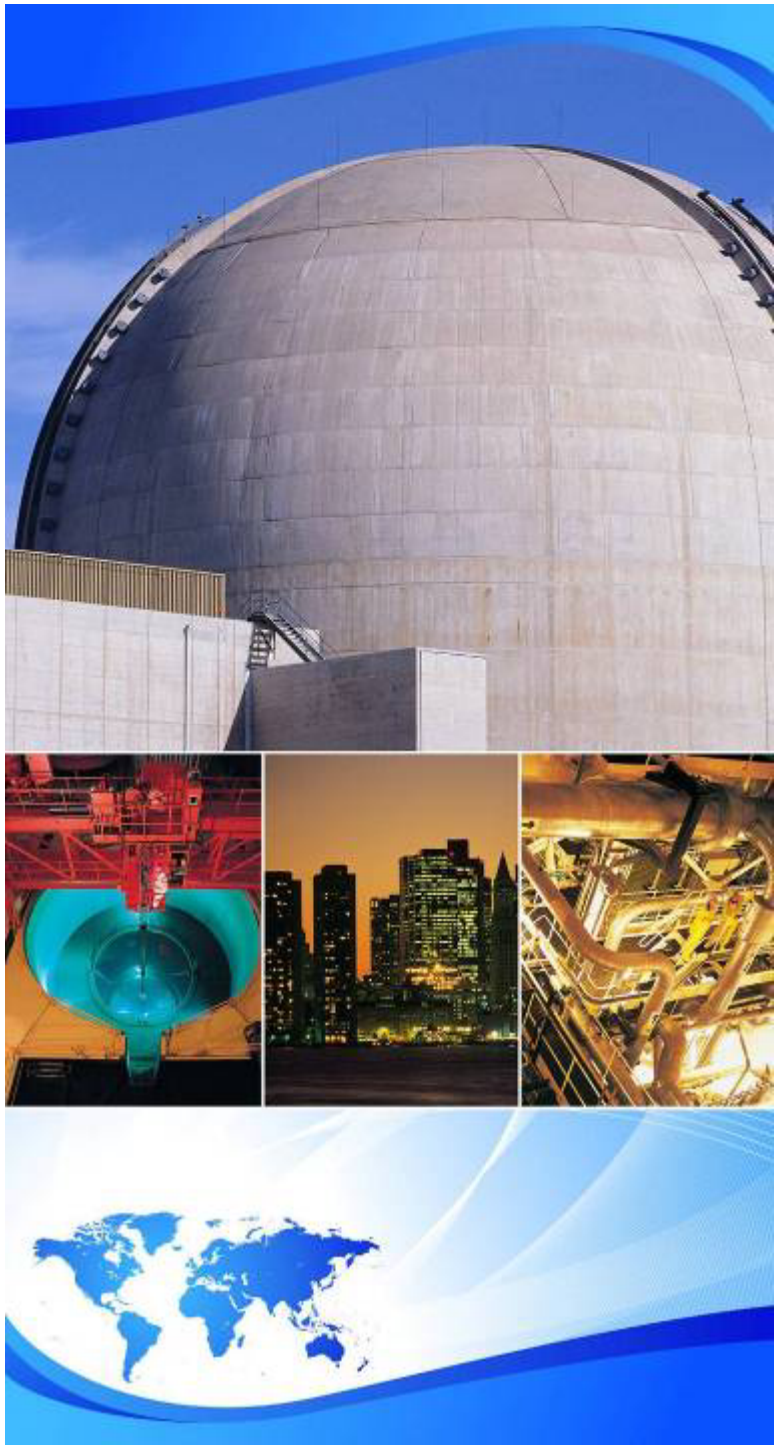

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An Overview of the EPRI/BPIG Recommended Program for Buried Piping

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Industry/NRC Meeting on Buried Pipe
October 22, 2009 White Flint, MD

Introduction

- The EPRI/BPIG recommended program

> "Recommendations for an Effective Program to Control the Degradation of Buried Pipe", Dec 2008 – Report # 1016456

Document placed in Public Domain

–Industry consensus document

–Periodic updates (update in progress)

- Guidance for concrete pipe
- Industry feedback from use

Objectives of Document

Recommend program elements supporting:

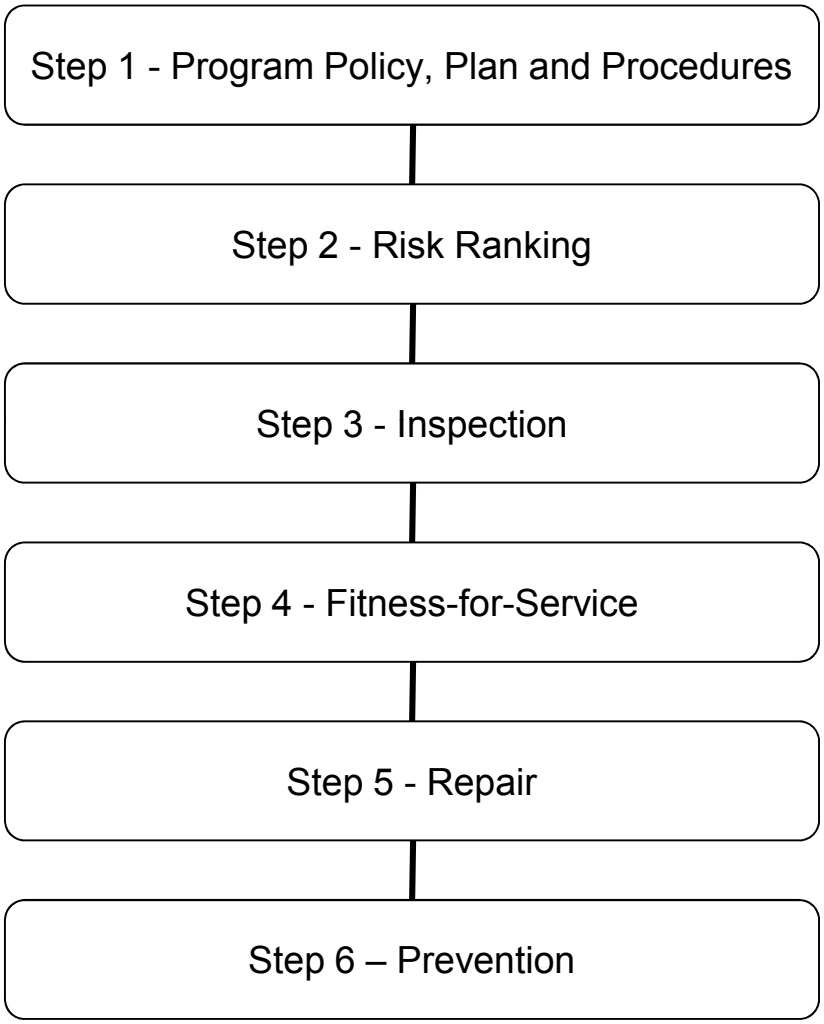
- Safe and reliable operation of buried piping systems
- A best practices/ industry consensus approach

