Quarterly Report – Public Page

Date of Report: *1st Quarterly Report – December 31, 2021*

Contract Number: *693JK3211RA0001*
Prepared for: *DOT PHMSA*
Project Title: ***Using Alternative-Steel and Composite Material in Gas and Hazardous Liquid Pipeline Systems***

Prepared by: *Gas Technology Institute*
Contact Information: *PM: Khalid Farrag, Ph.D., P.E.*
kfarrag@gti.energy - Phone: 847-344-9200
For quarterly period ending: *December 31, 2021*

1: Items Completed During this Quarterly Period

Task 1- Conduct Kick-off Meeting and Form Technical Advisory Panel (TAP): This task consisted of the following:

- Finalize project scope and analytical procedures.
- Form Technical Advisory Panel (TAP): The project team contacted industry experts and formulated the TAP members. The TAP currently consists of two pipeline operators, four manufacturers, one state agency, Operation Technology Development (OTD) representative, GTI, and PHMSA AOR. Additional members may be added throughout the project tasks. The TAP list is included in the Interim Report.
- Kickoff Meeting Minutes: Conducted the kickoff meeting on November 8, 2021.

2: Items Not Completed During this Quarterly Period

Started working on Task-2: Material Properties and Testing Procedures. A Task-2 Interim Report is due in the 2nd Quarter.

3: Project Technical Status

Work in this task included:

- The kickoff Meeting was performed on November 18, 2020.
- Formed Technical Advisory Panel (TAP): The project team contacted industry experts and formulated the TAP members
- Presented project scope and procedures. The project scope and task details are presented below.

Objective

- To provide the requirements for the installation, inspection, and integrity management of alternative-steel and non-steel composite systems in natural gas and hazardous liquid gathering and transmission pipelines.
- The study addresses: 1) material testing, 2) construction requirements, 3) damage and assessment of defects, 4) degradation of the pipe material, and 5) inspection and maintenance activities to ensure the integrity of these systems for safe and reliable implementation.

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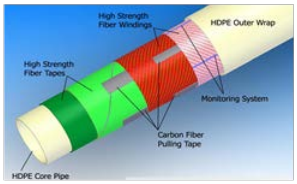
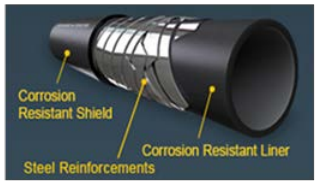
3

Background

- The resistance of these composites to chemicals and corrosion, with their high strength, light weight, and flexibility make them good candidates in high-pressure lines and in trenchless rehabilitation.
- Most of these installations are under PHMSA's special permit requirements under 49 CFR 190.341.



(a) Reinforced Fiber Smartpipe® Composite



(b) Steel-Reinforced Pipe by FlexSteel®

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4

Industry Needs/Challenges

Current Knowledge and acceptance of composites and alternative-steel material shows specific needs to address the following:

- Most of material specifications are based on vendor-specific data,
- Need for the design specifications to address variable construction issues and installation quality control,
- Development of non-destructive and in-service inspection procedures,
- Determine susceptibility to excavation damage and other external threats,
- Long-term performance of the material, potential failure modes, and repair,
- Evaluation of fittings and interconnecting with existing steel pipes.

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5

Project Scope

Activity	Completion Date from Agreement	Milestone/Deliverable	
Task 1: Kickoff and Technical Advisory Panel	Month 3	Task 1 Interim Report: Kickoff Minutes and TAP Group	
	Month 6	Task 1 Interim Report: Review of Alternative steel and composite systems	ALL
Task 2: Evaluate Material Properties and Testing Procedures	Month 12	Task 2 Interim Report: System Properties and Testing Requirements	C-FER
Task 3: Design for Maximum Allowable Operating Pressure	Month 15	Task 3 Interim Reports: Design Equations and Parameters for MAOP	C-FER
Task 4: Construction Damage and Quality Assurance	Month 18	Task 4 Interim Report: QA and Construction Requirements	GTI
Task 5: Assessment of Corrosion/Erosion Damage	Month 21	Task 5 Interim Report: Assessment of Corrosion and Erosion Damage	GTI
Task 6: Assessment of Other Integrity Threats	Month 24	Task 6 Interim Report: Integrity Management Plan	C-FER
Task 7: Degradation of Composite Material	Month 30	Task 7 Interim Report: Long-Term Durability Requirements	GTI
Task 8: Field Inspection and Monitoring for IM	Month 33	Task 8 Interim Report: Field Inspection and Monitoring	GTI
Task 9: Review Code Requirements	Month 33	Draft Final Report (with Final Task 9 Report)	K. Leewis
Task 10: Project Management and Reporting	Project Duration	Monthly Updates, Peer Reviews, Quarterly Reports	ALL
	Month 36	Presentation and Revised Final Report	

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7

Task 1 – Kickoff Meeting, Project Scoping, and TAP

- identify current systems in the market and related material properties and performance characteristics. The data will be analyzed from available manufacturers' data, operators' field monitoring programs, and experimental and analytical work by academic and research organizations.
- Industry input will be done with the collaboration of a Technical Advisory Panel (TAP).

