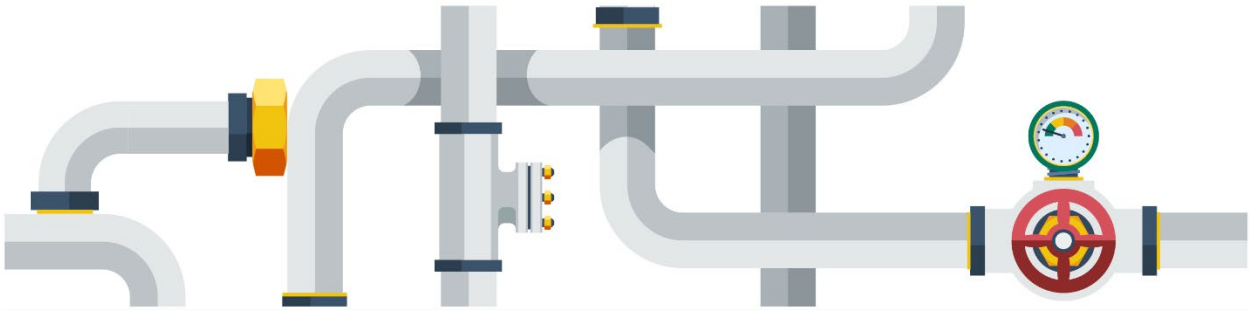
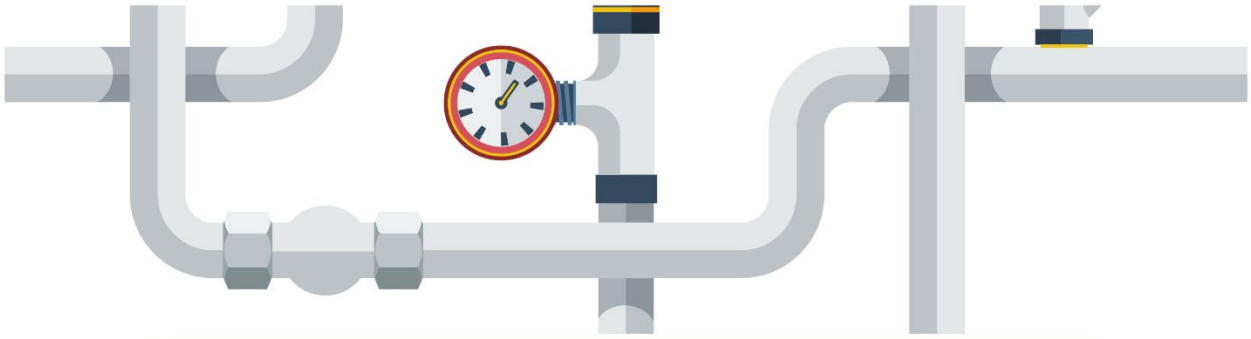
U.S. Department of Transportation
Pipeline and Hazardous Materials Safety Administration



Peer Review Report



Pipeline and Hazardous Materials Safety Administration

Pipeline Safety Research & Development Program

Peer-Reviews Conducted
October 14th, 15th & 21st, 2020

Peer Reviews Conducted
October 14, 15, and 21, 2020

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EXECUTIVE SUMMARY

In accordance with mandates from the Office of Management and Budget (OMB) and the Office of the Secretary of Transportation (OST), the U.S. Department of Transportation (DOT) Pipeline and Hazardous Materials Safety Administration (PHMSA) Pipeline Safety Research and Development (R&D) Program held annual peer reviews of 29 active Core Program (Core) research projects October 14, 15, and 21, 2020. These peer reviews—which have been conducted since 2006 and are designed to maintain research data quality—frequently are held virtually via teleconference and web-based communication platforms, saving both time and resources by foregoing physical meeting spaces. Additionally, virtual meetings facilitate attendance from Canada, Europe, and all U.S. time zones, increasing participation for panelists, researchers, project cosponsors, PHMSA Agreement Officer Representatives (AORs), and PHMSA Technical Task Inspectors (TTIs).

