



October 31, 2014

Karlene Fine,
Executive Director
North Dakota Industrial Commission
State Capitol-14th Floor
600 East Boulevard Ave Dept 405
Bismarck, ND 58505

Dear Ms. Fine,

On behalf of BOE Midstream please accept this letter as a formal submittal for the North Dakota Industrial Commission Oil and Gas Research Grant for the Waterline Crossing Wrap Pilot Project.

Requested funding will be leveraged with matching dollars for EERC to complete lab tests on the ability of a PVC pipe inner and outer wrap to provide protection where water supply pipelines are crossed by crude oil pipelines. It is anticipated the proposed project will provide a 3rd alternative to the current two methods of crossing waterlines with a crude oil pipeline which will be more economical and less environmentally invasive.

Enclosed is the \$100 application fee and our Oil and Gas Research Grant application. If you have any questions, please do not hesitate to contact me.

Sincerely,

A handwritten signature in black ink, appearing to read 'John Wadsworth'. The signature is written in a cursive style and is enclosed in a thin black rectangular border.

John Wadsworth, COO
BOE Midstream, LLC
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Oil and Gas Research Program

North Dakota

Industrial Commission

Application

Project Title: Waterline Crossing Wrap Pilot
Project

Applicant: BOE Midstream, LLC

Principal Investigator: Scott Besmer, KLJ

Date of Application: October 31, 2014

Amount of Request: \$36,242

Total Amount of Proposed Project: \$72,484

Duration of Project: 12 months

Point of Contact (POC):
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ABSTRACT

Objective: Evaluate the effectiveness of protecting water supply lines from potential crude oil contamination where the pipelines overlap by wrapping the water supply pipelines with VISCOTAQ®PVC Outer Wrap (VISCOTAQ) as an alternative to casing water supply pipelines with polyvinyl chloride (PVC) pipe or casing crude pipeline in steel.

Expected Results: VISCOTAQ will be proven as an effective method to protect water supply pipelines from potential crude oil contamination where water supply pipelines overlap crude oil pipelines.

Duration: January 2015-December 2015.

Total Project Cost: The total project cost is \$72,484. The project will be funded through a cash match from BOE Midstream and KLJ for \$27,076. In-kind contributions total \$9,166. The funding request from the NDIC Oil and Gas Research Council is \$36,242.

Participants: BOE Midstream, KLJ, Energy & Environmental Research Center of the University of North Dakota (EERC), and VISCOTAQ.

PROJECT DESCRIPTION

Objectives: A major concern with the crossing of crude oil pipelines and water supply pipelines is the potential contamination of crude, which could be detrimental to the integrity of the polyvinyl chloride (PVC) pipe used for water supply pipelines. A commonly used method of protection for water supply pipelines is to case the PVC pipe with additional PVC pipe at crude oil pipeline crossing points. However, a study conducted by the South Dakota State University¹ examined the impact of crude oil on the integrity of PVC pipe, high-density polyethylene pipes and casing materials. The results demonstrated exposure of pipe joints from crude oil pipelines resulted in hydrocarbon permeation through the pipe joint gaskets within 5 to 9 weeks of exposure. The study results suggested the casing of PVC pipelines may not provide adequate protection in the event of a crude oil pipeline leak. The study results showed a need for an alternative to protect PVC water supply pipelines.

VISCOTAQ® PVC Outer Wrap (VISCOTAQ), is a self-adhesive wrap designed to provide mechanical and chemical protection of PVC pipelines. VISCOTAQ creates a seal, protecting contact of crude oil with PVC joint gaskets. The EERC Analytical Research Laboratory

VISCOTAQ PVC Outer Wrap



VISCOTAQ PVC Outer Wrap is a Heavy Duty PVC in the form of a roll. The tape is used as an Outer Wrap for the mechanical protection of VISCOTAQ products against soil stress, back fill procedures and other forms of mechanical impact. Moreover it gives a continuous external pressure to the VISCOTAQ corrosion preventive inner material and forces this material, together with eventual soil stress, continuously to flow. VISCOTAQ PVC Outer Wrap is produced from a High Quality PVC with an excellent resistance to chemicals and is wrapped with a 50% overlap onto the VISCOTAQ corrosion preventive coating. The material is applied onto the substrate by hand or by means of a tape wrap machine.

