



EPRI

Buried/Underground Piping Activities Update

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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

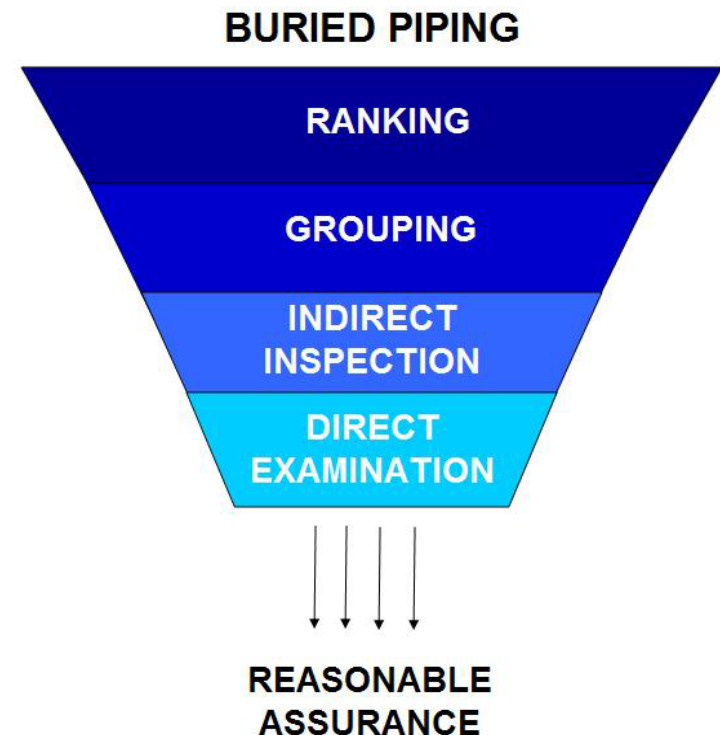
Background-NEI-Inspection Planning Guidance

- 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



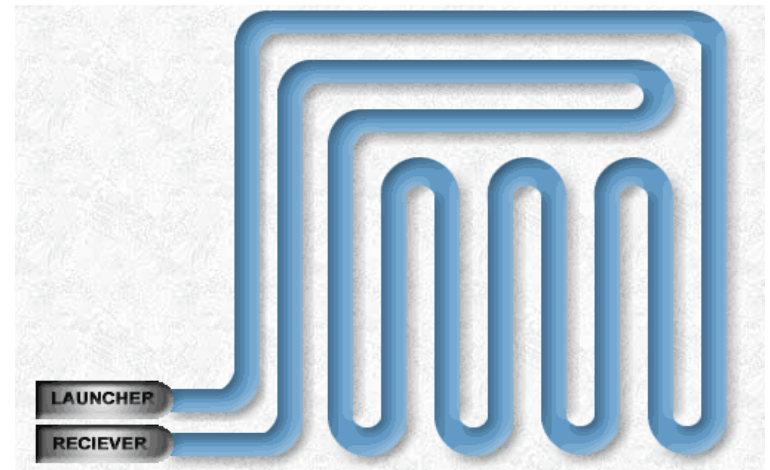
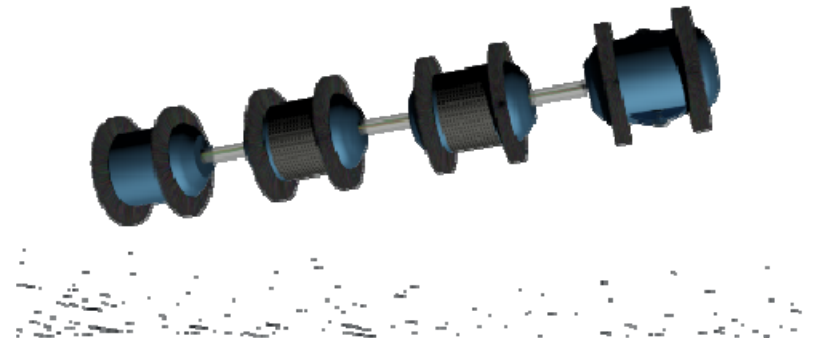
Buried Pipe Reference Guide Report

