



Advanced Welding Repair and Remediation Methods for In-Service Pipelines

DOT Follow Up Presentation
August 8, 2005



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Agenda

- Introductions
- Purpose of Today's Telecon
- Project Objectives
- Modified Task 3 Equipment Design
- Support from Partners
- Next Steps



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Purpose of Telecon

- Review Preliminary EWI System Design Drawings
- Present PRCI and TCPL Support Letter
- Present Cranfield University Support Letter
- Obtain DOT Approval of New Equipment Design
 - Obtain Permission to Continue Project
 - Obtain Permission for No-Cost Extension

DOT = \$410K

PRCI = \$406K

TCPL = \$50K

=> **\$860K Total**



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Project Objectives – No Changes

- Develop an automated welding system for use on in-service pipelines
- Incorporate real-time adaptive control system to ensure reliable welding conditions
- Evaluate system in laboratory
- Validate the system
 - Develop qualified welding procedures
 - Perform field trials



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Project Plan – No Changes

Task 1 – Review of Industry Needs and Current Practices

Task 2 – Write Technical Specification

Task 3 – Design and Build of System

Task 4 – Laboratory Development and Evaluation

Task 5 – Weld Procedure Qualification

Task 6 – Field Testing and Validation

Task 7 – Final Report



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Task 3: Design and Build System

- **EWI Moved Hardware Development Back In-House**
 - Use original design based on Serimer DASA welding tractors
 - In-kind contribution based on previous project work completed with Cranfield using a Serimer DASA bug
 - EWI has current project with Serimer and have extensive knowledge of the hardware and control system
- **Partner with Mechanized Tractor (a.k.a. Bug) Supplier**
 - EWI met with Serimer DASA to discuss commercialization/support



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Meeting with Serimer DASA

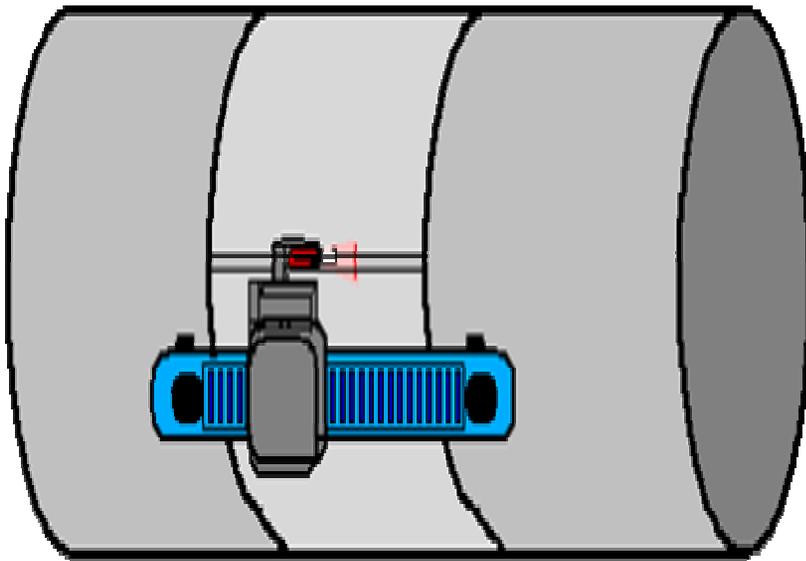
- Discussed EWI design concept
- Discussed equipment currently available or soon-to-be available from Serimer
- Discussed partnership and support of new equipment and interest in commercialization
- Serimer is interested in collaborating on the project and is determining staff availability
- Serimer can provide some equipment initially and additional equipment within a couple months



