

Contract No. G-043-084
“Pipeline Study Phase III (HB 1347)”

Submitted by: University of North Dakota Energy & Environmental Research Center
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PARTICIPANTS

Sponsor	Cost Share
North Dakota Industrial Commission/OGRC Funding	<u>\$500,000</u>
Total Project Cost	\$500,000

Project Schedule – 24 months

Contract Date – September 7, 2017

Start Date – July 1, 2017

Final Report: September 30, 2018*

*Presentations through June 30, 2019

Project Deliverables:

Status Report: October 31, 2017 ✓

Status Report: January 31, 2018 ✓

Status Report: April 30, 2018 ✓

Status Report: June 30, 2018 ✓

Final Report: September 30, 2018 ✓

OBJECTIVE/STATEMENT OF WORK:

This project was authorized by the North Dakota Legislature in House Bill 1347 to “include an analysis of leak detection and monitoring technology and a risk assessment of new and existing pipeline systems” in an effort to decrease pipeline leak incidents, volumes, and impacts. No matching funds are required for this project. The Energy and Environmental Research Center (EERC) will accomplish this work by assembling and engaging a stakeholder group comprised of pipeline operators, developing options for risk assessment protocols, analyzing a wide suite of specific risk factors (including in high consequence areas), identifying potential mitigation practices and technologies to address those risk factors and analyzing strategies for continuous improvement. The goal of this project is to reduce the frequency and total volume of leaks and spills from pipeline systems. This goal is supported by the following specific objectives:

- Improve industry and state knowledge of the factors influencing leaks and spills.
- Create a risk assessment process that enables operators to evaluate and prioritize risk factors for their specific pipeline system, if they are not already employing a protocol.
- Assess known risk abatement technologies, and identify situations for which each is best suited.
- Identify continuous improvement methodologies for use in the liquids gathering pipeline sector, and suggest mechanisms for measuring success in continuous improvement protocols.

STATUS

The Contract has been executed.

Quarterly report for work done July 1, 2017 - September 30, 2017 has been received. (The report is posted on the Oil and Gas Research Program website.) The report states in part the following accomplishments completed during the previous quarter:

- A stakeholder meeting was held at the EERC August 16–17, 2017. The meeting was attended by 47 representatives from 26 pipeline operations companies and two state entities. At this initial meeting, the EERC staff defined the scope of the study and requested input and feedback from experienced pipeline operators. Excellent discussion was engaged. This discussion helped to set the tone of the study and helped state entities understand initial stances from industry.

- EERC staff have initiated discussions with smart pig manufacturers to determine the limitations of that technology set relative to smaller-diameter liquids gathering pipelines and to encourage research and development (R&D) focused on smaller-diameter liquids gathering pipeline applications of these technologies.
- EERC staff have also entered discussions with unmanned aerial system (UAS) teams to explore the feasibility of employing advanced remote sensing solutions and advanced data analytics to address the challenge of pipeline leak detection. This effort will likely result in at least two research and development (R&D) proposals by these UAS teams to industry and to the state of North Dakota in the coming months.
- The EERC has proposed to pipeline operators participating in the stakeholder group an R&D consortium focused on developing new leak detection technologies and new inline inspection technologies specifically for liquids gathering pipeline systems. Several stakeholders have indicated that this function is not currently served by other pipeline research entities. Several stakeholders have responded positively, but none have yet committed to providing funding to the consortium.
- EERC staff have researched a number of documented approaches to risk assessment. An assessment of which, if any, of these approaches may be adapted to liquids gathering lines is under way. In parallel, EERC staff engaged in numerous discussions with individual pipeline operators to learn about their current formal approaches to risk assessment and to understand the challenges of applying formal risk assessment across large systems of multiple pipelines.
- The EERC project team has chosen three of the approaches mentioned above to use as illustrative examples, has defined a simplified, hypothetical pipeline system upon which these methods can be applied, and has completed a preliminary risk assessment with each method to demonstrate principles involved and to explore the strengths and weaknesses of each approach.

The quarterly report also includes information on future activities.

