

## **FINAL PROJECT SUMMARY REPORT**

### **BUSINESS AND FIRM ADDRESS**

[QuakeWrap, Inc](#) 6840 S. Tucson Blvd. Tucson, AZ 85718

### **DOT SBIR Program**

U.S. Department of Transportation/OST-R

### **DOT CONTRACT**

6913G620P80088

### **PERIOD OF PERFORMANCE**

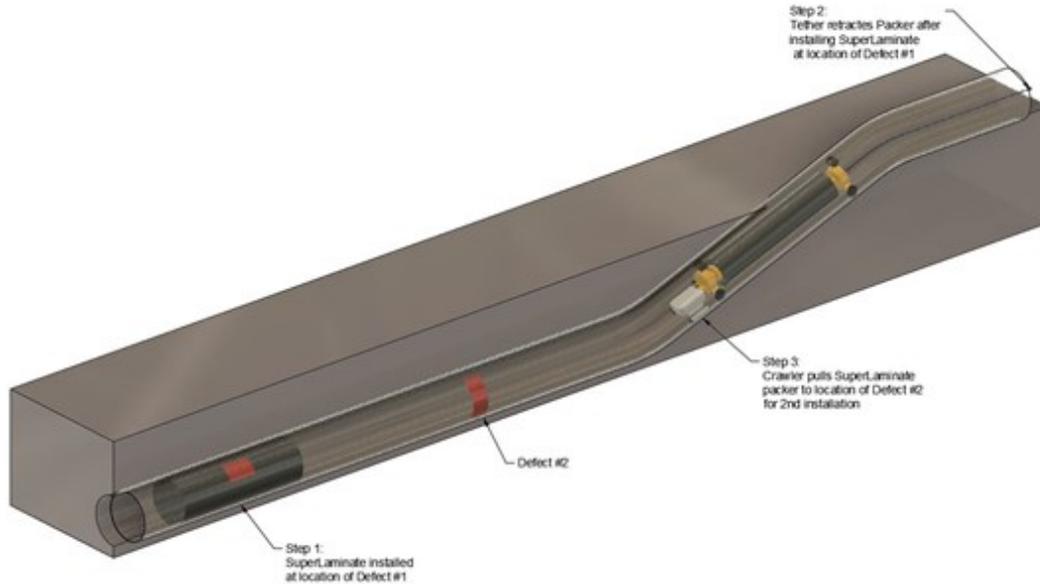
06/29/2020 – 01/06/2021

### **PROJECT TITLE**

No-Dig Point Repair Technology for Steel Oil & Gas Pipelines

### **SUMMARY OF COMPLETED PROJECT**

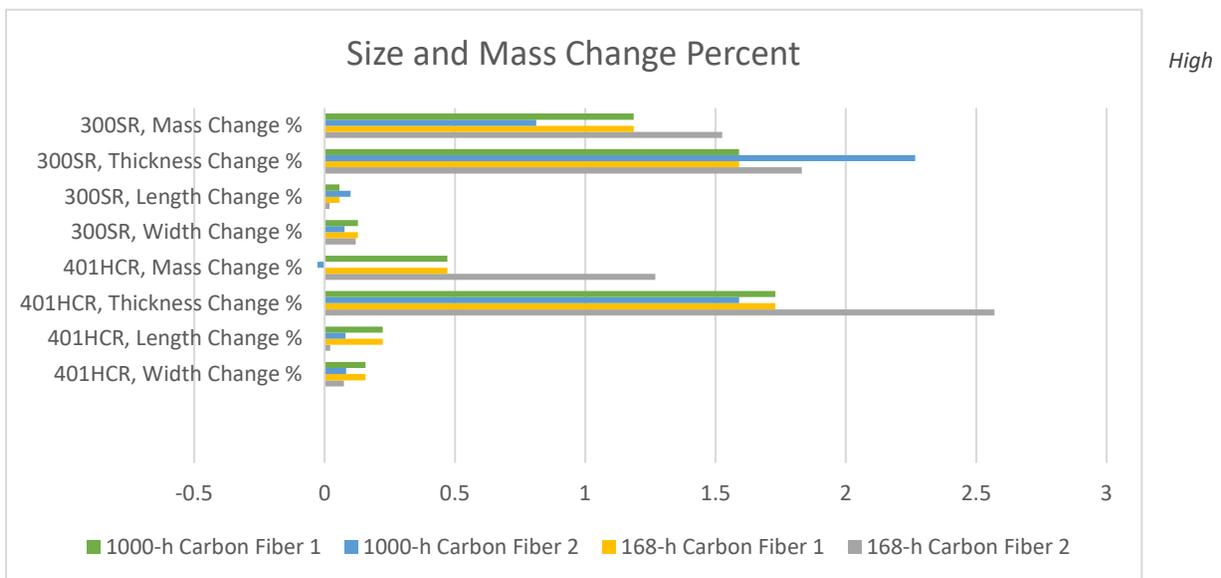
The experience and data to date suggest there is a need for practical solutions to address pipeline failures in conveying hazardous fluids. A key aspect is identifying pipe segments with a high risk of failure and the industry has made substantial progress in that department. The next step is rehabilitating those pipe segments before they fail in a feasible and economical manner with minimal impact to operations. That's where QuakeWrap offers a unique solution with SuperLaminate, a carbon fiber based composite point repair system that can be installed without excavation (no-dig). With the SuperLaminate technology, steel transmission and distribution pipe failures can be prevented by performing repairs proactively upon detecting any signs of anomalies (corrosion/wall thinning, pitting, weld seam defects, and other signs of distress in the pipe) via pipeline inspection. SuperLaminate is a carbon and glass fiber reinforced polymer based segmental pipe lining solution deployed by an inflatable packer. The main material used for producing SuperLaminate is carbon fiber reinforced polymer (CFRP), which is a very high strength (ultimate tensile strength three times greater than that of steel) and light weight material. This makes the SuperLaminate easy to install, sustainable solution with an expected service life of well over 50 years. SuperLaminate is installed with no or minimal excavation to repair buried pipes, this results in an insignificant amount of carbon footprint in comparison with the conventional, open-cut repairs. Based on the condition of a transmission main, multiple distressed pipe segments can be repaired by deploying the system through a single access point, adding further value to the repair solution in comparison with the conventional methods.