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

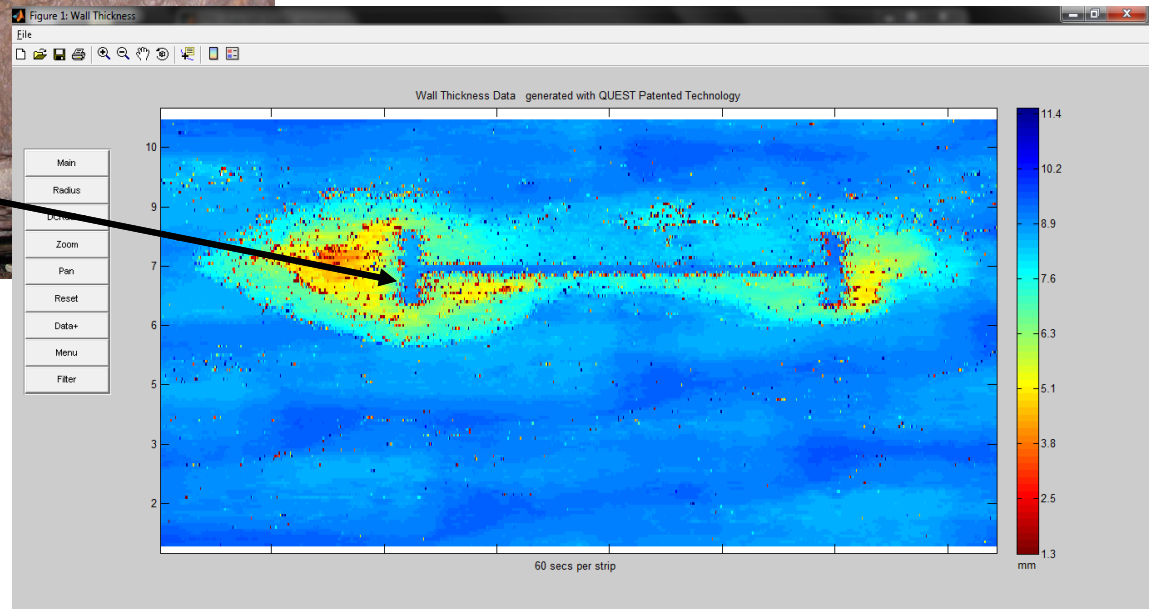
- Quest Integrity InVista™ Free Swimming internal ultrasonic
 - Widely used in other industries
 - Designed to navigate Short Radius - 1D - 180° bends
 - Transducer array provides 100% coverage
 - Imaging of ultrasonic data
 - On-board data collection
 - Not tethered



Recent Internal Ultrasonic Tool Assessment



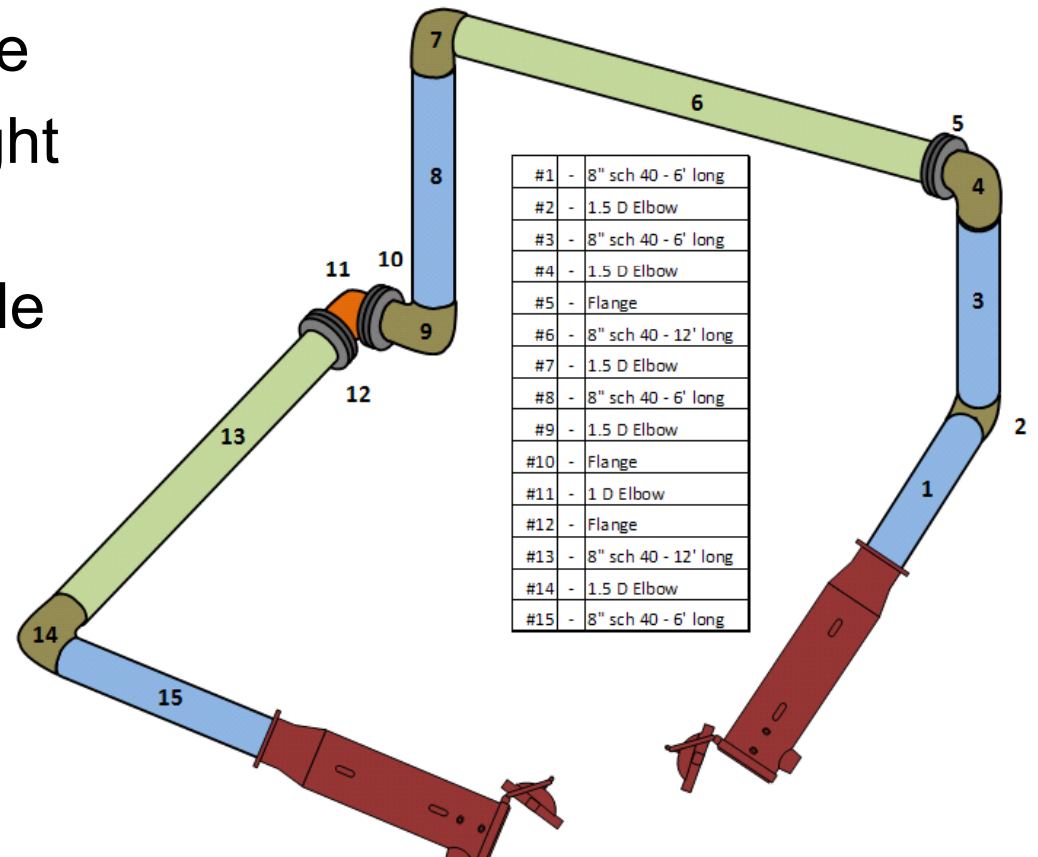
Example of corrosion damage around pipe support. (Courtesy Quest Integrity)



