



# Internal Repair of Pipelines

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National Energy Technology Laboratory

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Morgantown, WV

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Project Director

EWI

# Background

- It is predicted that natural gas consumption in the US will increase by more than 50% over the next decade
- In addition, new federal regulations will require pipeline operators to place increased emphasis on pipeline integrity management.
- The demands for increased throughput and pipeline integrity will place increased demands on the existing pipeline system and require the development of new and improved repair technology.

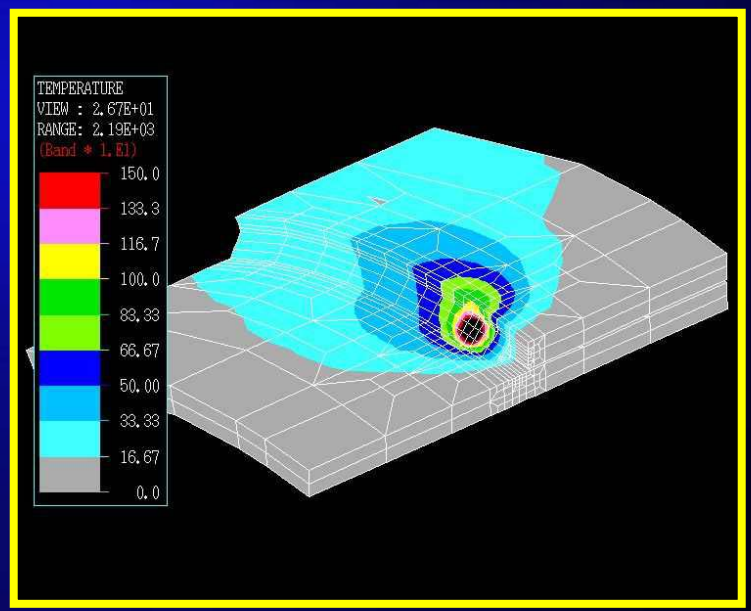
# Background Continued

- The standard method of repairing a pipeline is to excavate the damaged area to permit access and repair the damage by:
  - Cutting out the damaged section and adding a replacement section
  - Adding a full encirclement sleeve or clock spring
  - Welding directly onto the pipeline
- The latter two repair techniques can be undertaken whilst the line remains in service.