Basis

- Body of knowledge from
  - Oil and gas pipelines
  - Waterworks
  - Process plants
  - Power plants

NACE – API – PRCI – ASTM – ASME – AWWA – EPRI

Six-Step Program



Step 1 – Program Policy, Plan & Procedures

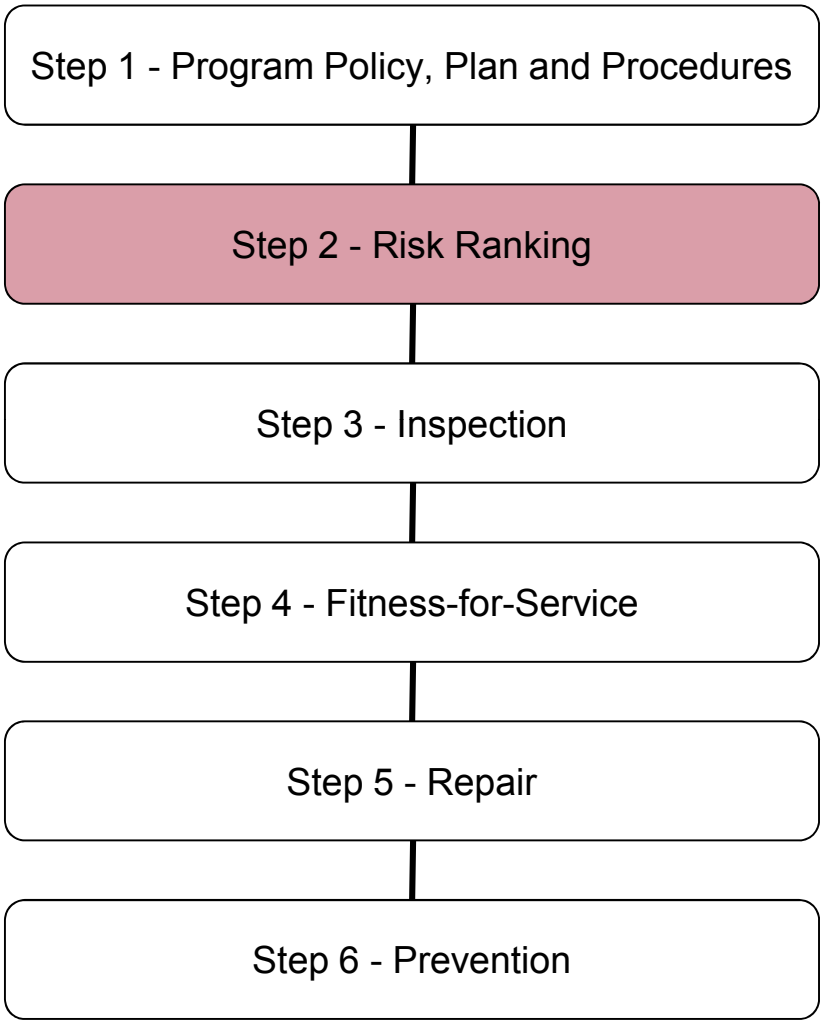
1. Procedures and Oversight

- ***Scope***
  - Both safety and non-safety
  - Piping designed to B31.1, B31.7, AWWA, Section III, and NFPA Codes
  - Metallic (ferrous and non-ferrous)
    - Intend to add concrete pipe in 2009
  - Liquids, gases, and vapors
- Recommendations apply to both ID and OD initiated degradation
  - Can exclude ID if covered in another program

1. Procedures and Oversight (continued)

- ***Policies and Procedures.*** A Buried Pipe Integrity Program Plan and implementing procedures should be developed.
- ***Program Database.*** A database should be developed to track key program data and performance indicators.
  - Other related data such as CP and coating surveys to be documented
- ***Performance Indicators*****.** System or program health reports and performance indicators should be developed for the Buried Pipe Integrity Program.

Step 2 - Risk Ranking



2. Risk Ranking (continued)

- Risk Ranking
  - Prioritize the selection of inspection locations.
  - Series of matrices that correlates
    - the likelihood of failure against the consequences of failure.

