2nd Quarterly Report to the
Office of Pipeline Safety, US Dept. of Transportation
Interagency Agreement DTRS56-04-X-0025
April 30, 2004 as Modified August 4, 2004

Task Order #01
External Corrosion of Line Pipe Steels
For the Quarter ending
Oct. 31, 2004

1. Progress, Findings, and Activities:

a) Task 1 Kick off meeting – Completed in first quarter.

b) Task 2 Literature Review
Approximately, 200 documents relevant to pipeline corrosion issues were identified for study by searching computerized literature databases available through the NIST virtual library. During this quarter, 50 more documents were identified and added to this database. The NIST staff will continue to search the published literature for publications relevant to pipeline corrosion and study these document throughout this program. These documents are being studied and will lead to the formation of a sound knowledge base for the staff working on this project.

c) Task 3 Collation of Corrosion rate data
Input for this activity was expected from PRCI Corrosion Committee during this quarter (Keith Wooten, Conoco-Phillips). Christina Sames, who provided staff support for the PRCI Corrosion Committee, resigned during this quarter and has been replaced by Marina Smith. A meeting with Marina Smith and Eldon Johnson (Alyeska Pipeline), who will be replacing Keith Wooten as the lead contact for the PRCI project oversight committee, is planed for the beginning of the next quarter (Nov. 17, 2004).

d) Task 4 Gap analysis and path forward
During this quarter NIST staff continued to evaluate the status of the NIST equipment for corrosion testing and the electrochemical measurement of corrosion rates. Figure 1 is a photograph of the electrochemical testing station assembled at NIST for this project. A hard disk crash near the end of the quarter limited experimental activities, but this problem should be fixed soon. While no SCC testing is currently planned, Figure 2 shows the NIST slow strain rate testing equipment.