# Pipeline Repair

- In-Service Pipeline Repair
  - Full Encirclement Sleeves

In-Service Welding

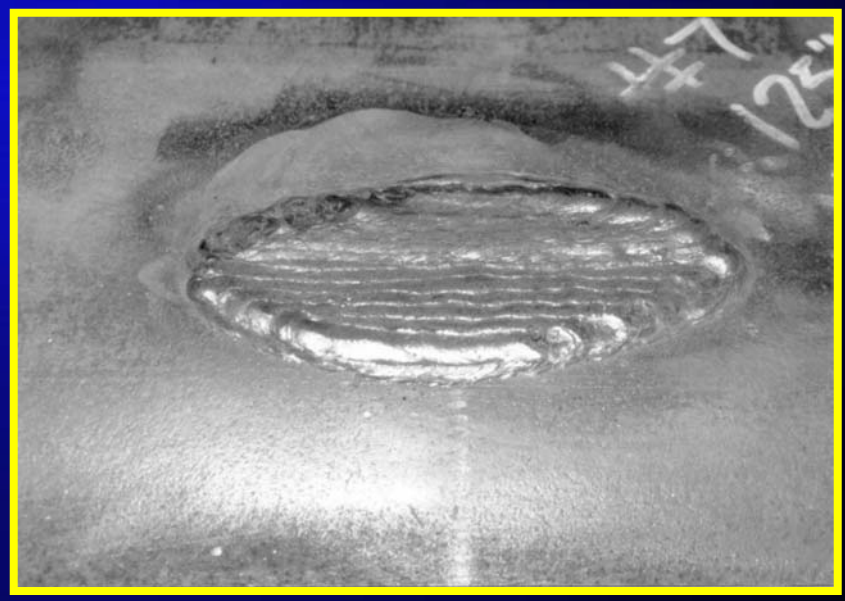



FEA Thermal Analysis

# Pipeline Repair

- In-Service Pipeline Repair
  - Direct Weld Deposition

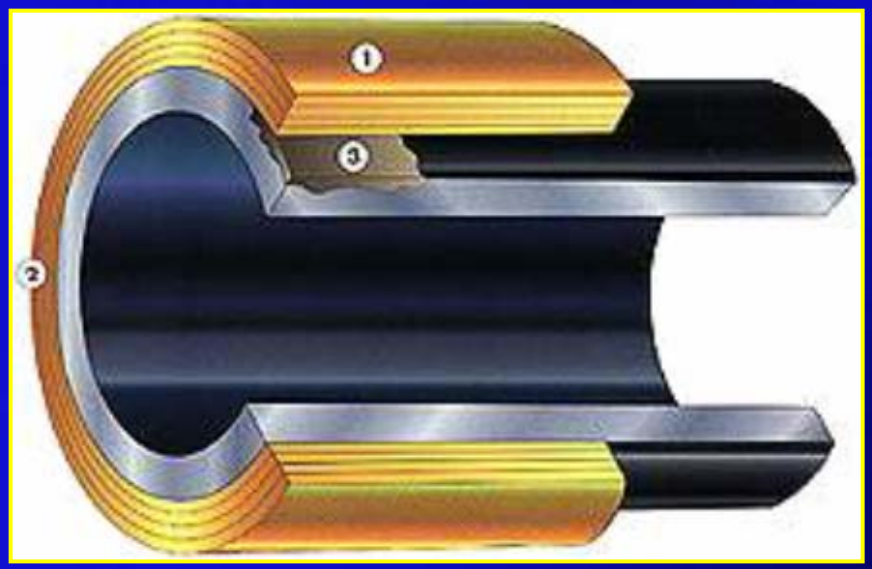

In-Service Welding



Completed Weld

# Pipeline Repair

- In-Service Pipeline Repair
  - Clockspring Repair




Cross-Section

Clock Spring Installation

# Background Continued

- Whilst standard repair technology works well in situations where the pipe can be readily excavated, it is not applicable in a number of situations:
  - River or estuary crossings
  - Pipelines running through swampland or similar terrain
  - Sub-sea pipelines
  - Environmentally sensitive and heavily populated urban areas.
- In such cases, an alternative option is to repair the pipeline from the inside (internal repair).

# Project Objectives

- *Evaluate, develop and validate internal repair methods for pipelines*
- *Perform a laboratory demonstration of internal pipeline repair*
- *Develop a functional specification for a combined prototype system to perform internal inspection and repair of pipelines*

# Internal Pipeline Repair Methods

- Weld Repair
  - Arc, Laser, Explosion, Thermite, Hyperbaric……
- Internal Liners
  - Composite Reinforced Plastic, Steel Coil, Shape Memory, ..
- Electro-Deposition
  - Electroless Ni Plating, ……
- Expandable Sleeves
  - Solid Expandable Tubulars, ……
- Surfacing
  - Thermal Spray, Surface H/T, Friction Surfacing, …..

# Benefits

- Enable operators to repair inaccessible pipelines using new innovative internal repair technology.
  - Permit the repair and continued operation of pipelines that may otherwise have to be retired from service.
  - Reduce the possibility of environmental damage.
- In high consequence, densely–populated locations or environmentally sensitive areas, it is estimated that ***Internal Repair*** could reduce pipeline repair costs by as much as 50%.
  - A single “cut out and replace” pipeline repair can cost as much as $1M depending on difficulties and disruptions caused by conventional excavation.

# Detailed Project Workscope

- ***Task 1: Research Management Plan***
  - Develop a detailed project workscope, budget and schedule
- ***Task 2: Technology Status Assessment***
  - Perform a critical technology review to determine the current state-of-the-art of pipeline repair technology.
- ***Task 3: Review Operators Experience & Repair Needs***
  - Survey Pipeline Companies to determine their repair needs and performance requirements for internal pipeline repairs.
- ***Task 4: Evaluate Potential Repair Methods***
  - Evaluate potential repair methods to assess their feasibility and suitability for internal pipeline repair.

# Detailed Project Workscope

- ***Task 5: Optimize and Validate Internal Repair Methods***
  - Optimize feasible repair procedures and verify pipeline performance by full-scale tests.
- ***Task 6: Develop Functional Specification***
  - Develop a functional specification for an internal pipeline repair system. The specification will cover repair and system operating requirements for a prototype system.
- ***Task 7: Demonstrate Internal Pipeline Repair Technology***
  - Perform a laboratory demonstration of the innovative pipeline repair technology.
- ***Task 8: Final Reporting***
  - Prepare detailed final report.