The annual peer review continues to build a systematic evaluation process that was developed by PHMSA's Pipeline Safety R&D Program and reviewed by the Government Accountability Office(GAO).[1] The Calendar Year (CY) 2020 peer review panel, which comprised seven academic and two federal agency representatives, reviewed all 29 projects using the following six evaluation criteria:

1. Is progress being made toward project objectives and project management for both the budget and the schedule?
2. Is there a plan for technology/knowledge transfer or the dissemination of results, including publications, reporting, and/or patents?
3. How much end-user involvement is incorporated into the scope of work?
4. Is the project work being communicated to other related research efforts?
5. Are the intended results consistent with scientific knowledge and/or engineering principles?
6. Are the intended results presented in such a manner as to be useful for identified end-users?

The rating categories assigned by the peer-review panel were Ineffective, Effective, More Than Effective, and Very Effective (**Table 3**). The average rating for the 29 projects assessed during the October 2020 review was More Than Effective (**Figure 3**). **Figure 4** provides a ranking and rating of each individually reviewed research project, and **Appendix B** provides additional details such as project descriptions and panel review comments.

The highest identified project strengths were technology/knowledge transfer, end-user involvement, and dissemination plans for project results. Conversely, communication of activities with other related projects was indicated as the evaluation criteria needing the most improvement.

Most researchers who had tasks and deliverables impacted by COVID-19 recovered from any delays.

[1] https://primis.phmsa.dot.gov/rd/gao2003.htm

PHMSA approves the process used to conduct these reviews as well as the CY 2020 findings and recommendations provided by the panelists. PHMSA accepts the findings and recommendations summarized in the report as shown in the official PHMSA response memorandum (Section 9).

1.0 Introduction

The purpose of this document is to report the results from the CY 2020 peer reviews of 29 research projects that were held by PHMSA's Pipeline Safety R&D Core. The reviews were held virtually via teleconference and web-based communication platforms on October 14, 15, and 21, 2020.

The purpose of the PHMSA's peer reviews—which are held annually for active Core research projects and usually occur during the second quarter of each CY—is to identify technical problems; ensure that projects achieve their original objectives and remain aligned with stakeholder needs; and provide technical guidance from objective, independent, and technically competent experts. (The CY 2020 review originally was planned for the May/June timeframe but was delayed by several months due to the impact of COVID-19 on the research projects.) Nine external experts from academia and other government agencies performed the peer reviews, which addressed a PHMSA Pipeline Safety R&D total investment value of approximately $18 million.

Applied safety research is primarily executed under PHMSA's Core, the main activities of which focus on developing new technologies or products, conducting demonstrations, and advancing technology toward commercialization or government adoption. Additionally, Core promotes the use of new knowledge by decision makers.

The findings and recommendations in this report were derived from scoring and comments provided by the peer review panelists. DOT Operating Administrations (OA) are required to develop and execute a systematic process for peer reviews on all published scientific information upon which policy decisions are based.

Through the Information Quality Act, Congress directed the OMB to "provide policy and procedural guidance to Federal agencies for ensuring and maximizing the quality, objectivity, utility, and integrity of information (including statistical information) disseminated by Federal agencies."[2] The resulting OMB bulletin, Final Information Quality Bulletin for Peer Review, prescribes the required procedures for federal programs.[3]

2.0 Research Program Background

PHMSA regulates safety of the design, construction, operation, maintenance, and spill response plans for over 2.8 million miles of pipelines that transport natural gas and hazardous materials. PHMSA is focused on reducing natural gas and hazardous liquid pipeline incidents that result in death, injury, significant property damage, or environmental harm.

The mission of the PHMSA Pipeline Safety R&D Program—the vision of which is to support PHMSA's mission to protect people and the environment by advancing the safe transportation of energy and other hazardous materials that are essential to our daily lives—is to sponsor R&D

[2] 106th Congress, Treasury and General Government Appropriations Act for Fiscal Year 2001 (Public Law No. 106-554-515(a)), U.S. Government Printing Office. Retrieved from: https://www.gpo.gov/fdsys/pkg/PLAW-106publ554/html/PLAW-106publ554.htm.
[3] https://obamawhitehouse.archives.gov/sites/default/files/omb/assets/omb/memoranda/fy2005/m05-03.pdf

projects focused on providing solutions that will improve the safety, reduce the environmental impact, and enhance the reliability of the nation's pipeline transportation system.