Quarterly report for work done October 1, 2017 - December 31, 2017 has been received. (The report is posted on the Oil and Gas Research Program website.) The report states in part the following accomplishments completed during the quarter:

- The EERC team completed a literature review focused on risk assessment, and those methods applicable to liquids gathering pipelines. Extensive guiding material is available in the literature, but this knowledge must be carefully considered when applying to liquids gathering pipeline networks, which present unique challenges when compared to larger, less networked transmission pipelines.
- The EERC team continued discussions with a wide variety of technology providers in an effort to develop a body of knowledge to discuss regarding emerging technologies for leak prevention and leak detection. The exploration of emerging technologies includes leak detection hardware and software, inline inspection hardware for leak prevention, artificial intelligence for pipeline monitoring, and drone applications.
- A second stakeholder meeting was held in Minot on December 6, 2017. The meeting was attended by 31 representatives of 19 pipeline operations companies. At this meeting, EERC staff outlined a body of knowledge developed to date on the topics of a) risk assessment applied to liquids gathering pipelines and b) emerging technologies that may provide additional options for leak

avoidance and leak detection strategies. Excellent discussion was engaged, thus facilitating the goal of improved industry awareness of these topics. Industry representatives provided excellent feedback to the EERC team that will assist in drafting the Phase III study report. Specifically, the stakeholder group expressed the following:

- The stakeholder group greatly values the forum provided by the EERC and by the Phase III study; this stakeholder forum serves to raise awareness among all pipeline operators in the state
 - The state of North Dakota and the EERC report must guard against placing too great an emphasis on the role of new technology in reducing the number of total liquid volume of pipeline leaks. While technology plays an important role, stakeholders emphasize that the most effective prevention is found in well-designed pipelines, properly installed, and operated with sound, validated procedures.
 - The stakeholder group desires knowledge of emerging technologies that may be considered as components of overall pipeline integrity strategies.
 - A strong, but not-yet-unanimous, interest in a pipeline R&D consortium focused on developing new leak detection technologies and new inline inspection technologies specifically for liquids gathering pipeline systems.
- EERC staff have started drafting the final report.

The quarterly report also includes information on future activities.

Quarterly report for work done January 1, 2018 - March 31, 2018 has been received. (The report is posted on the Oil and Gas Research Program website.) The report states in part the following accomplishments completed during the quarter:

- The EERC team completed a draft of the final report and then shared the draft report with the stakeholder group (25 pipeline operator companies) for comment. The EERC requested comments by May 4, 2018.
- Commitments were received from founding members of the liquids gathering pipeline R&D consortium. A proposal to the North Dakota Industrial Commission Oil & Gas Research Program was submitted by founding members of the program. The program proposal stipulated that it would ask the EERC to manage the program on behalf of industry and would serve as independent evaluator of demonstrated technologies. It is the intention of the program to begin demonstrations during summer 2018.

The quarterly report also includes information on future activities.

Quarterly report for work done April 1, 2018 - June 30, 2018 has been received. (The report is posted on the Oil and Gas Research Program website.) The report states, in part, the following accomplishments completed during the quarter:

- Stakeholders (generally, this group includes operators of liquids gathering pipelines within the state) reviewed an early draft of the study report and returned 203 comments. The EERC project team reviewed each comment, addressed changes to the report as appropriate, summarized the EERC response to each and every comment, then provided all comments and all responses to all stakeholders.

- On June 6, 2018, Brian Kalk, EERC Energy Systems Development Director, presented an update on project progress and schedule to the North Dakota Legislature's Interim Natural Resources Committee in Bismarck, North Dakota. Dr. Kalk confirmed to the committee that the EERC report on our Pipeline Study Phase III will be submitted by September 30, 2018, as mandated by the legislative language.
- The revised draft is now in a secondary, internal review process with EERC and other reviewers.

The planned activities for the next quarter are detailed below:

- Comments from internal reviewers are expected by August 17, 2018
- The EERC will complete the review process, addressing all comments from internal and external reviewers as appropriate, and finalize the report.
- The final report will be submitted to the North Dakota Legislature's Interim Natural Resources Committee and to the North Dakota Industrial Commission by September 30, 2018.
- Following submittal of the final report, the EERC will remain available to discuss the contents of the report with NDIC or with legislative committees, upon request.