Use and application:

- *As a mechanical outer wrap up to surface temperatures of +85° C/ +185° F*
- *Continuous operating temperature up to 85° C/+185° F*
- *Application temperature > +5° C/+41° F*

¹ DeBoer, D.E., and Julson, D., 2012 Improving safety of crude oil and regional water system pipeline crossings: Final Report to the Pipeline and Hazardous Material Safety Administration, Brookings, South Dakota, South Dakota State University.

(ARL) will conduct lab tests on the performance of VISCOTAQ in preventing the degradation of PVC bell and spigot joint seals.

Methodology: Currently the only two allowed methods of casing crude oil pipelines and water supply pipelines is to 1.) Encase the crude oil pipeline with larger diameter steel pipe for a distance of 20 feet on either side of the crossing. The steel encasing has a high probability of causing corrosion of the crude oil pipeline and then possibly causing a leak. This method is very expensive and disruptive to the environment. 2.) Encase the already in service water supply pipelines. This method requires a new section of waterline that is encased in a fused PVC line to be constructed then “cut-in” to the in-service waterline. Encasing an already in service waterline is very expensive and requires disruption in water service at the time of installation and during the time the air is bled off the system. Bleeding air off the system can take months of work for the water company. The pilot project will verify if encasing a water supply pipeline in VISCOTAQ will protect in-service waterlines without taking the waterline out of service. The integrity of the water supply pipeline will not be compromised by “cutting-in” therefore no air will need to be bled off. The proposed alternative is the most cost effective and least environmentally invasive.

Bench-scale testing

The objective of the bench-scale testing is to determine if and when crude oil permeation occurs within PVC bell and spigot joints commonly used for water supply pipelines in North Dakota and to verify the performance of PVC joints wrapped in VISCOTAQ. A total of six PVC joints will be tested - all will be identical material, but three will be wrapped with VISCOTAQ and three will be unwrapped. In addition, one set of PVC pipe joints (one wrapped and one unwrapped) will be tested with an internal fluid pressure of 45 psi, which is similar to the pressure used in rural water supply pipelines.

Experimental Design

A detailed experimental design for testing of the wrapped and unwrapped PVC joints will be prepared by EERC and provided to KLJ and appropriate regulatory agencies for review. All interested parties will weigh-in on the proposed approach, testing apparatus design, and test conditions before testing begins. For purposes of this funding application, a proposed testing apparatus design and test approach is described below.

Testing Apparatus Assembly

A sealed, rectangular metal vessel will be constructed to simulate exposure of the wrapped and unwrapped PVC to the shallow subsurface conditions that may be encountered adjacent to an oil pipeline leak. The bench-scale experiments will be conducted at room temperature, which is higher than the temperatures expected at the buried pipeline depths. Lower experimental temperatures may be incorporated into the research.

The vessel will be constructed using 14-gauge, 304 stainless steel sheeting that allows for exposure of the PVC joints to Class 2 (or equivalent) sand that is saturated with Bakken crude oil. Representative samples of Bakken crude oil will be provided by KLJ. The ends of the PVC pipes and joints will extend beyond the walls of the vessel to allow for periodic sampling and replacement of the water therein. To properly wrap the PVC joints, a representative from VISCOTAQ will travel to the EERC Laboratory to provide training to ensure proper material placement.

