

Mitigation and Repair

R&D Forum

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Strategic Objectives

1. Develop programs to maintain integrity

- Reduce Corrosion Maintenance costs
- Improve ILI tools

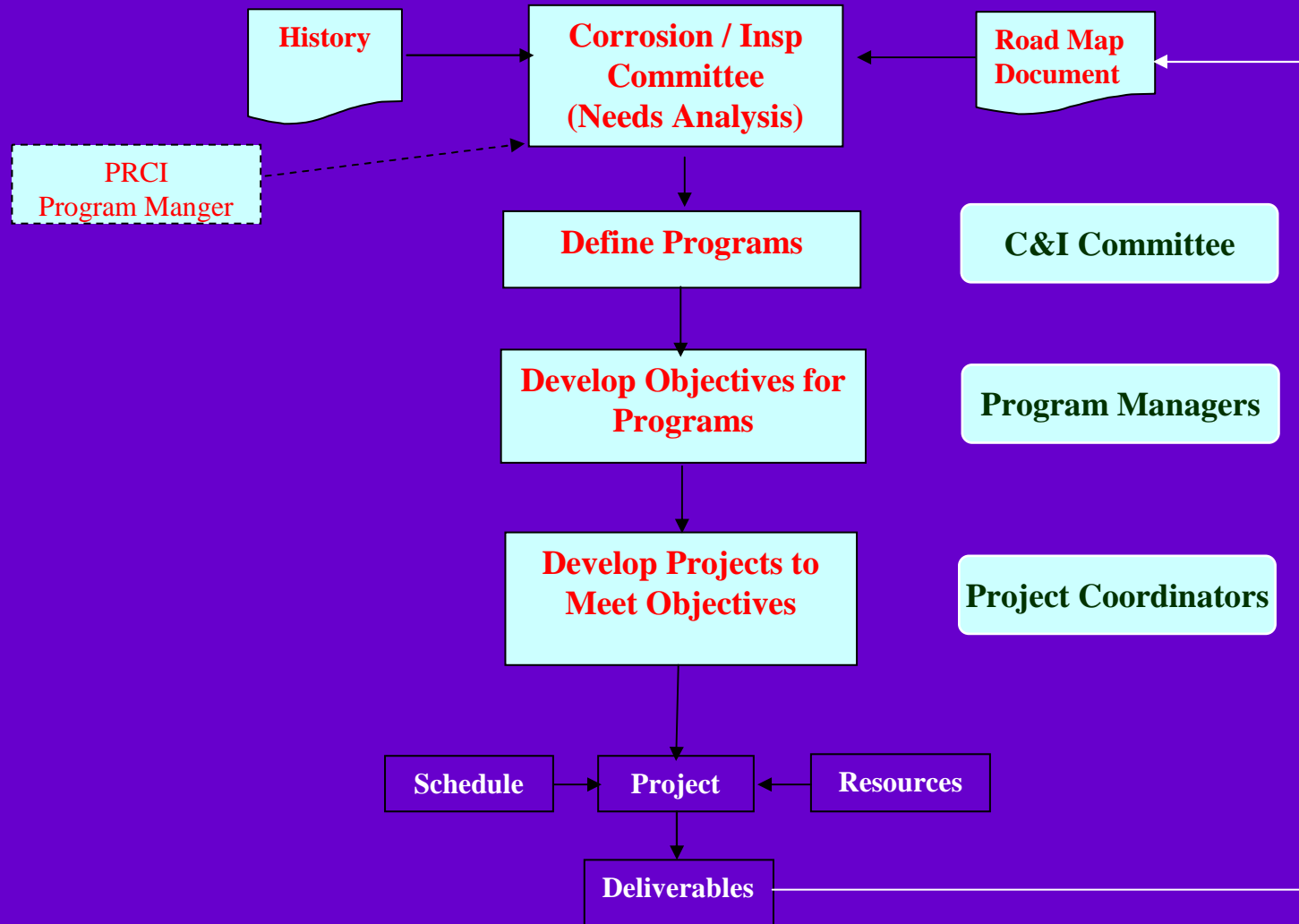
2. Develop programs to influence regulatory requirements associated with safety & integrity