	No Consequence	Low Consequence	Medium Consequence	High Consequence
High Likelihood				
Medium Likelihood				
Low Likelihood				

2. Risk Ranking (continued)

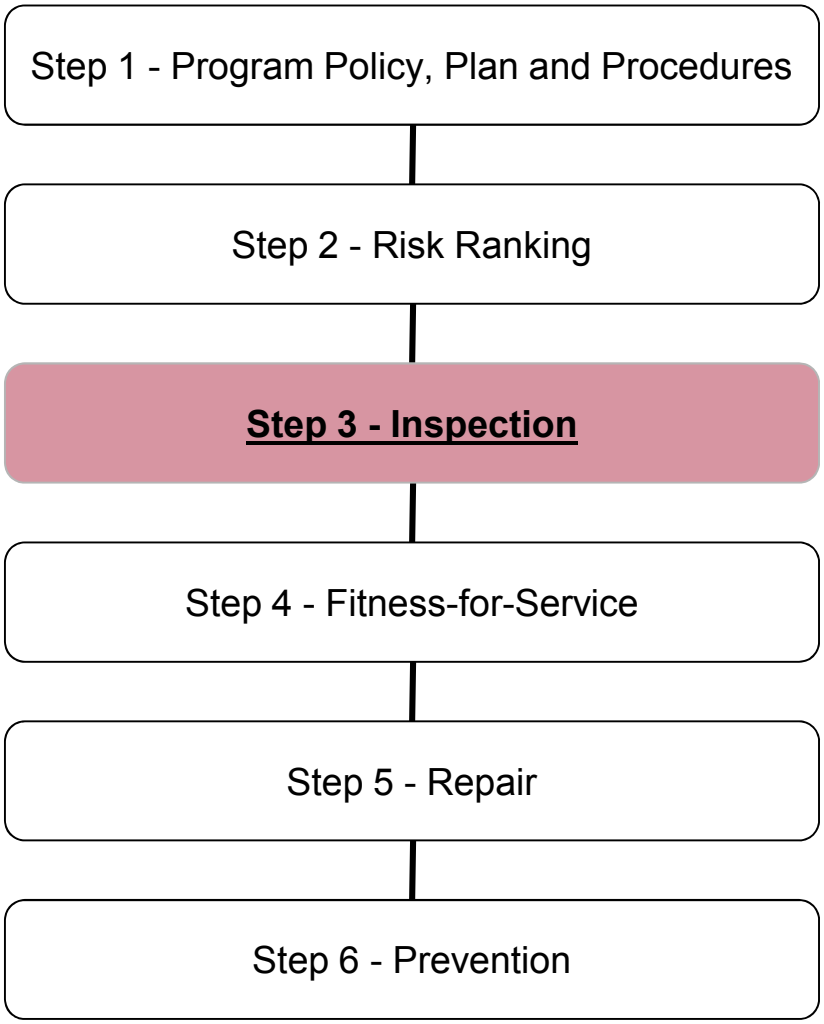
The steps involved in Risk Ranking include:

- ***Developing Scope Drawings***
- ***Route Confirmation***
- ***Scope Exclusions***
- ***Data Collection***
- ***Definition of Segments***
- ***Soil Analysis***
- ***Cathodic Protection Check***
- ***Over-the-Line Surveys***
- ***The Likelihood of Leak***.
- ***The Likelihood of Break***
- ***Failure Modes***

2. Risk Ranking (continued)

- Segment risk is maximum of:
  - Likelihood of ID or OD leak, break, or occlusion versus consequences of occurrence of the failure mode
- The risk ranking should be periodically reviewed and updated as necessary.

Step 3 - Inspection



3. Inspections (continued)

- Inspections
  - Should be performed at the piping locations that have the highest risk
  - Access and cost may be considered when rankings equal
- 4 means of direct pipe inspection:
  - Entry or excavation
  - In-line inspection
  - Corrosion monitoring
  - Hydrotest
- Selection of the appropriate inspection method is left to the Owner

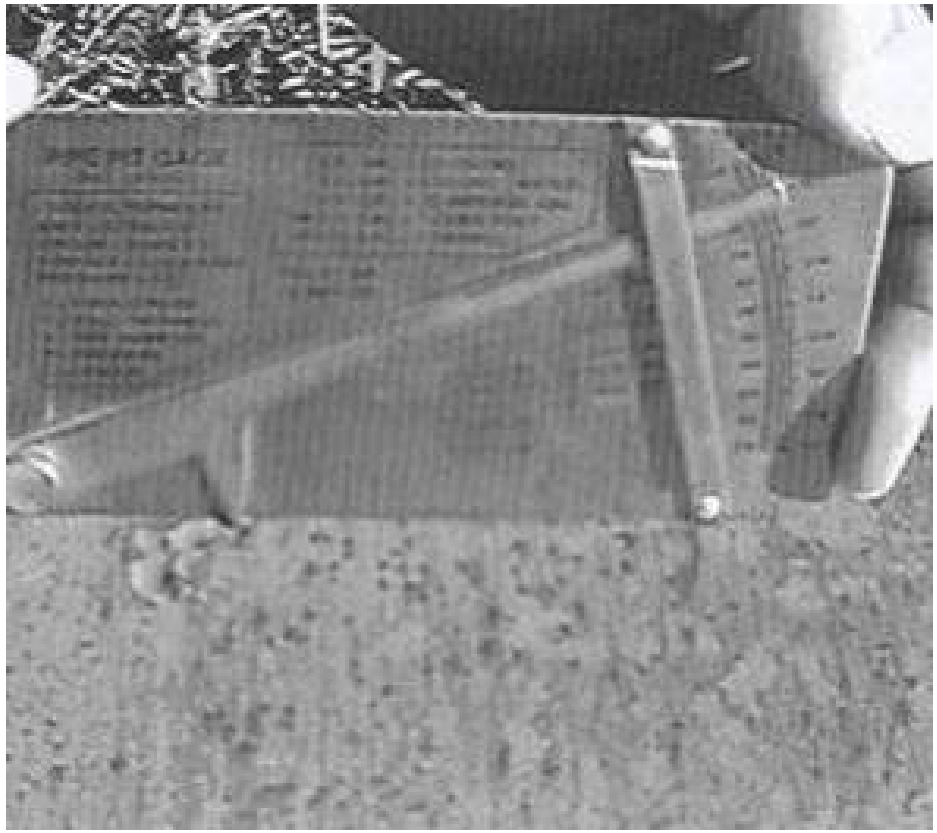
3. Inspections (continued)

