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Nuclear Plant Buried Piping Aging Management

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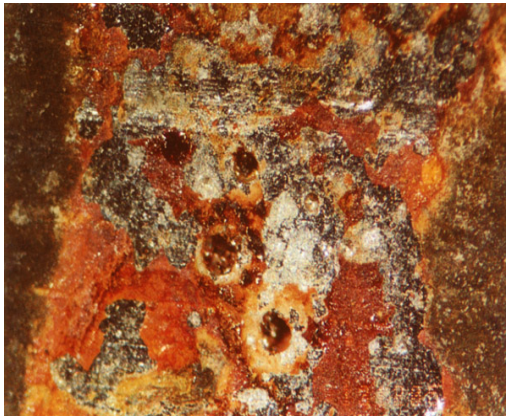
Integrity of Buried Piping Problems

Microbiological Influenced Corrosion



Tuberculation

Preferential Weld Attack

Pitting

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Integrity of Buried Piping
Problem Statement

- Degradation of raw water piping is affecting plant reliability and increasing O&M costs
- Problem is particularly acute for buried piping lines including under buildings and equipment
- Three main components to the issue:

1. Assessing the health of existing piping and determining remaining service life
2. Developing methods to repair buried piping in-situ
3. Selection and qualification of better materials and service environments (e.g., HDPE, water treatment, cathodic protection, etc)

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Assessment of the Condition of Buried Pipe

- Physical Access to Exterior of Pipe
  - Where to inspect, how to excavate, how to inspect, and how to properly backfill and cover
- Guided Wave Inspection Technology
  - Signal impressed on pipe; reflected wave provides indication of flaws and wall thickness
  - May be able to inspect a few hundred feet of length
  - Current reality is tens of feet are assessable
  - Many factors need further understanding to address problems with attenuation and noise

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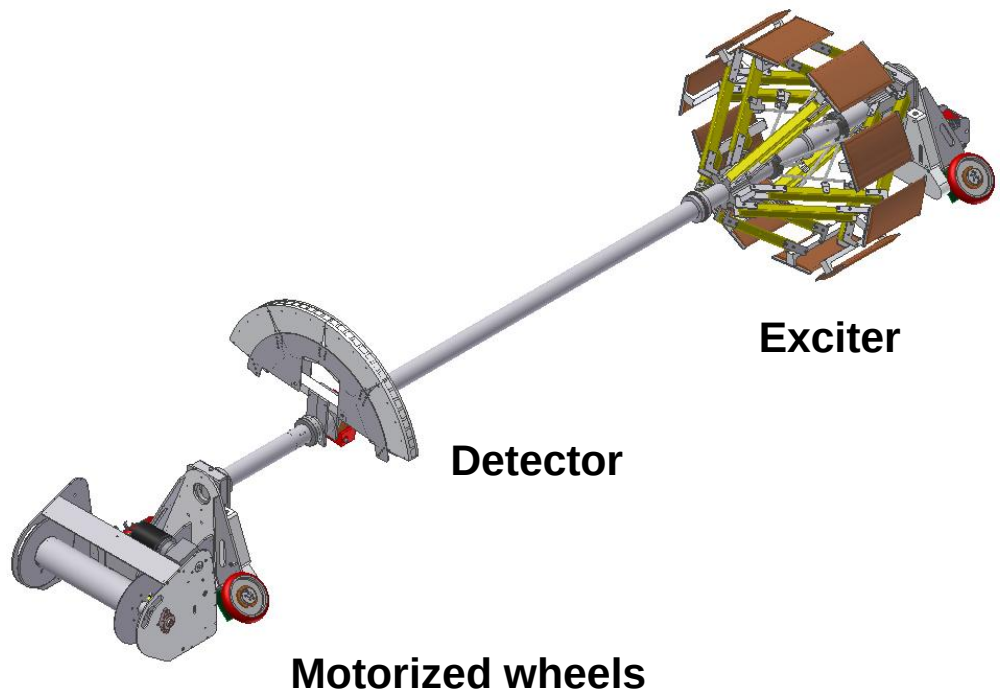
Interior Inspection Techniques

If guided wave inspection identified a problem, in-pipe inspection would be used to further quantify the problem.

Remote Field ET Pipe Inspection Tool



Instrumented Vehicle

Detection of
- External corrosion
- Internal corrosion

Assessment through
- Mud
- Coatings
- Cement or plastic liners

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Repair/Replacement Options

- Repair Types
  - Liners that provide a corrosion barrier (old pipe is pressure boundary) (already in-service)
  - Liners that are strong enough to be the pressure boundary (Yet to be accepted for service)
  - Exterior joint repairs strong enough to be the pressure boundary (Yet to be accepted for service)
- Replacement in Kind (concrete or carbon steel)
  - Essentially gives the same expected life as replaced pipe (20 to 40 years)
- Replacement with High Density Polyethylene or exotic metals (6% moly SS or titanium): Promise of very long life

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Research Activities for Buried Piping

- **Technology for Condition Assessment of Buried Piping**
  - Technology to inspect large-diameter piping with high resolution (36” $\leq$ D $\leq$ 12’)
  - Technology to inspect intermediate diameter piping (12” $\leq$ D $\leq$ 36”)
  - Technology to inspect medium-diameter piping without draining the pipe
- **Qualification of High-Density Polyethylene for ASME Class 3 Piping**
  - Testing to determine engineering and materials properties needed for general plant design
  - Support of Code Case N-755 through regulatory review

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Research Activities for Buried Piping (continued)

- **Repair of Buried ASME Class 3 Piping In-Situ**
  - Testing to determine engineering properties of cured in-place piping (CIPP) needed for general plant design
  - Support of Code Case N-589-3 (use of CIPP for ASME Class 3 piping) through ASME and regulatory review
  - Qualification of other types of non-metallic repairs (e.g., sprayed resins, wraps, etc) for partial restoration of degraded pipe
- **Degradation of Concrete Pipe**
  - Identification of degradation mechanisms and projects to resolve the issues – each type of concrete pipe had different failure mechanisms with different assessment needs and cures
- **Optimization of Service Environments**
  - Optimization of cathodic protection

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Research Activities for Buried Piping (continued)

- Exterior Inspection of Piping - Overall research on how to implement inspections
- Improvement of Guided Wave Inspection Techniques
  - Full understanding of causes of attenuation and means of improvement of signal to allow longer pipe lengths to be inspected
- Evaluation of need for coatings/linings and wrapping on exotic metals to assure the availability of alternate technology to HDPE

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Questions?

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