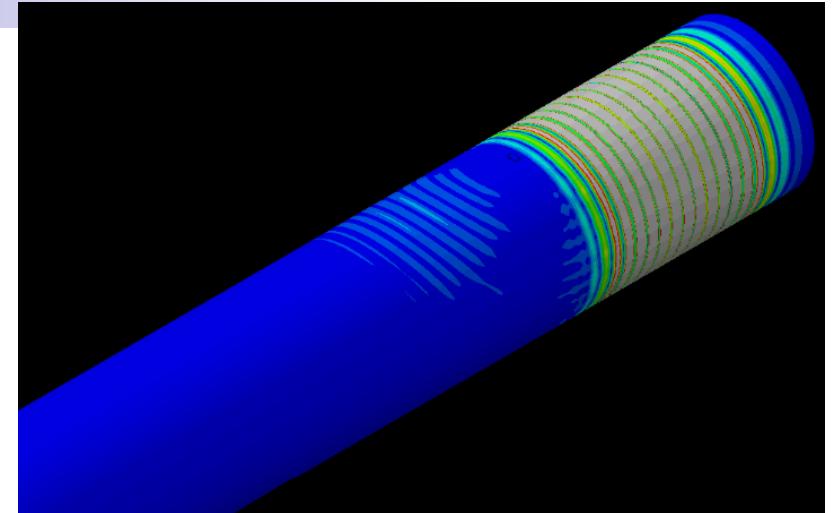
Guided wave personnel qualification Codes and Standards currently do not exist. EPRI is engaged in NDE industry movement to create such requirements:

- American Society of Nondestructive Testing (ASNT)
- American Society of Mechanical Engineers (ASME)
 - Drafted Article 18 under Section V to establish guided wave as a method for testing piping
- British Institute of Non-Destructive Testing PCN
 - Independent body has drafted a scheme for certification and qualification of guided wave testing personnel

Guided Wave Computer Modeling and Empirical Study

Guided Wave Numerical Modeling:

- Alternative to building mockups
- Optimize data acquisition setups
- Data analysis tool
- Training and testing resource



EPRI Guided Wave Modeling Work

- Working with PRCI, TWI, SwRI, and Penn State University
- Issuing report on results of modeling assessment in 2011
 - Acquired guided wave data on piping mock-ups
 - Laser profile of discontinuities
 - FEM model of laser profiled discontinuities
 - Modeling data consistent with empirical data

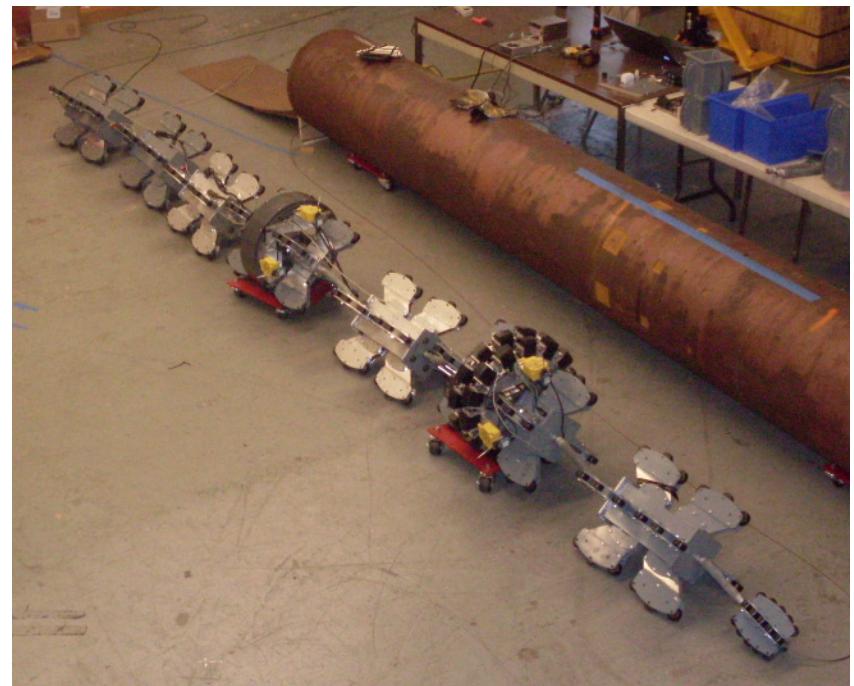
In-line Examination of Intermediate Diameter Piping

EPRI Developed Technology

- Develop instrumented robot for the examination of plant piping with minimal facility modifications for diameter range of 12" to 30"
- Provide utilities with cost effective tooling to determine buried pipe wall thickness conditions

Current Status

- Robot development completed
- Demonstration in Seabrook mockup completed



Future Buried Pipe NDE Work

Guided Wave

- Develop a basis for obtaining credit as a direct examination
 - Identify necessary parameters and essential variables:
 - Identify performance indicators for above to show a reliable examination was achieved
- Buried Pipe Structural Health Monitoring (SHM)
- Buried Pipe Data Analysis Development