Entry or Excavation

- High risk segments can be uncovered to survey the condition of the pipe and coating

3. Inspections (continued)

Surface visual examinations can be performed to characterize pitting or cracking



Pitt Measurements

3. Inspections (continued)

- **Volumetric examinations** can provide wall thickness for FFS assessment
  - Classic UT scan
  - On-line UT

3. Inspections (continued)

In-line inspections of ID

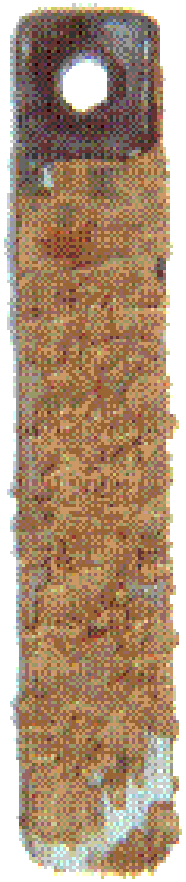
- Borescope
- Robotics (source: RS Technical Services)
- Direct access

3. Inspections (continued)

- **Intelligent pigs** can be used to inspect high-risk segments
  - MFL pig
  - UT pig
  - Caliper pig
  - Tethered pig
- Challenges
  - Access openings
  - Pipe size changes
  - Bends
  - Valves
  - Cleanliness

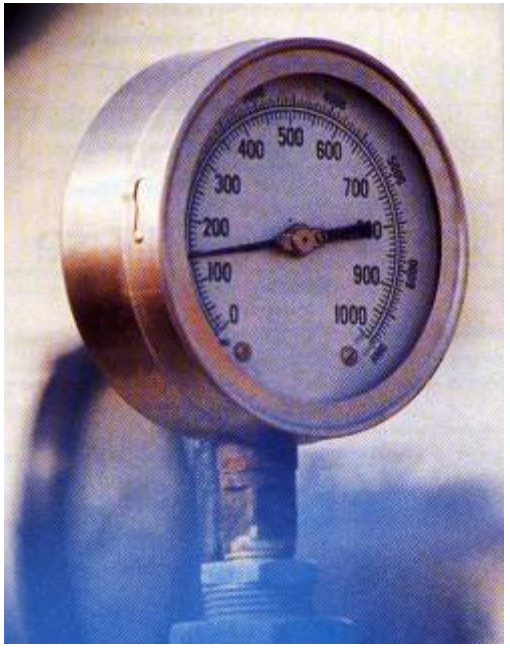
3. Inspections (continued)

- **Corrosion monitoring** using corrosion coupons or probes can be considered for high-risk (ID corrosion) segments
  - Corrosion coupon
  - ER probe

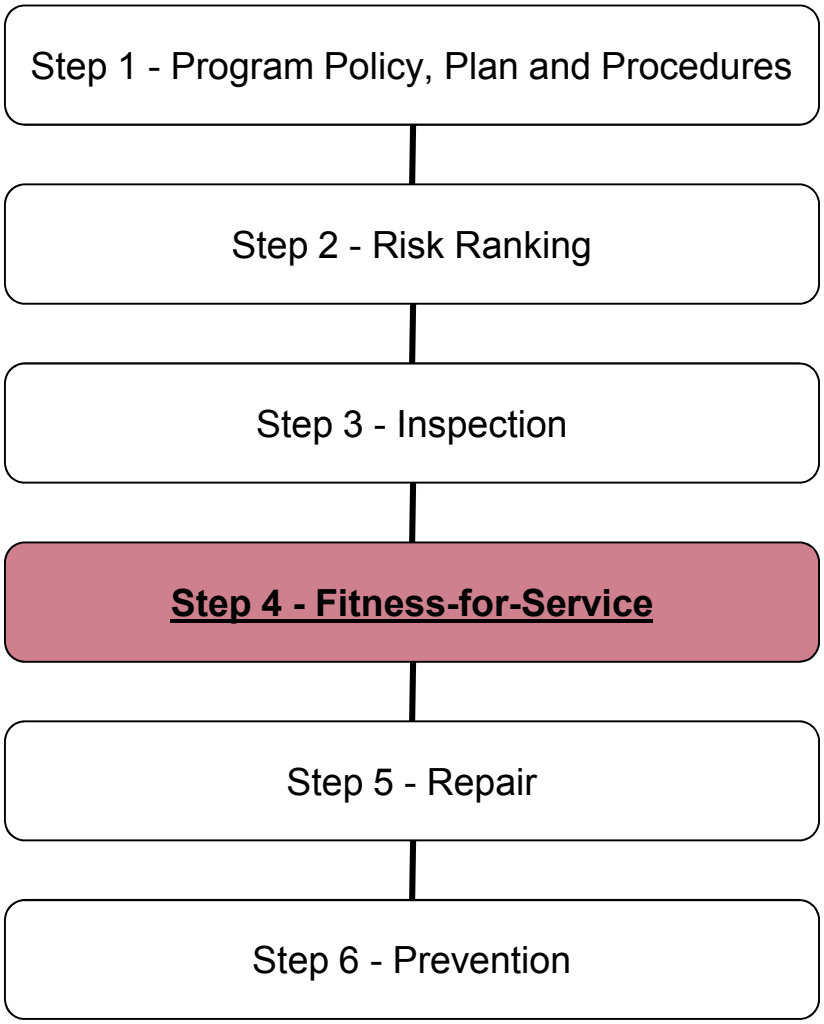


3. Inspections (continued)

- For high-risk (rupture likelihood segments) hydrotest is an option when the line is out-of-service. The test should be at anticipated pressure-transient pressure
  - Can back-calculate maximum flaw/pit geometries upon successful hydro
  - ASME B31G