Task 2 – Evaluate Material Properties and Testing Procedures:

Testing requirements for alternate materials such as plastic and fiberglass are specified in:

- API RP 15S Qualification of Spoolable Reinforced Plastic Pipe (API 15S)
- ISO 14692-2 Petroleum and Natural Gas Industries – Glass-reinforced Plastic (GRP)
- API Specification 15HR Specification for High Pressure Fiberglass Line Pipe.

These standards will be reviewed to determine how current testing procedures for steel, fiberglass, and plastic pipes might need to be modified to be applicable for the full range of modern materials.

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10

Task 3 – Design for Maximum Allowable Operating Pressure (MAOP)

- Current methods for determining hydrostatic design pressure (HDP) and life span of fiber reinforced plastic pipe (as described in ISO 14692-2 and ASTM D 2992) are based on results from long-term hydrostatic or cyclic pressure tests. Due to the inherent variability in composite materials, the test method requires at least 18 specimens and uses statistical methods to estimate the long-term pipe performance and service life.

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11

Task 4 – Assessment of Construction Damage and Quality Assurance

- Assess the construction damage of these systems in both trenchless and open trench installations.
- Induced deformations during construction and their effect on connections and joints will be investigated from reported field measurements such as from embedded fiber-optics for strain measurements in some of these systems.
- The outcome of this task will recommend the construction operator qualifications and related requirements for the pipeline operators.

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12

Task 5 – Assessment of Corrosion/Erosion Damage

Assess the likelihood and severity of corrosion damage in alternative-steel systems. Work will include the following:

- Literature review of relevant corrosion of alternative-steel pipes and erosion in non-steel composite pipe materials under various operating conditions and environments.
- Recommendations to mitigate corrosion damages. Evaluate the need for continuous cathodic protection when metallic-composite systems are joined with other steel pipes.

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13

Task 6 – Assessment of Other Integrity Threats

- Risk-based assessment in API 1160 will be reviewed to identify the methods used to evaluate these threats compared to steel pipe.
- Potential methods to reduce the risk, especially where the factors influencing risk for alternate materials differ significantly from those that influence steel pipe, will be evaluated.

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14

Task 7 – Degradation of Composite Material:

- Literature search to investigate degradation mechanisms of materials such as from exposure to ultraviolet (UV) and H2S-containing production fluids.
- Identification of operating conditions that enhance material degradation and mitigation strategies based on NACE MR0175 approach.
- Review tests performed by manufacturers that assess long-term material properties.

The deliverable of this task will provide the factors affecting the properties of the exposed layers. In the absence of available data, long-term accelerated testing will be performed on material coupons to evaluate the loss of material strength, hardness, and pressure limits.

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15

Task 8 – Field Inspection and Monitoring for IM

- Inspection and assessment of damage and defects of non-steel or alternative-steel pipes and connections for remediation.
- Applicability of existing integrity methods, such as direct assessment and pressure tests, to evaluate threats.
- Technology search to evaluate applicable non-destructive examination technologies and sensors. This will be used to identify damage, delamination, and material defects. A framework of applicable technologies or research needs will be recommended.

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16

Task 9 – Review of Code Requirements

Date	Requester	Nature of Permit
April 21, 2010	Cinco Natural Resources Corporation	Use of FlexSteel for gathering system in Corpus Christi Bay, Nueces County, TX. The permit was for using 3-inch FlexSteel pipe in approximately 7,062 feet of an existing (but previously abandoned) 6-inch pipeline.
January 20, 2011	Monument Pipeline	Installation of Smart Pipe for test project at facility in Missouri City Texas. It includes the installation of one segment as tight fit liner inside 12-inch nominal steel pipe.
September 29, 2011	Nicor Gas Company	Use of Smart Pipe inside four 6-inch diameter steel lines underneath Illinois River through Illinois Commerce Commission. The lines are operating at 230 psig in Class 1 area.
June 11, 2012	BreitBurn Energy Company LP	Replacement of a segment of steel pipeline located in the city of Los Angeles, CA. Insert a 6-inch OD Smart Pipe system into a current 12-inch OD existing steel gas gathering line. The normal operating pressure is 220 psig and MAOP is 245 psig. The line is Class 4 area.
August 27, 2019	National Fuel Gas Corporation	5.8 miles 6-inch diameter FlexSteel pipe in Class 1 and 2 locations inserted inside 12.75-inch pipe. The pipeline operates at MAOP of 720 psig.

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17

4: Project Schedule

The following figure shows the project schedule and progress as of the end of this quarter.

Schedule

Task	Tasks	Duration per Quarter 1	2	3	4	5	6	7	8	9	10	11	12
1	Kickoff and Technical Advisory Panel (TAP)												
2	Evaluate Material Properties and Testing Procedures												
3	Design for Maximum Allowable Operating Pressure												
4	Construction Damage and Quality Assurance												
5	Assessment of Corrosion/Erosion Damage												
6	Assessment of Other Integrity Threats												
7	Degradation of Composite Material												
8	Field Inspection and Monitoring for IM												
9	Review Code Requirements												
10	Project Management and Reporting												

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18

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