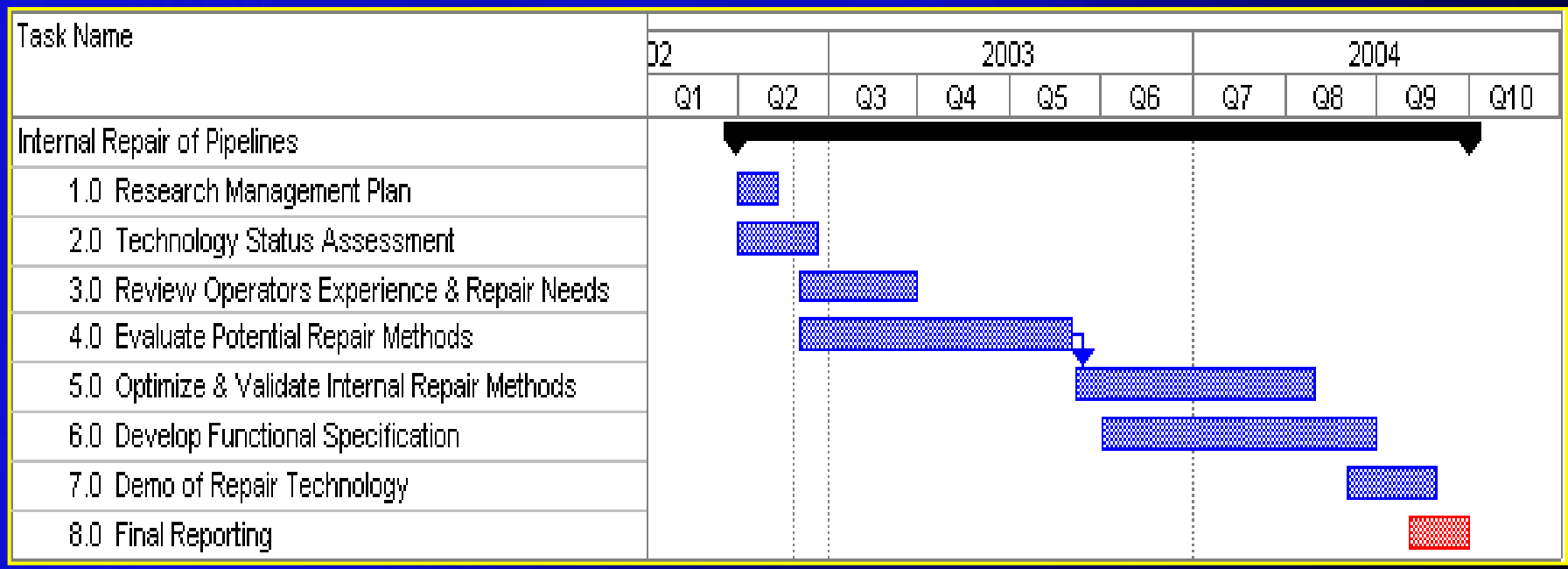
EWI

# Deliverables

- Research Management Plan
- Technology Status Assessment
- Summary of Industry Needs for Internal Repair Technologies
- Review & Evaluation of Technologies
- Full-Scale Validation Test Summary
- Functional Specification for an Innovative Pipeline Repair System

# Project Schedule

## Project Duration : 24 Months



# Budget

| Grant Program, Function or Activity | Funds |
|---|---|
| DOE | $531,751 |
| Cost Match | $225,000 |
| Total | $756,751 |

# Project Team

*Lead Organization*

EWI

Pacific Gas and Electric Company

WE DELIVER ENERGY.

PRCI

Technology for Energy Pipelines

*Subcontractor*

*Advisory & Oversight*

EWI

# Project Team

- **Edison Welding Institute (EWI)**
  - EWI is the largest R&D organization in North America dedicated to Materials Joining Technology. EWI is an internationally recognized leader in the development of in-service pipeline repair technology and laser-based scanning technology for pipeline inspection and assessment.
- **Pacific Gas and Electric (PG&E)**
  - PG&E is one of the largest combined electric and gas utilities in the nation with more than 40,000 miles of natural gas pipeline.
- **Pipeline Research Council International (PRCI)**
  - PRCI is an internationally recognized consortium of 23 pipeline operating companies that funds, plans, manages, and executes pipeline technology development projects.

# Project Cost Share

- The project will benefit from over $300k of direct cost share through parallel R&D projects:
  - A $50k EWI project to evaluate the feasibility of repairing pipelines using composite internal liners.
  - A $50k PRCI project to review operators experience and define repair needs.
  - A $200k PRCI project to develop automated weld procedures to repair pipeline damage by direct deposition.

# Project Cost Share

- In addition the project will benefit from the following experience and indirect cost share:
  - Over $2M of previous work conducted by PG&E to develop an internal pipeline inspection system and evaluate the feasibility of internal repair of pipelines.
  - Over $2M of previous work conducted at EWI to develop and validate in-service repair methods for pipelines.
  - Review and Technical oversight of the PRCI Materials Technical Committee. This technical oversight, including travel to and from the review meetings by PRCI representatives will be provided at no cost to the project.

# PG&E IPNS System

The internal pipeline inspection system provides the capability to size and map internal damage in pipelines and may be an ideal platform for an internal pipeline repair system.

# Key Project Staff

- ***Robin Gordon - EWI (Project Director)***
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# Summary

- ***Project Objectives***
  - *Evaluate, develop and validate internal repair methods for pipelines.*
  - *Perform a laboratory demonstration of internal pipeline repair*
  - *Develop a functional specification for an internal repair system*
- ***Project Schedule***
  - *24 Months*
- ***Project Team***
  - *Edison Welding Institute (EWI)*
  - *Pacific Gas and Electric (PG&E)*
  - *Pipeline Research Council International (PRCI)*
- ***Cost Match***
  - *$300k of direct cost match (Parallel R&D Programs)*
  - *Over $4M of indirect cost match & experience*