

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 #02
Fatigue Fracture and Crack Arrest in High-Strength Pipeline Steels
For the Quarter ending
October 31, 2004

1. Progress, Findings, and Activities:

- a) Task 1 Standards - Awaiting data on which to act
- b) Task 2 Fatigue - The main objective of the second quarter of this project was to obtain appropriate pipe and to begin production of test specimen and fixtures. We received the material that was promised by PG&E last quarter (representative of current and previous pipe technology) and continue to have discussions with Oregon Steel and ISC (for higher strength material). The PG&E pipes are 20 to 25 in. in diameter and have wall thicknesses a little under a ½ inch. We have a few tons of pipe sections, in lengths of three to 12 ft. They represent a variety of ages, ranging from a few pieces that are 70 years old to some that seem to be about 20 years old, and we expect that they have strengths up to about X60. We continue to collect background information on these pipes, and will conduct some screening tests (composition and strength) to confirm their identities. While the older pipe should be well represented in historical databases of mechanical properties, we are considering making a few fatigue tests to evaluate the effect of aging on its properties. The PG&E pipes are sufficient for all fatigue, crack arrest, and corrosion tests planned for the lower strength levels.

We continue to solicit feedback on our reduced-section fatigue test specimen design (with a gage length of 6 inches and an overall length near 18 inches), and have received support for this design from a number of our collaborators so far. The width of the specimen is a minimum of 3 inches, within the tolerances of the loading capacity of one of our larger fatigue machines, yet wide enough to develop valid data, and allow the addition of stress risers (notches) and intentional deformation (to simulate third-party damage). The specimens will be oriented along the length of the pipe, and so will primarily assess crack-growth properties in the hoop direction. The fixtures will have a curved surface that matches the original curvature of the pipe, and so will not induce any bending stresses. We are also considering specimens oriented along the hoop direction, to develop data in both major load directions.

We continue to collect background information on the state-of-the-art in the testing of these materials and the types of data in existence. For measuring the tendency toward crack arrest in these steels, we are currently leaning toward the use of the CTOA procedure (a combination of linear crack extension and Charpy v-notch tests).

We continue to work with Colorado School of Mines on finishing the Proceedings of the April 2004 Workshop on Coating Technology (held in Biloxi, Mississippi). The process is held up by one or two key manuscripts, but we held meeting on October 15th to refine the formats and review the status of the current documents. The missing manuscripts have been promised (again) to be finished soon, so we expect to be able to print and distribute them in a few months. In addition to these activities, NIST staff were promised input from Keith Wooten, Chair of a Pipeline Research Council Corrosion Committee, on our work plan.

2. Activities Planned for the Next Reporting Period

- a) Task 2 - Fatigue - ongoing
NIST is cutting the PG&E pipe to smaller sections, which can be machined into specimens. Now that the steel is here, we can machine the fatigue fixtures to the proper radii and check the gripping capability. We expect to start the fatigue crack growth matrix near 60 % of the ultimate strength for the various pipe strengths.
- b) Task 3 – Crack Arrest
Once the fatigue testing is proceeding smoothly, we will start to develop the crack arrest task of our measurement plan.
- c) Other Tasks 4 to 6
These tasks will follow the initial fatigue testing.
- d) Meetings and Committee Activities
NIST will continue to support pipeline R&D community through participation in organization of meetings, standards committee activities, and through participation in the interagency PSIA coordinating committee. CANMET has asked us to visit for a more detailed discussion of potential collaborations, and we have been invited to attend the April 2005 Pipeline meeting in Banff.

3. Problems, Issues or Concerns

None at this time.

4. Anticipated Task Completion Dates

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

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