Water Sampling and Analysis

Once the test apparatus is assembled, each PVC pipe will be flushed with the same volume of tap water to remove any residual particulate matter and/or potential contaminants. Tap water will be also be used to fill the pipes for testing to simulate the water quality expected in water supply pipelines. The water

used to fill the pipes initially and following subsequent sampling events will be tested for total organic carbon (TOC) content as a background reference. Samples of water from the pipes will be collected once a week and analyzed for TOC content as a first indicator of hydrocarbon breakthrough. If the water from one of the pipes contains TOC levels above background concentrations, the sample will be also be analyzed for total petroleum hydrocarbons.

Reporting

Upon completion of the project, a final report will be provided to KLJ that documents the final results of the project, including the detailed methodology, water-sampling results, and conclusions. The results of this study will also be submitted as a paper for submission to an appropriate conference or peer-reviewed journal.

Anticipated Results: The pilot project will provide a third alternative that is recognized by the ND State Water Commission for protecting water supply pipelines crossing a crude oil pipeline in North Dakota.

Facilities: The research will be conducted in EERC's ARL. The ARL provides quality data, flexibility, and rapid turnaround time in support of research activities at the EERC. The laboratory is equipped for routine and specialized analyses of inorganic and organic constituents, which are performed using classical wet-chemistry and state-of-the-art instrumental procedures. Established analytical techniques allow for the chemical characterization of a variety of environmental and biological sample types, including fossil fuels. The laboratory will be a controlled environment to simulate a crude oil spill and measure the effectiveness of VISCOTAQ and establish a time frame of the integrity of the product in protecting water supply pipelines from crude oil spill contamination.

The EERC laboratory staff follows U.S. Environmental Protection Agency (EPA), ASTM International, and other standard methods for the analysis of samples. Analytical methods are routinely monitored for

precision and accuracy with certified reference materials from the National Institute of Standards and Technology (NIST), the South African Bureau of Standards (SABS), the International Atomic Energy Agency (IAEA), and other sources.

Resources: VISCOTAQ will provide staff to assist the test efforts at the EERC's ARL to ensure the proper installation of the VISCOTAQ Outer Wrap. VISCOTAQ employees will train EERC researcher on proper installation and handling methods to maintain the integrity of the research findings.

Techniques to Be Used, Their Availability and Capability: EERC will test VISCOTAQ in their Analytical Research Lab. VISCOTAQ is a proven product to protect PVC pipelines, however the product has not been tested in relation to protecting water supply pipelines from crude oil contamination. EERC's is committed to completing the research and reporting the findings. The techniques to be used during the research is detailed in the Methodology section.

Environmental and Economic Impacts while Project is Underway: The pilot project will be tested in the EERC's ARL, therefore there will be no environmental or economic impacts.

Ultimate Technological and Economic Impacts: The Waterline Crossing Wrap Pilot Project will test VISCOTAQ and its effectiveness in protecting water supply pipelines from crude oil contamination. If successful, the wrap will be a non-invasive alternative for private industry oil companies and public water supply entities. The technology will allow water supply pipelines to remain in operation during the installation of the outer wrap. The probability of crude oil pipeline corrosion is not a threat with the wrap and the cost of wrapping the pipeline will decrease significantly.

Oil and gas companies will have a feasible alternative, which according to 2014 USD estimates, the cost to encase a 16-inch crude oil pipeline is \$50,000 and \$20,000 to encase a 12-inch water supply pipeline. The estimated cost to install VISCOTAQ is \$7,000.

The proposed project has the potential to establish North Dakota as a leader in utilizing VISCOTAQ. EERC's research would be the first of its kind conducted to measure the effectiveness of VISCOTAQ protecting water supply pipelines from crude oil contamination. The research could prove valuable to states where pipeline crossings are regulated.

Why the Project is Needed: The proposed project will provide a more economical and less environmentally invasive alternative to enhance the protection of water supply pipelines when crossed with crude oil pipelines. The outer wrap will allow water supply pipelines to remain in-service rather than cutting the pipeline as is current practice, therefore eliminating inconveniences to end water users and threatening the operations of public works and public safety entities.