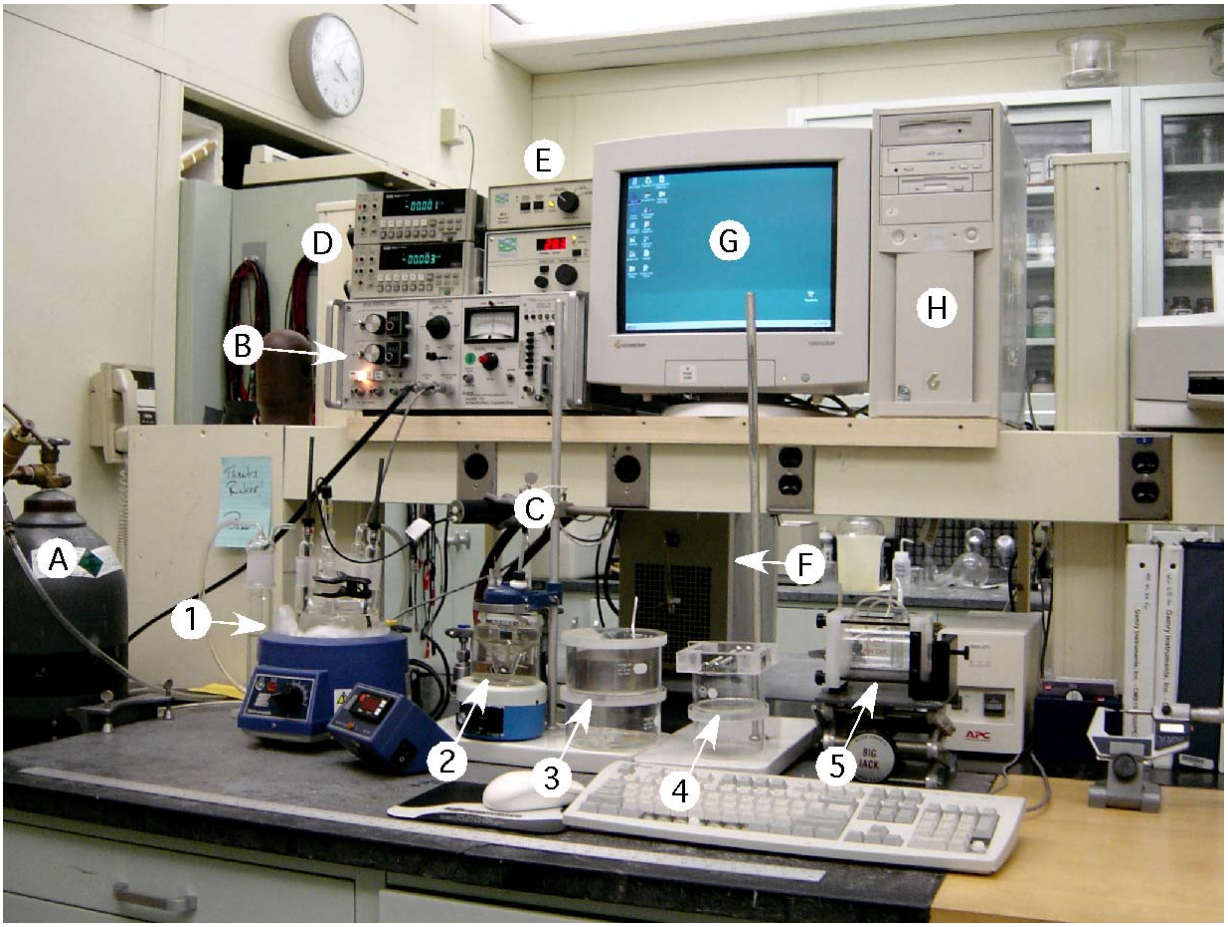

Figure 1. Electrochemical testing station with two potentiostats assembled for the evaluation of pipeline corrosion issues in this project including the measurement of corrosion rates in soils. This photograph includes 5 electrochemical testing chambers: (1) a 1.0 liter glass cell in temperature controlled for standard electrochemical measurements, (2) a doubled walled glass cell for controlled temperature testing using recirculating bath and temperature controller for ±0.25 °C control of temperature from –20 to 100 °C, (3) glass chamber with stainless steel counter electrode ring for measuring corrosion rates in soil samples, (4) glass chamber for estimating corrosion rates from electrochemical noise measurements, (5) a cell for holding flat sheet samples for measuring corrosion rates on samples of pipeline steels. The photograph also shows the supporting apparatus and instruments: (A) gas cylinders for control of oxidizing gases dissolved in testing environments, (B) the first potentiostat, a commercial potentiostat with interface for computerized control of experiments and data acquisition (PAR 173 with a 276 interface capable of ±100 V, ± 1.0 A, and a slew rate of 10^7 V/s), (C) high input impedance buffer amp (electrometer probe) for potentiostat, (D) high-input impedance digital voltmeters for monitoring of current and voltage independent of measuring instruments, (E) digital controllers for recirculating temperature controller, (F) refrigeration and heating bath for temperature controller, (G) computer monitor, (H) the second potentiostat, in addition to a IEEE 488 card for communicating with the first potentiostat, this computer contains a second commercial potentiostat on a PC card inside it for conduction ac impedance (aka electrochemical impedance spectroscopy) and electrochemical noise measurements (Gamry PC3/750 ±12 V, ±0.5 A, and a slew rate of $8x10^6$ V/s and CMS 100 software).