NDE Technology Assessment

- Facilitate Field Trials
- Continued to assess and development NDE technology

Summary - Buried Pipe Activities

- **Increased focus on Coatings and Cathodic Protection**
 - Increased Technical Knowledge
 - System Performance
 - Supports Mitigation and Restoration Methodologies
- **NDE Technology Assessments**
 - Updated Reference Guide
 - Technology Capability Demonstrations
 - Transition from OD inspection to ID inspections
 - Guided Wave
 - Data Analysis
 - Structural Health Monitoring
 - Obtaining Credit for Exams

Underground Piping and Tank Integrity Strategic Roadmap

Buried Pipe NSIAC Initiative Implementation Timeline																
	2010	2011	2012	2013	2014	2015	2016									
Utilities	Develop Procedures & Oversight	Procedures & Oversight – R1 added scope	Buried Pipe NSIAC Initiative Implementation Timeline													
	Complete Risk Ranking	Prioritization – R1 added scope														
	Develop Inspection Plans	Cordition Assm't Plan – R1 added scope														
	Implement Inspection Plans (Start NLT 6/12)			Plan Imp'l – R1 added scope	Asset Plan in place – R1	Implement Asset Management Plan										
	Develop Asset Management Plan			Implement Asset Management Plan												
Equipment Reliability APC	Reasonable Assurance Inspection Plan		Program Development													
	BPWORKSTM V.2.0	BPWORKSTM V.2.1						BPWORKSTM V.2.2								
	Req. for Effective Program Rev. 1	Req. for Effective Program Rev. 2						Req. for Effective Program Rev. 3								
	Balance of Plant: Corrosion Training and Operating Experience															
	Buried Pipe Integrity Group (BPIG)/BPWORKS Training/Program Owner Training															
Nondestructive Evaluation APC	Inspection Results Sharing Database		Inspection Results Sharing Database													
	CP Training Course	CP Training Course	CP Training Course	CP Training Course	CP Training Course	CP Training Course										
	Buried Pipe (BP) Inspector Training Course Development															
	Reference Materials		Buried Pipe (BP) Ref. Guide Rev 1	Buried Pipe (BP) Ref. Guide Rev 2												
	Coatings Assessment Field Guide			Aging Study for Coal Tar Epoxy & Enamel												
	Guidance on Corrosion Rates for Buried Pipe (BP)															
	Evaluation of Pipe In Concrete															
	Design and Fitness for Service Code Case Support (Metallic)		ASME Code Case Support													
	Repair Methodologies (Metallic)															
	SIFs for HDPE	High Density Polyethylene (HDPE) Workshop	Slow Crack Growth (High Density Polyethylene)	HDPE Material Testing												
	Assessment of Cold Fusion in High Density Polyethylene (HDPE)		Repair Methodologies (High Density Polyethylene)													
	OD Coating Degradation Detection		Buried Infrastructure Protection													
	CP Workshop	Cathodic Protection (CP) Users Group					Cathodic Protection (CP) User's Group									
	Specs for CP Design															
	Using Leak Detector for Reasonable Assurance															
	Technology Development															
	Guided Wave (GW) Data Analysis Development					Guided Wave (GW) Data Analysis Development										
	Guided Wave (GW) Structural Health Monitoring Technology					GW Structural Health Monitoring Technology										
	BP NDE Ref. Guide Updates	BP NDE Ref. Guide Updates	BP NDE Ref. Guide Updates	BP NDE Ref. Guide Updates	BP NDE Ref. Guide Updates	BP NDE Ref. Guide Updates										
	Intermediate Diameter Vehicle Field Trial	RFT Reference Guide	ID UT Reference Guide													
	RFT Depth Sizing Development															
	Direct Exams thru Coatings															
	Guided Wave (GW) Procedure Standardization		Non-Destructive Evaluation (NDE) Capability Assessment/Demonstration/Qualification/Industry Support													
	Guided Wave Training	Guided Wave Training	Guided Wave Training	Guided Wave Training	Guided Wave Training	Guided Wave (GW) Personnel Resource Development										
	Guided Wave (GW) Personnel Resource Development															
	Buried Pipe (BP) Non-Destructive Evaluation (NDE) Capability Assessment					Buried Pipe (BP) NDE Capability Assessment										
	Technologies from other industries					Technologies from other industries										
						Performance Demonstration										
	NDE Industry Support-BFITF/BPIG/NACE					Non-Destructive Evaluation (NDE) Industry Support-BFITF/BPIG/NACE										
	Obtain Credit for Guided Wave (GW) Exams															

- ◆ Key Milestone
- Funded Work
- Unfunded Work
- Funded Work
- Unfunded Work

Together...Shaping the Future of Electricity