STANDARDS OF SUCCESS

The overall success of the pilot project will be to have research results verifying VISCOTAQ protects water supply pipelines from potential contamination from crude oil, specifically during the event of a leak in a crude oil pipeline. The pilot project will be of great value to North Dakota as a non-invasive and economical alternative method to protect water supply pipelines. Public water supply entities will not have to disrupt water service to users and the proposed technology will not impact the integrity of the water supply pipeline. The private sector will benefit from an immediate cost savings potential of \$13,000-\$43,000 each time a crude oil pipeline crosses a water supply line by utilizing the new technology.

BACKGROUND/QUALIFICATIONS

Project partners include BOE Midstream, KLJ, EERC and VISCOTAZ.

BOE Midstream is a private midstream company that has committed to infrastructure improvements in North Dakota. The company is investing in the proposed project to find an economical and less invasive alternative to protect water supply lines.

KLJ is involved in almost every component of oil and gas development in North Dakota. Project experience includes design and building of pipelines with numerous crossings, wrapping pipelines, excavation around in-service water supply pipelines and state and federal environmental regulations. KLJ will manage the project timeline and report on the research findings.

EERC is a nationally recognized leader in energy research. EERC will ensure the integrity of the research.

VISCOTAQ is a patented product used for corrosion prevention at pipelines, storage tanks, soil to air transitions, above ground flanges, pipe crossings and in the ditch application. VISCOTAQ staff will travel to the EERC research lab to ensure proper installation of the VISCOTAQ Outer Wrap. VISCOTAQ will also supply the materials.

MANAGEMENT

Scott Besmer, KLJ, will serve as the Principal Investigator/Project Manager of the proposed project. Scott will be responsible for quality control/quality assurance of the research findings. He will be the main point of contact for BOE Midstream, EERC, and VISCOTAQ. During the project kick-off meeting, Scott will verify the established timeline and delivery date is achievable and that the project team understand the reporting benchmark requirements. EERC ARL will supply test results to KLJ. It is anticipated testing will last six months. After the testing is complete, EERC Analytical Research Laboratory will author a white paper of the research.

Scott will be responsible for reporting quarterly updates and the final report to the Oil and Gas Research Councils.

TIMETABLE

Milestones	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
Kick-off meeting												
Experimental Design Preparation and Peer Review												
Quarterly Reporting to OGRC												
Material Acquisition and Construction of Testing Apparatus												
Bench-Scale Testing, Recurring Water Sampling and Analysis												
Final Report Preparation												
Present Final Report												

BUDGET

Waterline Crossing Wrap Pilot Project							
Proposed Budget							
Category	Description	Cost Share			In-Kind		Total Cost
		NDIC OGRC	BOE Midstream	KLJ	KLJ	VISCOTAQ	
EERC	Laboratory research to measure the effectiveness of VISCOTAQ outer wrap on PVC water supply pipelines and white paper	\$36,242	\$17,121	\$ 9,955			\$ 63,318
VISCOTAQ	Staff to train EERC researchers and VISCOTAQ supplies					\$2,000	\$ 2,000
KLJ	Project Management				\$7,166		\$ 7,166
Total							\$ 72,484

EERC Research Budget	
Category	Project Total
Labor	\$44,930
Supplies	\$5,280
Other	\$203
Laboratory Fees & Services	
Analytical Research Lab	\$9,824
Graphics Service	\$734
Outside Lab	\$2,400
Total Project Costs	\$63,371

KLJ Project Management Budget	
Category	Project Total
Labor	\$6,300
Travel	\$866
Total Project Costs	\$7,166

CONFIDENTIAL INFORMATION

No confidential information is part of the application.

PATENTS/RIGHTS TO TECHNICAL DATA

No patent or rights issues is part of the application.

STATUS OF ONGOING PROJECTS (IF ANY)

The applicant has not received previous funding from the North Dakota Industrial Commission Oil and Gas Research Council.