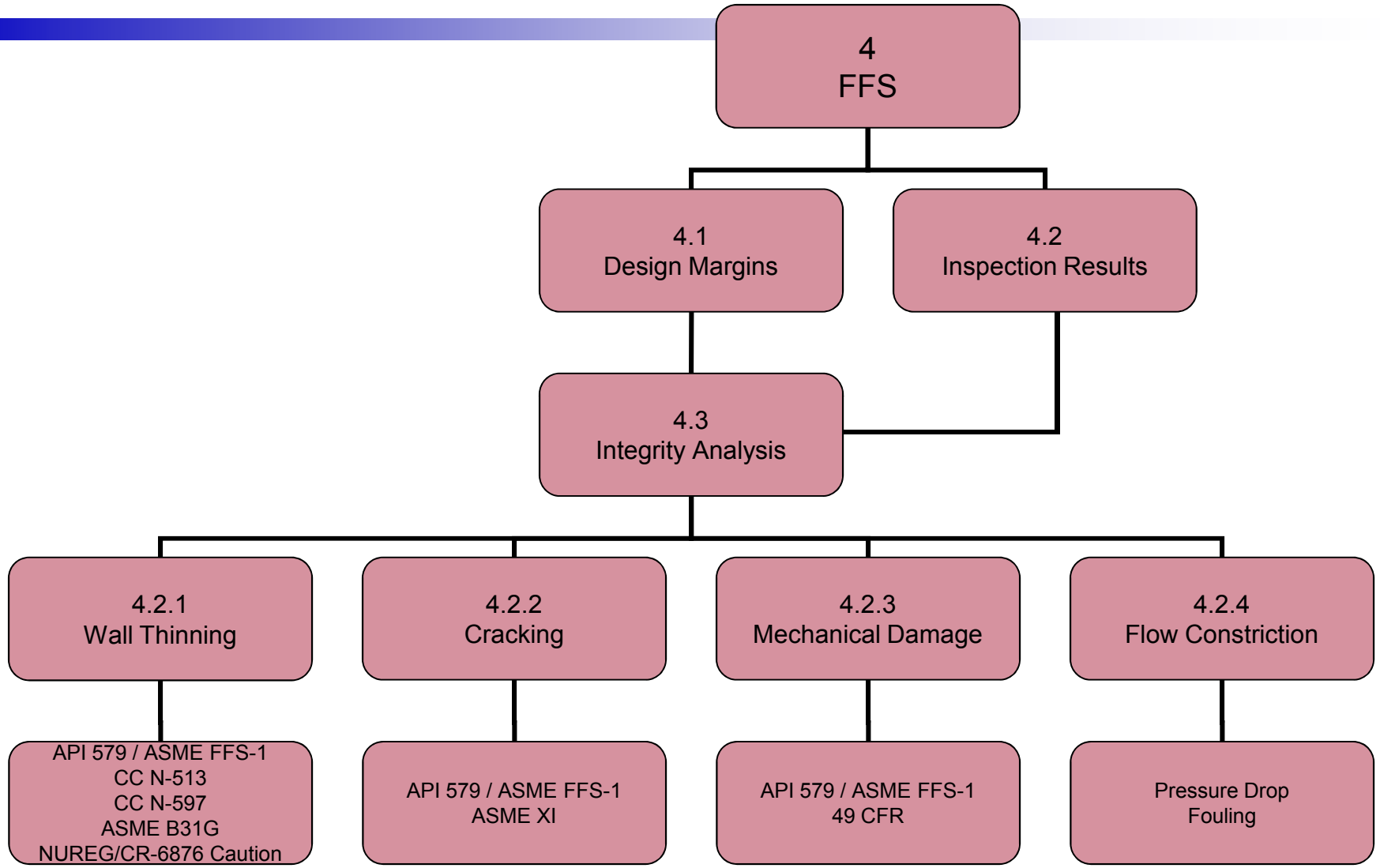
Step 4 – Fitness-for-Service



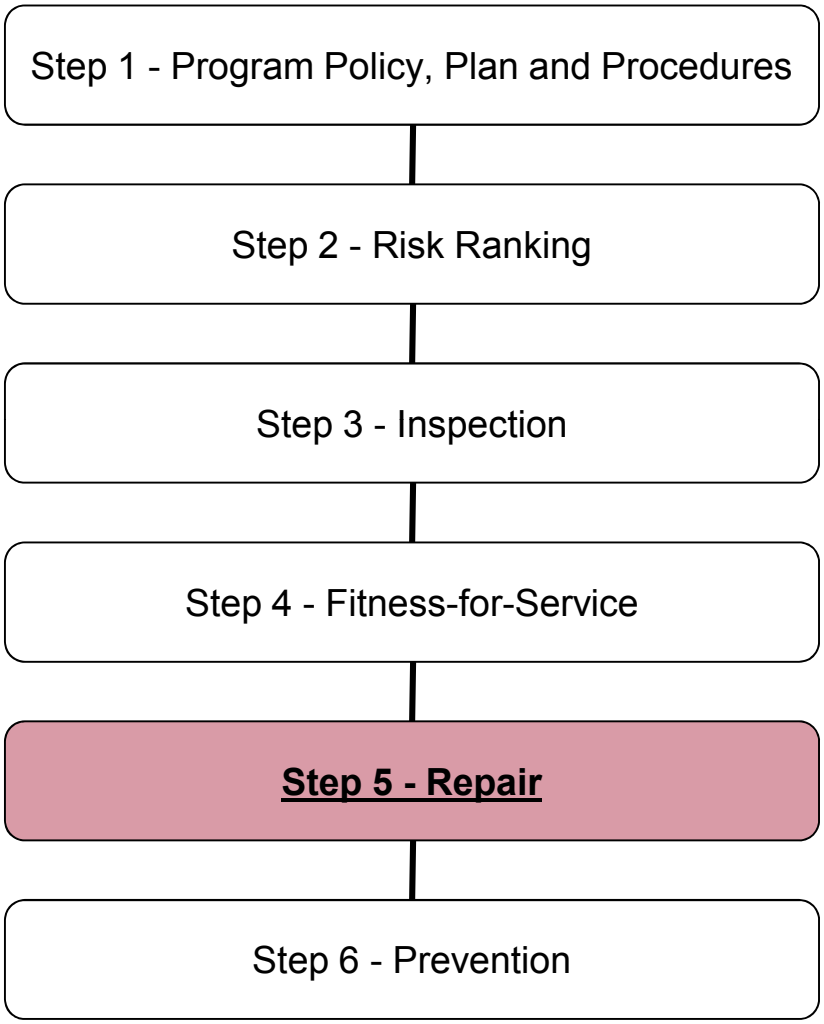
4. Fitness-for-Service (continued)