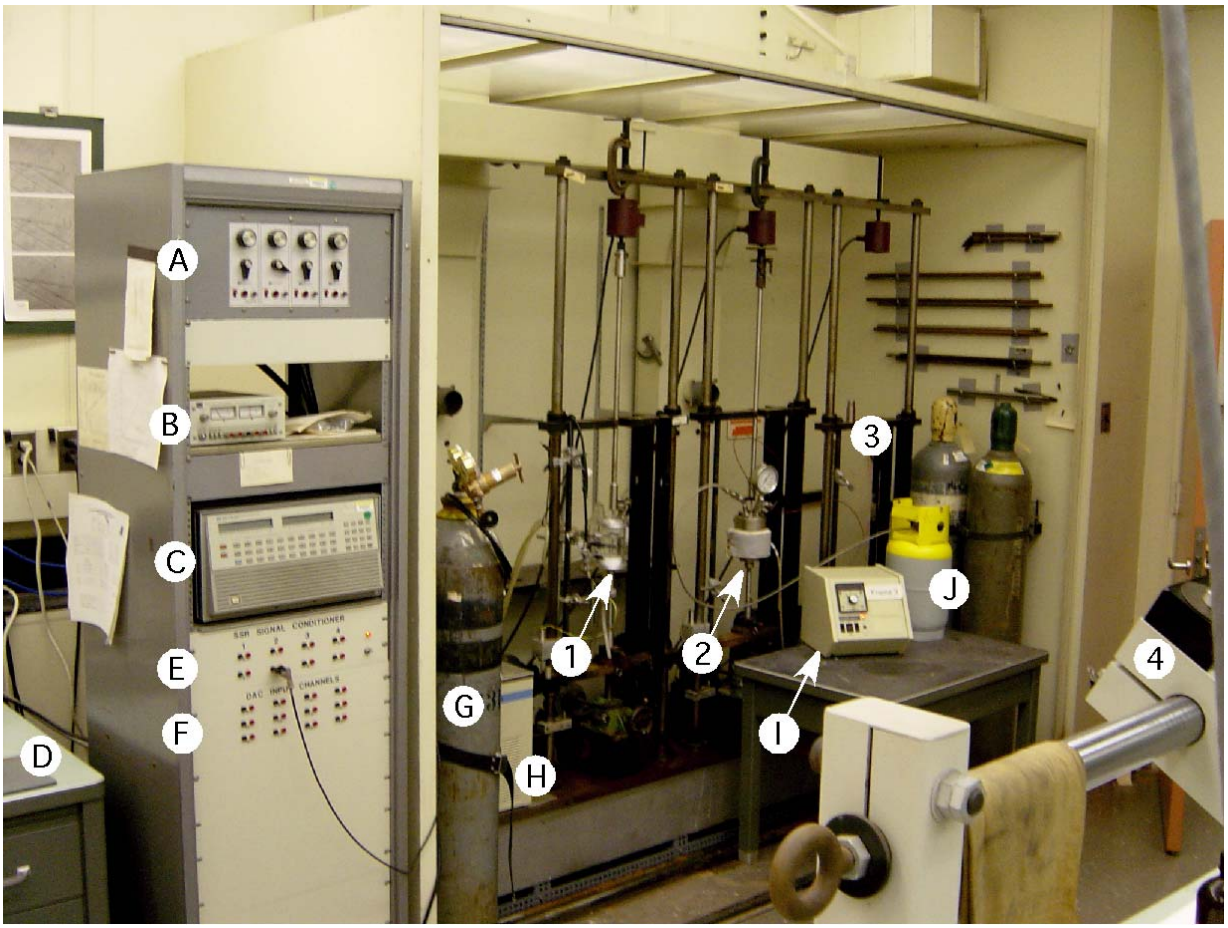

Figure 2. The NIST slow strain rate testing facility consisting of 3 computer controlled testing frames: (1) double walled glass chamber for testing at atmospheric pressure at temperatures from –20 to 100 °C, (2) PTFE lined stainless steel autoclave for testing in gases or liquids at elevated temperatures and pressures, (3) a frame without a test cell installed, and (4) the cross-head of the horizontally mounted servo-hydraulic corrosion-fatigue testing machine is partially shown in the foreground. The supporting instrumentation shown in this figure includes: (A) analog motor speed controllers (the computer turns these on and off), (B) load cell power supply, (C) computer data acquisition and control unit (HP3852/A), (D) computer not shown, (E) signal conditioners for load and position measurements with outputs for monitoring with digital voltmeters, (F) additional inputs to enable monitoring of up to 3 additional signals per testing frame with computer controller, (G) gas cylinder for control of oxidizing gases dissolved in testing environments, (H) recirculating temperature controller, (I) temperature controller for autoclave heating unit, (J) gas/liquid cylinder for filling chamber with either gas phase or liquid phase. This system was originally design ca. 1968 for testing in H_2S and connects to the building's chemical hood exhaust system. The track for the plexiglass doors, which are not shown in this figure, can be seen in the floor and these doors can be installed to limit the escape of gases to the laboratory environment. This system has been in almost constant use since construction and was modified ca. 1988 for computerized control and data acquisition. This testing system and chambers as shown in frame (2) were used extensively for the NIST study of

the propensity of candidates to replace Halon as a fire suppression agent on aircraft to cause SCC of aircraft materials.