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

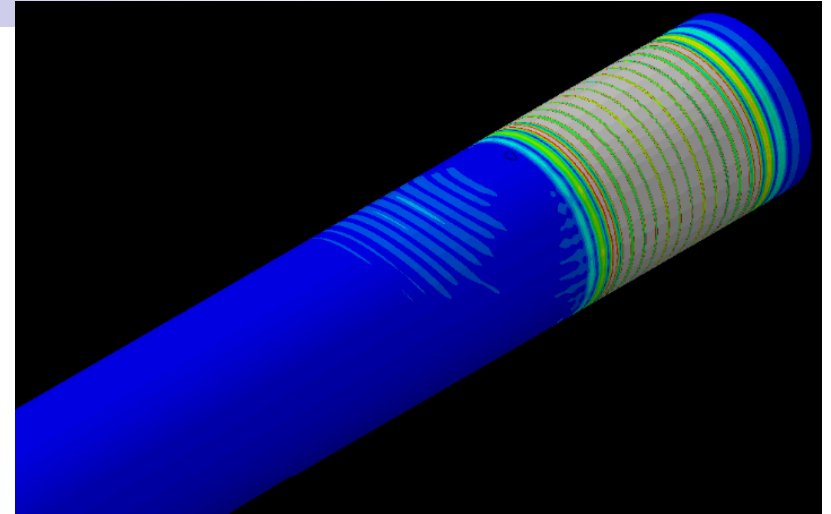
Guided wave personnel qualification Codes and Standards currently do not exist. EPRI is engaged in NDE industry movement to create such requirements:

- 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

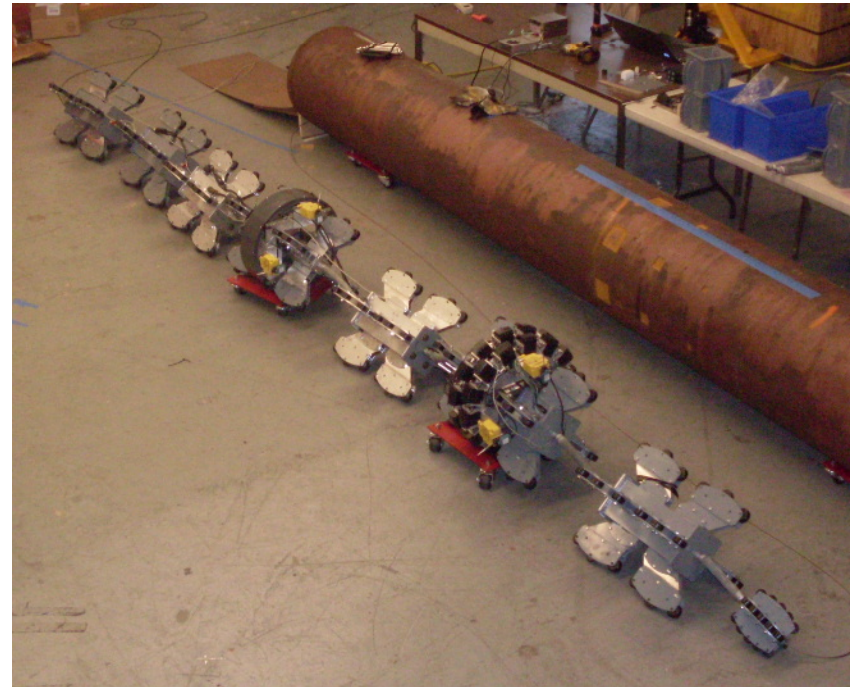
In-line Examination of Intermediate Diameter Piping