- Support integrity and **Direct Assessment** initiatives

3. Develop programs to reduce capital costs of new pipelines

- Improve Corrosion Control Systems

The Process



The Road Map

- Program Name
- Program Description
- Background
 - History of previous projects

- Objectives
- Projects
- Deliverables
- Schedule / Cost

Program Name	2004	Co-Funding	2005
Locate Mechanical Damage	586	865	250
Enhance Integrity of Non Piggable Pipelines	1220	500	355
Protecting Shielded Pipe & Enhance Corrosivity Models	356	450	100
Manage Internal Corrosion – Monitoring and Mitigation	545	980	200
Optimize Integrity Assessment Intervals	175	0	0
Managing SCC	415	0	65
Improve CP Effectiveness	390	265	150
Total	3696	3060	1120

Integrity of Non-piggable Pipelines

- **Description:**
 - Develop inspection technologies and procedures that enable the use of alternative methods of integrity assessment for non-piggable pipelines.



Protecting Shielded Pipe & Enhance Corrosivity Models

- **Description:**

- Develop protocols to detect and mitigate corrosion at areas shielded from CP using above ground techniques. Develop soils models and measurement techniques for mitigating external corrosion.



Protecting Shielded Pipe & Enhance Corrosivity Models

2003 Highlights:

- **Identify pipeline sections susceptible to shielding**
 - Susceptible coating systems
 - Environmental factors
 - Differentiate poor bond from shielding

- **Determine corrosion activity**

- **Develop mitigation protocol**

Protecting Shielded Pipe & Enhance Corrosivity Models

- Determine effects of soil type on corrosion
- Determine the role of soil type on the deterioration of coatings
 - Permafrost
 - MIC
- Develop new method for monitoring corrosion

Identify and Prioritize Locations for Internal Corrosion Inspection, Monitoring and Mitigation

■ Description:

Reduce the internal corrosion management costs of essentially dry gas (< 7 #/ MMSCFD) systems subjected to occasional upsets in gas quality by targeting the locations most susceptible to corrosion for inspection and monitoring, improving the effectiveness of mitigation methods, and prioritizing lines for maintenance activities.



Identify and Prioritize Locations for Internal Corrosion Inspection, Monitoring and Mitigation

2003 Highlights:

- Corrosive and inhibitive properties of condensates
- Internal Corrosion Direct Assessment –DOT/RSPA
- Guidelines and quality standards for transportation of gas

Identify and Prioritize Locations for Internal Corrosion Inspection, Monitoring and Mitigation

2004 Highlights

- **Pipeline Drip Corrosion Mitigation**
- **MIC Test Method**
- **Fluidized Sensors (RFID)**
- **Effect of Solids & Bio-film on Dew Point**
- **Microbial Ecology Survey (DNA)**

Optimize Integrity Assessment Intervals

- **Description:**

Establish a sound technical basis for establishing integrity assessment intervals for internal and external corrosion.



Optimize Integrity Assessment Intervals

2003 Highlights:

- **Develop a statistical basis for re-inspection intervals**
 - Coating systems susceptible to disbonding
 - Environmental factors
 - Differentiate poor bond from shielding

- **Establish the largest defect left after inspection**

- **Develop methods for integrating various assessment methods**

Improve CP System Effectiveness

- **Description:**

The focus of this work will be in two main areas:

- 1) Performance monitoring
- 2) Pipeline protection in high resistivity soils



Improve CP System Effectiveness

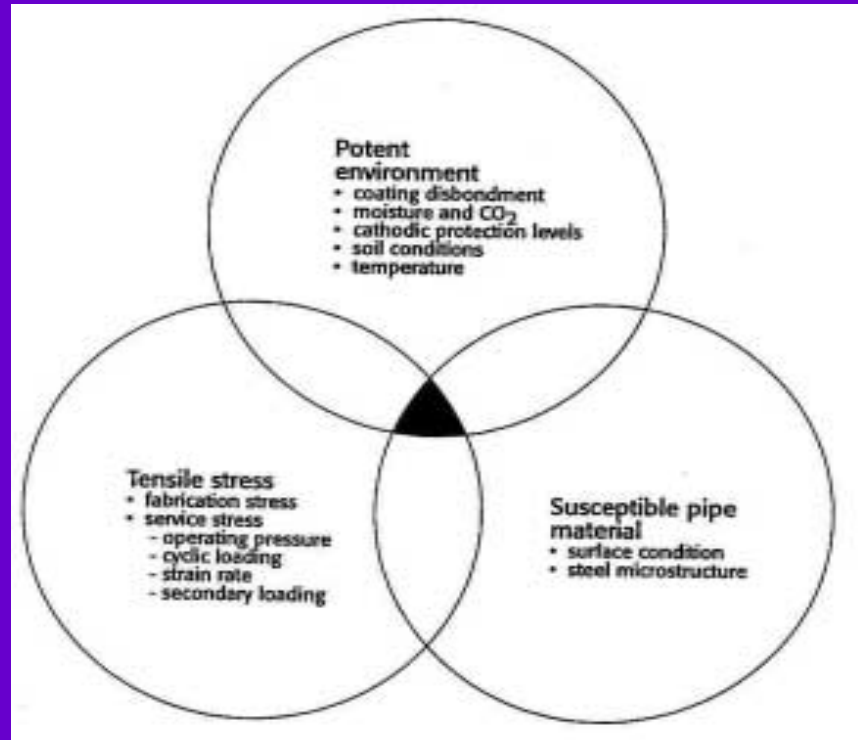
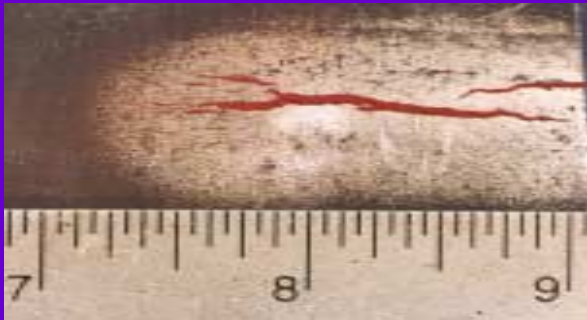
2003 Highlights:

- **Develop improved permanent reference electrode**
- **Establish conditions influencing AC corrosion**
- **Characterize coating performance as a function of surface prep**
- **Effects of telluric currents on CP systems and pipelines**

Managing SCC

■ Description:

Reduce the cost and increase the effectiveness of SCC management including understanding the role of the local environment for high-pH and near-neutral-pH SCC