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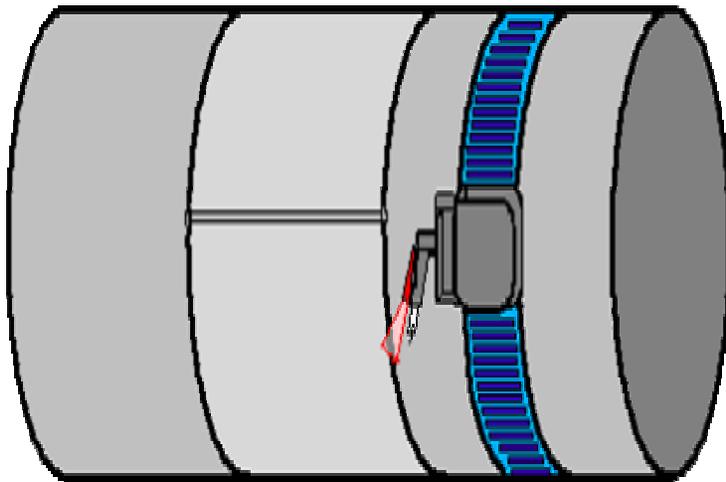
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Serimer DASA Comments – Longitudinal Sleeve



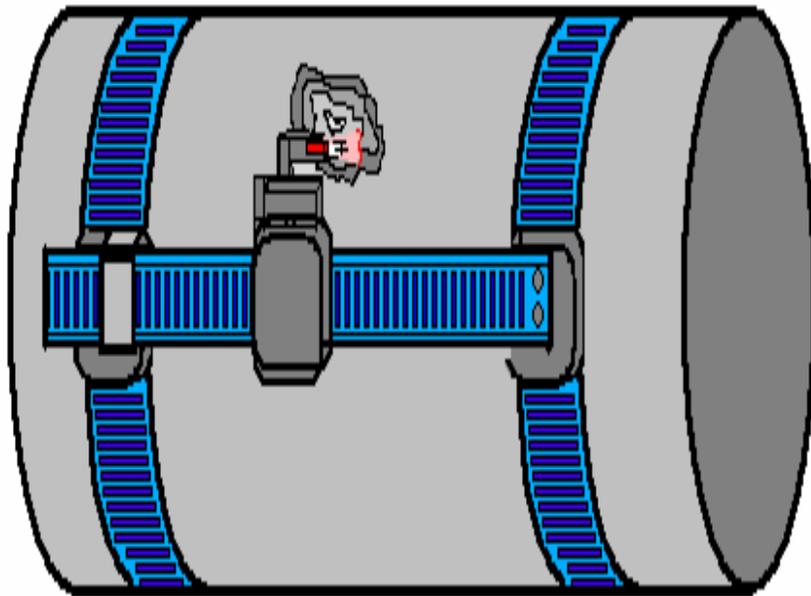
- Magnetically-attached straight track has already been used and proven by Serimer
- This design concept is essentially ready to go
- Equipment required:
 - STX bug
 - STX controller box
 - Straight track
 - Magnets

Serimer DASA Comments – Circumferential Sleeve



- Bug must have ability to tilt torch at 45° to make this weld
- Serimer suggest their new bug design with pendulum oscillator
- EWI suggests using standard bug and coordinated motion to create oscillation at 45° angle
- Equipment Required:
 - STX bug
 - STX controller box
 - Circumferential track
 - Torch tilt bracket
 - Coordinate STX motion

Serimer DASA Comments – Corrosion Patch Fill



- Serimer did not agree with trying to coordinate two bugs for traveling
- Serimer suggested extending the reach on the cross-seam axis and using only one bug and track
- Serimer is already developing a more robust cross-seam axis for another application
- Equipment Required
 - STX bug
 - STX control box
 - STX circumferential track
 - Modified STX axis
 - Coordinate STX motion

New Design Concept

- **Three Welding Capabilities**
 - Longitudinal repair sleeve weld
 - Circumferential repair sleeve weld
 - Weld deposition for repair of corroded area
- **One set of tools – different configurations**
 - STX bug
 - STX control box
 - STX straight and circumferential track
- **EWI amends standard bug with software and hardware**
 - Coordinate motion for oscillation at 45° angle
 - Coordinate motion for encircling corrosion patch and for weld fill
 - Add on torch work bracket and hardware for torch work angle
 - Increase length of cross-seam axis for filling corrosion patch