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

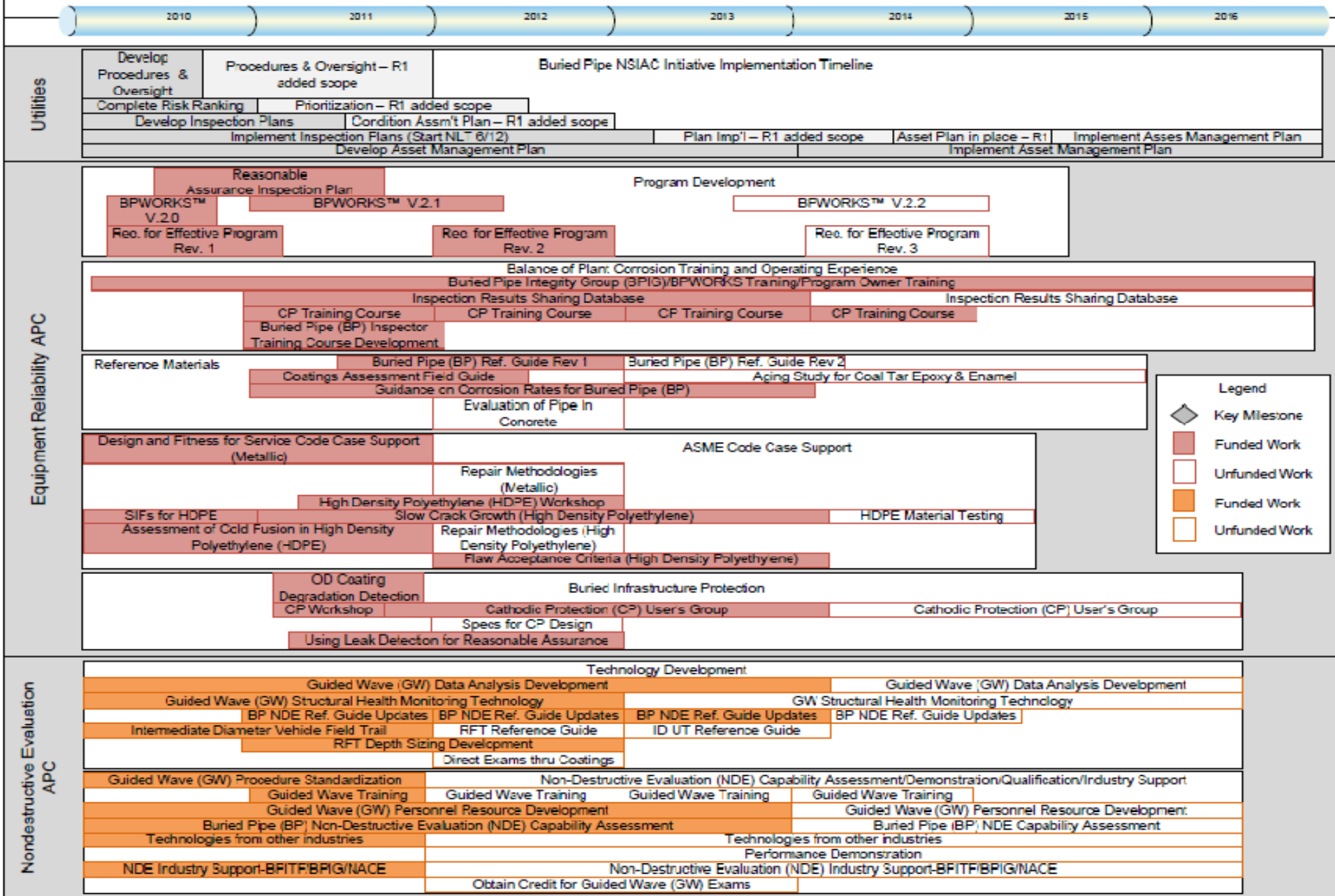
NDE Technology Assessment

- 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





Together...Shaping the Future of Electricity