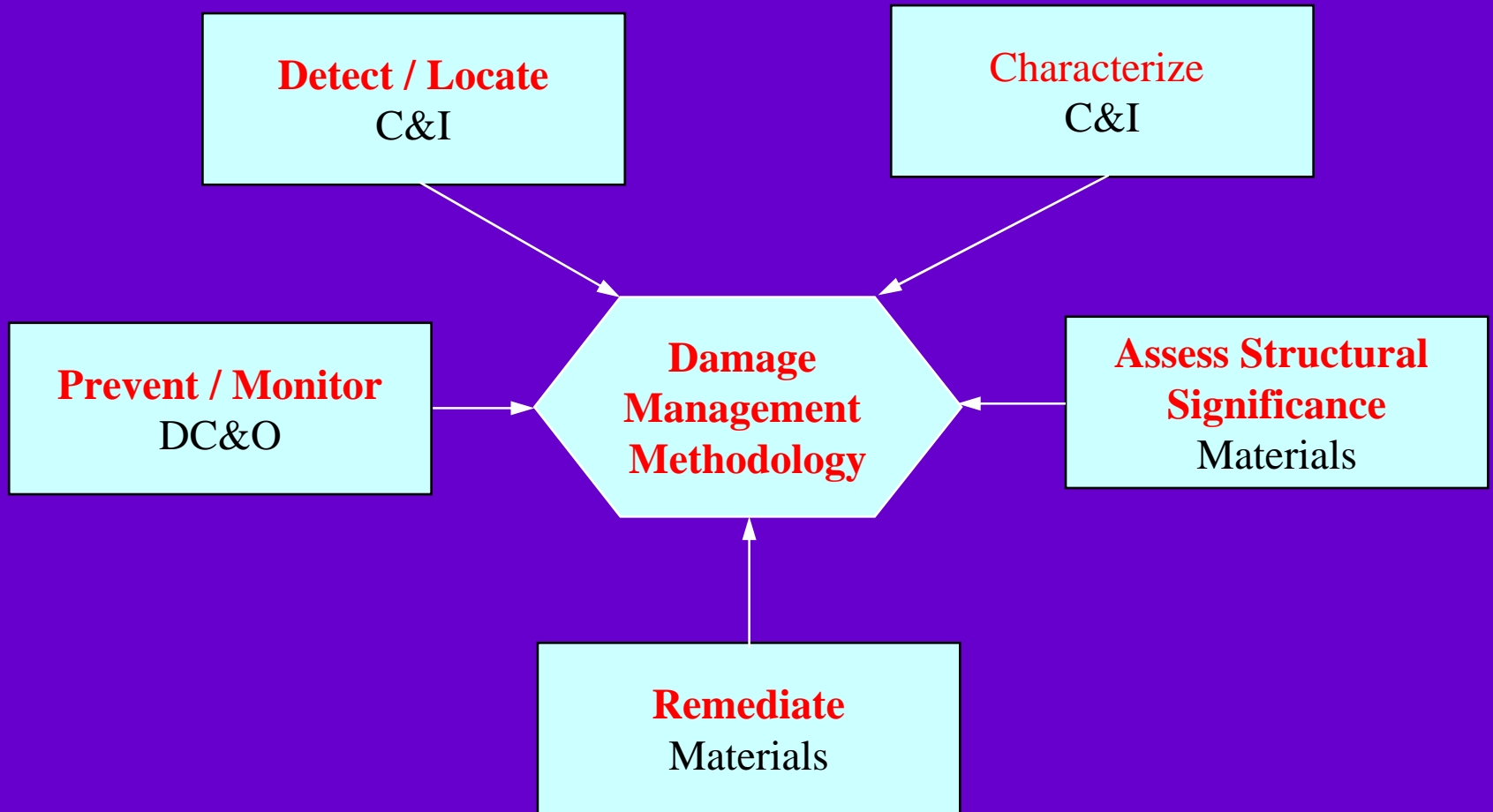


Managing SCC

2003 Highlights

- **Mechanism of Organic Soil Inhibition of SCC**
- **Direct Assessment Development Support**
- **Non-Traditional Methods for Detecting Cracks**
- **Gas Coupled UT (SwRI)**
- **Circumferential MFL Capability of Detecting SCC**
- **Increase Number of Wheel Sensors, different coupling methods, PII CDUT Density**

Locate Mechanical Damage



Gaps / Additional Research Needs

- SCC mitigation methods
 - The effect of soils
 - The effect of pipeline operating conditions
- Methods for preventing corrosion under disbonded coating
- Above ground detection methods for disbonding

Summary

- Various Programs Which Address Operators and Regulators Concerns
- Consensus Process
- Broad Spectrum of Input by Researchers, Gas Pipelines, Liquids Pipelines and Regulators
- Road Map to Ensure Focus