the Energy to Lead

gti

QUARTERLY REPORT

GTI PROJECT NUMBER 21874

Characterization and Fitness for Service of Corroded Cast Iron Pipe

Contract Number: DTPH56-15-T-00006

Reporting Period: 2nd Project Quarter

Report Issued: March 29, 2016

For Quarterly Period Ending: March 31, 2016

Prepared For:

U.S. Department of Transportation
Pipeline and Hazardous Materials Safety Administration
Office of Pipeline Safety
Chris McLaren
281-216-4455
Chris.mclaren@dot.gov

Technical Team:

Project Manager:
Kristine Wiley - GTI
(847) 768-0910
kristine.wiley@gastechnology.org

Technical Contact:
Daniel Ersoy - GTI
R&D Executive Director, Infrastructure
(847) 768-0663
daniel.ersoy@gastechnology.org

Gas Technology Institute
1700 S. Mount Prospect Rd.
Des Plaines, Illinois 60018
www.gastechnology.org

Legal Notice

This information was prepared by Gas Technology Institute ("GTI") for DOT/PHMSA (Contract Number: DTPH56-15-T-00006).

Neither GTI, the members of GTI, the Sponsor(s), nor any person acting on behalf of any of them:

a. Makes any warranty or representation, express or implied with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately-owned rights. Inasmuch as this project is experimental in nature, the technical information, results, or conclusions cannot be predicted. Conclusions and analysis of results by GTI represent GTI's opinion based on inferences from measurements and empirical relationships, which inferences and assumptions are not infallible, and with respect to which competent specialists may differ.

b. Assumes any liability with respect to the use of, or for any and all damages resulting from the use of, any information, apparatus, method, or process disclosed in this report; any other use of, or reliance on, this report by any third party is at the third party's sole risk.

c. The results within this report relate only to the items tested.

Table of Contents

Page
Legal Notice ii
Table of Contents 1
Project Objective 2
Executive Summary 3

Project Objective

Gas Technology Institute's (GTI) objective in this project is to

- Provide a Fitness-For-Service (FFS) model and method for operators to characterize and grade graphitic corrosion defects on cast iron natural gas pipes. This will help operators make monitoring, repair, and replacement decisions, as well as prioritize accelerated replacement decisions related to cast iron mains and services.
- Summarize and categorize the required input parameters to the FFS model related to cast iron material, graphitic corrosion geometry and characteristics, and operational environment.
- Validate the FFS model by comparing its output to a statistically analyzed set of historical cast iron failure data.
- Provide a physical testing program to fully validate the FFS model.

Executive Summary

During this quarter we completed the Task 2 Literature Review. This milestone report summarizes a literature search and review on cast iron materials and corrosion. The report includes a background section on the history of cast iron, its use as a pipeline material, general composition, corrosion, and the categories/types. The report also provides a detailed review on gray cast iron microstructure, composition, and mechanical properties, a detailed explanation of graphitic corrosion of gray cast irons along with short explanations of other corrosion mechanisms like pitting, stress corrosion cracking, corrosion in waters, etc. Select mechanical property information from this literature review will be used as inputs to the finite element modeling and stress analysis tasks of this project. The corrosion information will be incorporated into the project task on field corrosion characterization.

The work in Task 3 Historical Cast Iron Failures Statistical Analysis also progressed this quarter. We have collected an initial set of cast iron field inspections from one operator. We also began our review of historical cast iron failures which includes looking at properties of cast iron pipes in gas distribution systems, deformations (due to external loads, temperature changes and soil movement), acceptable criteria of pipe stresses and deformations and cast iron reported incidents.

Task 4 Finite Element Analysis of Failure Modes was initiated this quarter. A nonlinear, 3D finite element (FE) model, simulating a single pipe span, has been created and is under further development. We will be using two simulation spaces: simulation or calculation of pipe span loading based on field condition inputs including soil loading etc. and simulation of stress state at the location of corrosion based on pipe span loading and field inputs of material loss due to corrosion. The two-space approach helps to simplify the FE models by decoupling field condition variables such as pipe depth, soil density, vehicle load, and joint stiffness from the variables that are directly relevant to the pipe material stress state such as pipe bending moment, vertical and axial loads, and internal pressure.

Task 5 Characterize Graphitic Corrosion Severity was also initiated this quarter. We began collecting references and data to help operators characterize graphitic corrosion in the field in a manner that will allow input to the fitness for service model.