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Preliminary Design Concept for Sleeve Repair



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Preliminary Design Concept for Corrosion Repair



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Advantages to New Design Concept

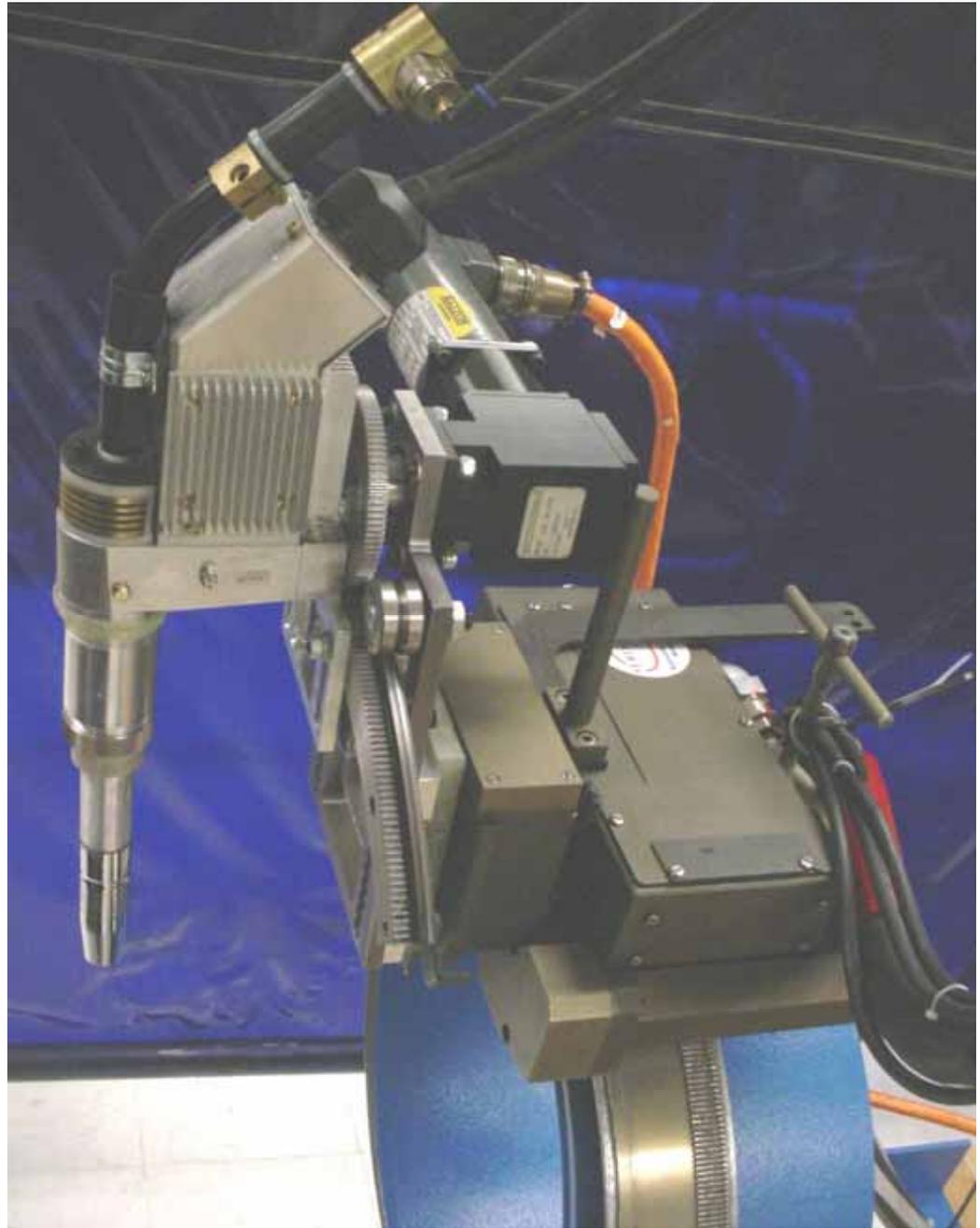
- Partner understands welding environment and all perils of land-based pipeline fabrication
- System will be field ready, not a lab prototype
- System uses already existing equipment
- EWI can demonstrate longitudinal welding of sleeve very quickly (3 months)
- EWI has extensive experience with the STX bug
- System will have a logical commercial supporter with chosen partner
- System can be maneuvered and operated by existing operators- no lifting equipment or tradesperson required
- System components are replaceable in the field and widely available