- ***Design Analysis***: The integrity assessment should be based on the design analysis of the buried piping system.
  - The analysis should be regenerated if it cannot be retrieved. Loads to consider include:
- ***Minimum Code Requirement***
- ***Inspection Data***
- ***Run/Repair decision***
- ***Feedback to Risk Ranking***

Step 4 – Fitness-for-Service (continued)



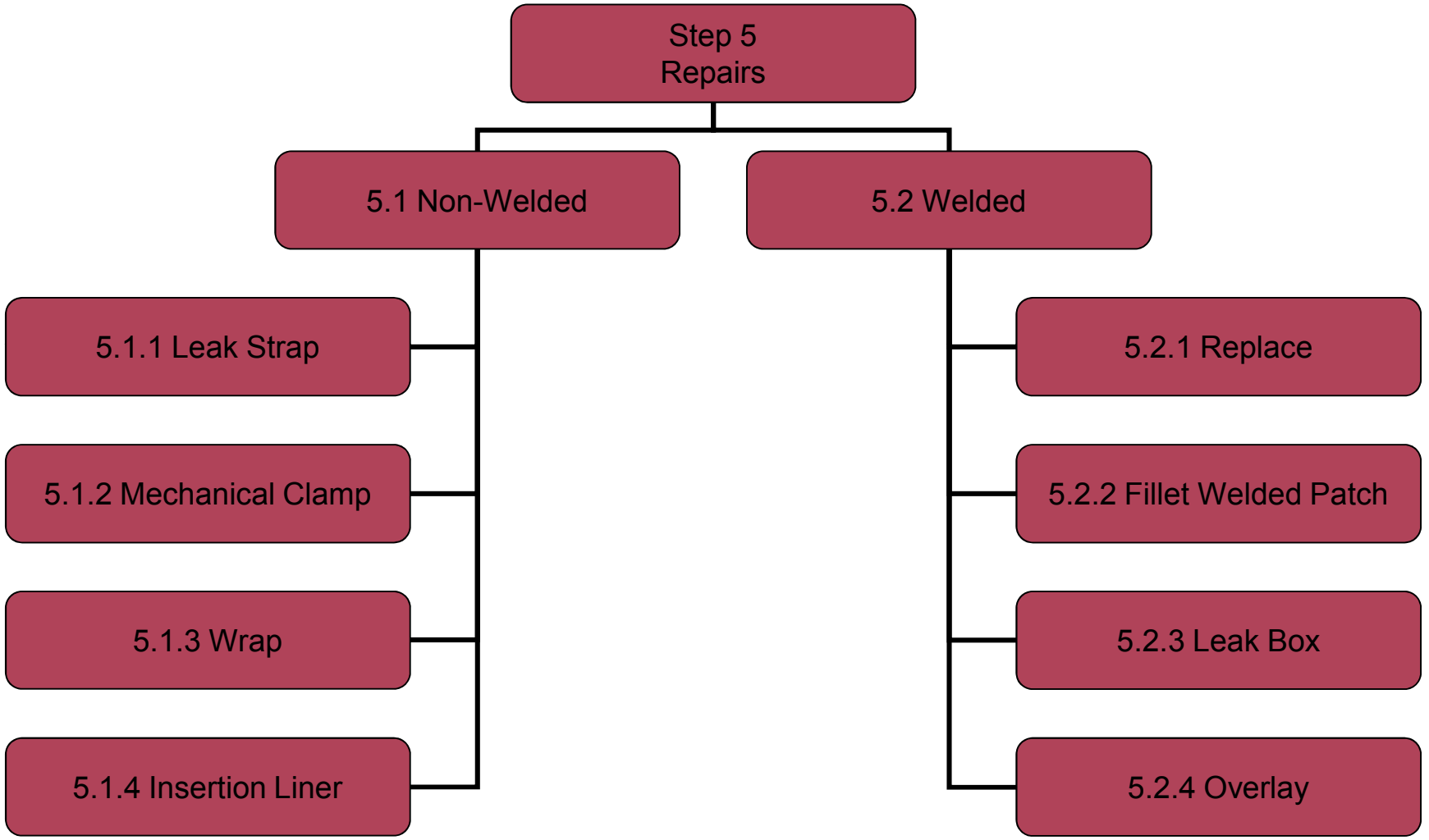
Six-Step Program



5. Repairs (continued)

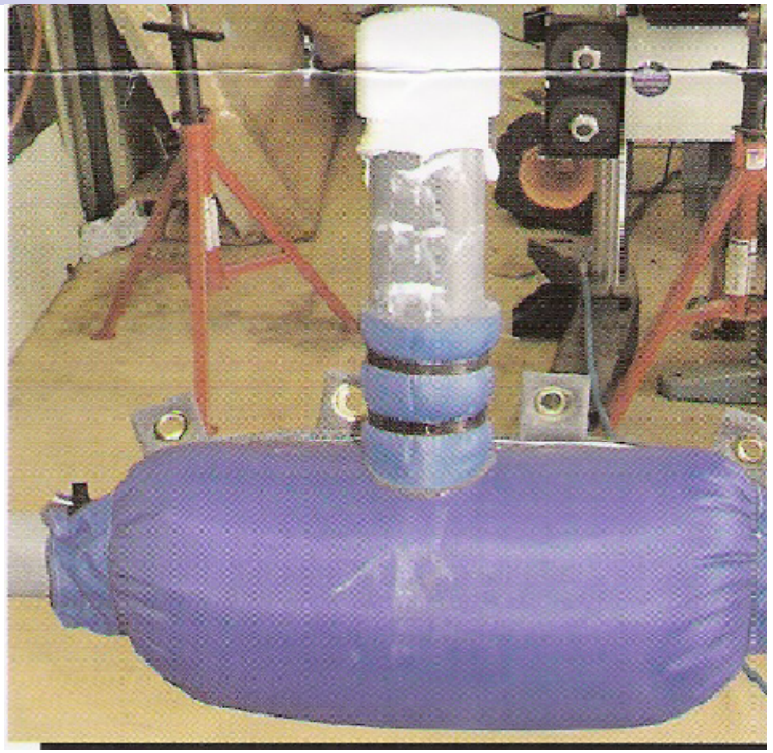
- ***Pre-Approved Repair Options*** should be in place for prompt implementation in case a buried pipe fails. The detailed design of the selected repair should accommodate the specifics of the failure.
- ***Leak Detection and Isolation*** techniques and options should be pre-selected for prompt implementation should a leak occur.

5. Repair Techniques (continued)



5. Non-Welded Repairs - Clamps

5. Non-Welded Repairs - Wraps



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5. Non-Welded Repairs - Liners