In addition to these activities, NIST staff participated in the following meetings, committee activities, and preparations:

i) Quarterly PSIA Coordination Meeting, Aug 11, Herndon, VA
DOI/MMS hosted this quarterly meeting of government agencies involved in pipeline research. Participants included representatives from DOI/MMS, DOT/OPS (J. Merritt, R. Smith), DoE/FE (C. Freitas, R. Anderson), TLW (T. Wilke) and DoC/NIST (R. Ricker, F. Gayle)

ii) Government-Industry Pipeline R&D Forum, Organizing Committee Meetings
This planning committee holds a conference call meeting about once a month to plan this meeting and NIST staff participate as part of this program.

iii) Meeting with Christine Sloane, General Motors Corp., August 25 Dr. Sloane is GM's "Global Leader for Fuel Cell Vehicles codes and Standards" and she specifically asked to speak to someone about pipeline reliability, safety, codes, and standards during her visit to NIST on this date. She said that her company is greatly interested in assessing the ability of the existing infrastructure to provide hydrogen fuel and enable the growth of this new technology. As a result of this meeting, Dr. Sloane was suggested as a potential speaker on the impact that a change to hydrogen fuels may have on pipelines for the Pipeline R&D Forum.

iv) Meeting with John Grocki, SPLASH Aug 31, John Grocki is a materials and marketing consultant working with a consortia of stainless steel makers interested in exploring the potential of using stainless steel for pipelines (SPLASH). Their main interest is buried water pipelines. He read about our pipeline program and the ongoing retrieval of the NIST buried stainless steel samples by INEEL and he called and requested that he be allowed to meet with us and discuss the similarities and differences between the two different types of pipelines, pipeline materials, and the soil environment.

v) Quarterly PSIA Coordination Meeting, Oct 20, Washington, DC DOT/OPS hosted this quarterly meeting of government agencies involved in pipeline research. Participants included representatives from DOI/MMS, DOT/OPS (J. Merritt, R. Smith), DoE/FE (C. Freitas, R. Anderson), TLW (T. Wilke) and DoC/NIST (R. Ricker, C. Handwerker)

2. Activities Planned for the Next Reporting Period

a) Task 2 Literature Review – on going
NIST will continue to examine the published literature in an attempt to identify reliable data sources and information that will reduce experimental needs. Analysis of existing data sets will be attempted in an effort to provide potential corrosion damage rate modeling approaches.

b) Task 3 Collation of Corrosion Rate Data – on going

DoE/INEEL Underground Corrosion Program NIST personal will continue to provide technical support in the retrieval and review of samples in this program.

c) Task 4 Gap Analysis and Path Forward – on going
NIST will continue to establish experimental capabilities in this area. In particular, some preliminary experiments will be conducted to evaluate the effectiveness of different experimental approaches, measurements methods, or hypotheses for the corrosion damage rate predictions.

d) Meetings and Committee Activities
NIST will continue to support the pipeline R&D community through participation in the organization of meetings, standards committee activities, and through participation in the interagency PSIA coordinating committee. Planned for the coming quarter are the DOE LNG R&D Roadmapping Workshop, a meeting with PRCI, DOT/OPS, and Southwest Research Institute. In addition, the PRCI corrosion and materials committees plan to hold meetings in January.

3. Problems, Issues or Concerns

Communication and coordination with PRCI has not been as beneficial as originally expected. However, the meeting with Eldon Johnson planned for Nov 17 should resolve this issue and we fully expect communications and cooperation to improve.

4. Anticipated Task Completion Dates

On schedule per the statement of work in the August 4, 2004 modified agreement.

Submitted by

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