The Final Report has been received. It is posted on the website. The Executive Summary states, in part, the following:

The Energy & Environmental Research Center (EERC) has concluded a three-phase study of liquids gathering pipelines. Phases I and II of this study served to inform the state on the status of the liquids gathering pipelines industry in North Dakota and to demonstrate different approaches to leak detection, respectively. Phase III of this study (the focus of this report) is focused on emerging technologies to prevent and detect leaks from these pipelines and risk assessment methods that can be applied to prioritize these pipelines for additional preventative actions. The ultimate goal of the three-phase pipeline study is to reduce the frequency and total volume of leaks and spills from liquids gathering pipeline systems in the State of North Dakota. The results of this study phase serve to inform stakeholders on possible approaches to risk assessment, which may facilitate appropriate layering of risk abatement approaches, including employment of technology.

Emerging Technology for Liquids Gathering Pipelines

A significant quantity of new pipeline leak detection and leak prevention technology has emerged since the first phase of this pipeline study was completed in 2015. The EERC suggests that four factors contribute to this rapidly changing landscape of available or developing technology:

- 1) A rapidly expanding new market for technology solutions suited to small-diameter liquids gathering pipelines.
- 2) New regulation on liquids gathering pipelines caused by rapidly expanding infrastructure.
- 3) Increased public attention on pipelines in recent years due to a variety of factors not all of which are directly related to otherwise safe operations of pipelines.

4) Pipeline operator's desire for increased efficiency in operations.

This report summarizes a partial sampling of emerging technologies that may have applicability to liquids gathering pipelines in the near future. This summary of new and emerging technologies is not a comprehensive overview of all new technology applicable to leak prevention and leak detection for liquids gathering pipelines, but it does provide insight into emerging options such as:

1. Artificial intelligence (AI) employed in leak detection
 - a) Drone-based AI applications
 - b) Platform-independent AI applications
2. Distributed measurements via fiber optic cable
3. Miniaturized in-line inspection tools
4. Dedicated leak detection for challenging situations and remote areas

Conclusions

A variety of new technologies is emerging to address the needs of liquids gathering pipelines. These emerging technologies are at various stages of development and all will require additional testing and demonstration to provide the proven performance expected by stakeholders. It is anticipated that with willing pipeline operators as demonstration partners, some of these technologies can be matured to directly contribute to the safe operation of liquids gathering pipelines. The development status of these technologies will likely change rapidly in the near term. Therefore, pipeline operators and state authorities should monitor their progress to determine appropriate timing for possible implementation.

Risk Assessment and Continuous Improvement

Risk assessment is an exercise in either quantifying risk or sorting multiple risks in order of importance or hazard level. Risk assessment is broadly applied across industries and government organizations seeking to improve safety, environmental, and financial performance by reducing losses. Unfortunately, little information focusing specifically on risk assessment's application to liquids gathering pipeline exists in available literature. The current study intends to bridge that gap.

Conclusions

The ultimate goal of risk assessment and risk management is to identify and prioritize actions to ensure pipeline safety and integrity. Available standards recommend that operators be provided great latitude performing risk assessment to ensure that the purpose and approach match the needs and resources of the situation. Principles of continuous improvement are woven into every approach to risk assessment.

The reliability, usefulness, and resources demanded for each approach to risk assessment approach vary greatly. Naturally, more complex quantitative methods provide greater potential for insight but also require significant additional resources to complete and, therefore, are not globally applicable. The EERC suggests three overarching lessons were derived from application of various risk assessment approaches to an uncomplicated, hypothetical scenario:

- *Risk Assessment Is Not Easy* - No approach was “easy.” Each pipeline operator must determine what level of accuracy and uncertainty is both practical and sufficient for each specific application of a particular risk assessment approach.
- *Any Systematic and Thoughtful Method Can Be Useful* - All methods provided some insight into the relative risk of different segments. Each model results in a list of considerations that facilitate the desired prioritization for subsequent actions.
- *Models Exhibited Surprising Consistency* - Models exhibited significant consistency in many respects, especially in final ranking of segments by risk.

The EERC has provided the final report to a legislative interim committee and is scheduled to present the final report to the Oil and Gas Research Council on December 18, 2018. Future presentations may be requested during the 2019 Legislative Session.

This contract is closed.

Updated 12/17/2018