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EWI's STX Bug with added Hardware



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Video of EWI System – Side View



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Video of EWI System – End View



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TransCanada/PRCI Support Obtained



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Assessment of Equipment Need

- **There is a Need for this Equipment in Industry**
 - Need capability to weld pipelines in-service
 - Gas flow not interrupted
 - Potential to reduce costs by 50%
 - Manual welding in-service saves \cong \$8K per sleeve
 - Automated GMAW will improve productivity over manual welding



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Opinion on Moving Design/Build to EWI

- This is the right decision
- Resignation of Stephen Blackman Director of the Welding Research Center of Cranfield University has negatively impacted several PRCI funded and co-funded projects of which this is one.
- Decision based on Input from PRCI Materials Technical Committee in May 2005.
- New design is far less complex and enhances tools that are routinely used
- Recruitment of in-service welding equipment supplier Serimer DASA adds further validation to modified approach



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PRCI Projects Successfully Completed by EWI

- Review of Procedures for Welding onto Pressurized Pipelines
- Criteria for Hot-Tap Welding, Further Studies
- Repair of Pipelines by Direct Deposition of Weld Metal
- Guidelines for Weld Deposition Repair on Pipelines
- Examination of External Weld Deposition Repair for Internal Wall Loss
- Effect of Procedure Variables for Welding Onto In-Service Pipelines
- Development of Simplified Weld Cooling Rate Models for In-Service Gas Pipelines
- Welding onto In-Service Thin Wall Pipelines



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PRCI Projects Successfully Completed by EWI

- Improved Root Pass Quality for In-Service Branch Connection Welding
- Evaluation of Preheat Requirements for In-Service Welding
- Burnthrough Limits for In-Service Welding
- Refinement of Cooling Rate Prediction Methods for In-Service Welds
- Effect of Factors Related to Hydrogen Cracking for In-Service Welds
- Enhance PRCI Thermal Analysis Model for Assessment of Attachments
- External Weld Deposition Repair for Internal Wall Loss in Tees and Elbows - Further Validation
- Realistic Hardness Limits for In-Service Welding



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PRCI Projects In Process at EWI

- Internal Repair of Pipelines
- Advanced Welding Repair and Remediation Methods for In-Service Pipelines
- Best Approach for Predicting Burnthrough for In-Service Welds
- Effect of Pressure on Burnthrough Risk
- Cooling Rate Simulation for Welding onto In-Service Pipelines



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TCPL/PRCI Conclusions

- Delay in completing project can't be avoided
- Work should continue at EWI
- EWI has successfully completed a long list of related PRCI projects
- EWI experience is invaluable and cannot be sourced elsewhere



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Cranfield University Support Letter



- Cranfield will loan a Servo Robot Mini I Laser to EWI for the duration of the project
- Cranfield obtaining permission to provide EWI X100 pipe material



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Next Steps

- Obtain DOT Concurrence on New Design
 - Submit No-Cost 12-Month Extension to DOT
 - Submit Concurrent No-Cost Extension to PRCI
- Subcontract with Serimer DASA
- Obtain Equipment and Materials



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