The objective in Phase I of the USDOT/PHMSA SBIR grant on the *Internal Repair of Steel Transmission Pipelines* was to prove SuperLaminate can be used safely to repair steel pipes conveying natural gas and hazardous liquids. This was accomplished by implementing the following tasks:

*Expert Workshop:* A virtual workshop was held on 8/26/20 with the industry experts to collect past experiences and receive feedback on the proposed project tasks.

*Chemical Resistance Tests:* Specimens of SuperLaminate were exposed to 20% of methanol solution for 1,000 hours and then tested for any changes in physical and mechanical properties.



*Pressure Test:* A 24-inch (ASTM A252 Grade 2) steel pipe sample was ground to 25% of its original wall thickness to mimic a heavy corrosion scenario, and then was repaired with the SuperLaminate system.

The repaired pipe was pressurized up to 660 psi, and no apparent failure was observed. The test setup was also simulated by computational modeling with the finite element method (FEM). Actual test data and model results were in reasonable agreement.



*Design Method Development:* The pressure test setup was designed per the equations provided in ASME PCC2 – Part 4 Non-metallic and Bonded Repairs. Nevertheless, the test data and further analysis with the FEM suggest a modification to the PCC2 equation is needed to make it more suitable and not overly conservative for SuperLaminate design.

*Commercialization:* The main commercialization activity conducted in Phase I was the Commercialization Readiness Assessment Report prepared by Foresight, an independent consultancy in technology development. In preparation of that report, Foresight interviewed multiple pipeline integrity professionals, and the feedback received was encouraging. The interviewees confirmed that there is currently no technology on the market that can repair a transmission pipe internally without any excavation. Additionally, QuakeWrap has started on the industry outreach to develop a business model and formed an Industry Advisory Board with representatives from pipeline operators, inline inspection companies, and a testing/validation company.

## APPROVAL SIGNATURES

Name	Title	Date
V. Firat Sever	Pipeline Division Manager, QuakeWrap, Inc.	2/24/2021