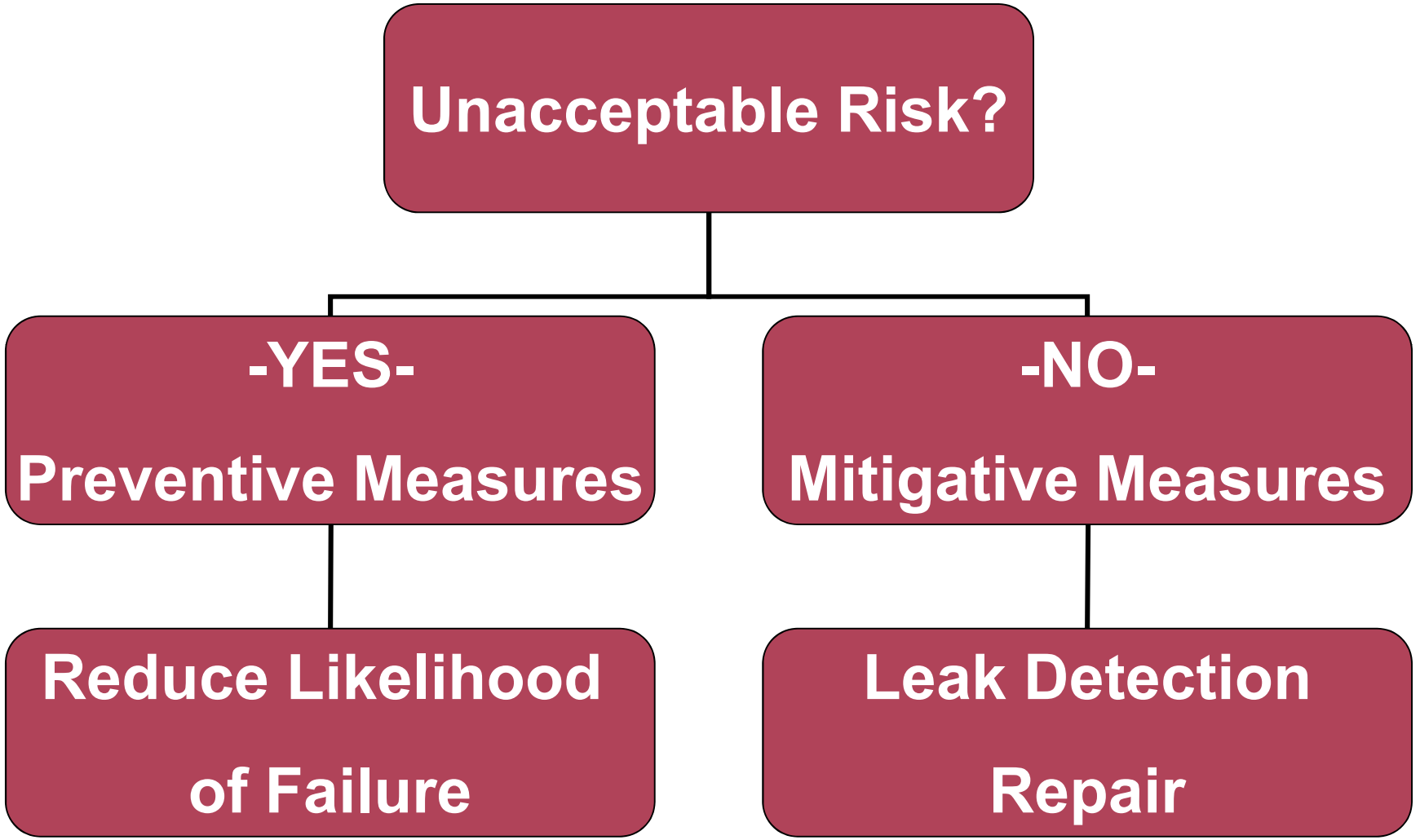
5. Welded Repairs

Fillet-Welded Patch

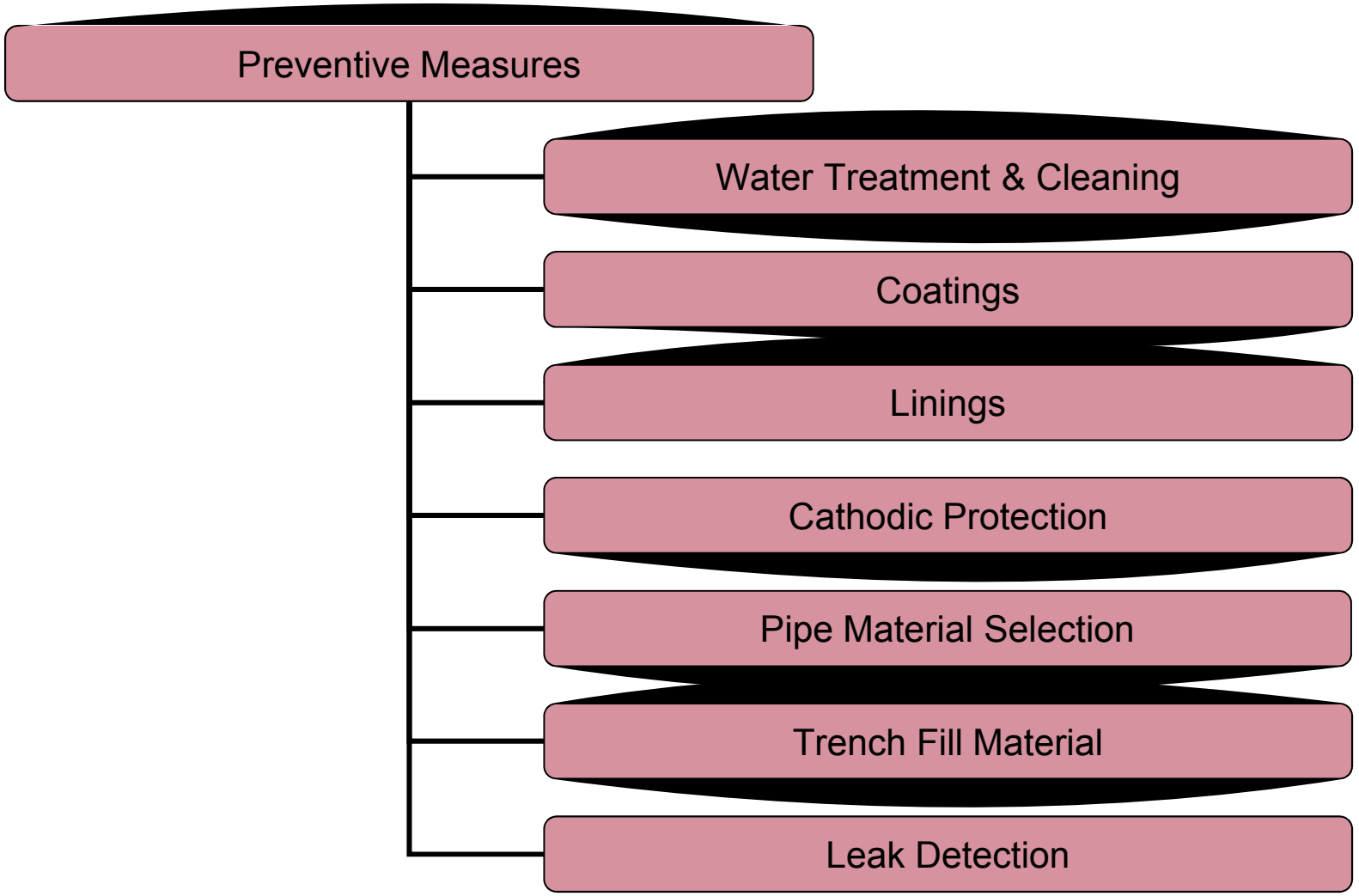
Welded Leak Box

Step 6 – Prevention and Mitigation

Prevention and Mitigation



6. Prevention and Mitigation (continued)



6. Prevention and Mitigation (continued)

- Resistant materials can virtually eliminate susceptibility

Use of High Density Polyethylene

EPRI's Survey on Buried Pipe Programs

- July 2009 Informational Survey
  - Roughly gauge industry's implementation of BP programs
- Survey asked questions such as:
  - Number of operating units that have begun implementing a Buried Pipe Integrity Program (BPIP)
  - Has Corporate document governing BPIP been issued?
  - Have Site-Specific document(s) governing BPIP been issued?
  - Number of operating units that have BPIP program basis document and database.

EPRI's Survey on Buried Pipe Programs

- Survey questions (continued)
  - Has Guided Wave (GW) been performed on high risk areas, as determined by BPIP database?
  - What actions have been employed as a result of information gained from your BPIP (such as cathodic protection, alternative material used for replacement, permanent monitoring techniques, etc.)?
  - Have you excavated buried piping for the sole purpose of performing inspections?

EPRI's Survey on Buried Pipe Programs

- Survey Results
  - Over 90% of units have begun implementing a Buried Pipe Integrity Program (BPIP)
  - 24 of 27 responding utilities have issued BPIP procedures
  - 14 of 27 utilities have performed GW on high risk piping
  - 8 of 27 utilities have excavated solely for pipe inspection

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