PHMSA has regulatory responsibility regarding the safe transportation of natural gas and hazardous liquid pipelines. Beginning in 2001, PHMSA strengthened its role in the safety of the nation's pipeline system in numerous ways—including promulgating new integrity management regulations—as a response to several nationally recognized pipeline failures.[4,5,6] Both the regulations and the new inspection processes used by regulators to evaluate operator compliance rely on 1) operator access to technologies that support improved safety and integrity performance and 2) regulator access to information on the appropriate use and limitations of these technologies. Congress expanded support for the PHMSA Pipeline Safety R&D Program in 2002 to address the needs for new pipeline integrity technologies and data to validate those new technologies.[7] As authorized by Congress, PHMSA sponsors R&D projects that are focused on providing near-term solutions to increase the safe, reliable, and environmentally sound operation of U.S. energy pipelines.

The Pipeline Safety R&D Program contributes directly to PHMSA's mission by focusing on the following objectives:

1. Advancing innovation and the development of new technologies to improve pipeline safety performance
2. Providing scientific research and data to inform pipeline decision-makers on safety improvements for the transportation of energy products by pipelines.

The Pipeline Safety R&D Program is organized around eight programmatic elements—each of which have associated safety issues, technology needs or gaps, and R&D opportunities—that reflect PHMSA's statutory responsibilities, guidance, and challenges identified from both pipeline experts and stakeholder groups. All ongoing and future projects are linked to at least one of these program elements. Program goals define the desired outcomes for R&D projects and are associated with each R&D program element. Additionally, each program goal bears a direct relationship to the longer-term enhancement of pipeline safety. **Table 1** describes these program elements and their long-term objectives.

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[4] Code of Federal Regulations. (Rules effective May 29, 2001, and February 15, 2002). *Pipeline Integrity Management in High Consequence Areas for Hazardous Liquid Operators* (49 Code of Federal Regulations Part 195). U.S. Government Publishing Office.

[5] The Federal Register. (December 15, 2003.) *Pipeline Safety: Pipeline Integrity Management in High Consequence Areas (Gas Transmission Pipelines)* (68 FR 69777). Final Rule. Retrieved from: https://www.federalregister.gov/documents/2003/12/15/03-30280/pipeline-safety-pipeline-integrity-management-in-high-consequence-areas-gas-transmission-pipelines

[6] The Federal Register. (May 26, 2004). *Pipeline Integrity Management in High Consequence Areas (Gas Transmission Pipelines)* (69 FR 29903). Final Rule, as amended. Retrieved from: https://www.federalregister.gov/documents/2004/05/26/04-11789/pipeline-safety-pipeline-integrity-management-in-high-consequence-areas-gas-transmission-pipelines

[7] 107th Congress. (December 17, 2002). *Pipeline Safety Improvement Act of 2002* (Public Law No. 107-355). U.S. Government Printing Office. Retrieved from: https://www.congress.gov/107/plaws/publ355/PLAW-107publ355.pdf

Table 1: Program Elements of the PHMSA Pipeline Safety R&D Program

Program Elements	Description	Anticipated Outputs/ Long-Term Objectives
Preventing Pipeline Threats/Damage	Addressing damage to pipe by excavation activities and outside forces from transportation, construction, and natural forces. Investigation also includes preventing/mitigating corrosion and the use of risk assessments/models.	Research in this area will develop new or improved products, technology, and knowledge to prevent damage to pipelines and other facilities—thereby preventing releases to the environment.
Improving Pipeline Leak Detection Systems	Addressing leaks of any quantity and product from all pipeline types. Among the possibilities for improving leak detection are monitoring systems that can detect small releases, sensors for small leak detection, technologies for aerial surveillance for airborne chemicals, improvements in the cost and effectiveness of current leak detection systems, and satellite imaging.	Research in this area will develop new or improved technology solutions for reducing the volume of product released to the environment.
Improving Anomaly Detection/ Characterization	Addressing both in-the-ditch as well as internal inspection and characterizing anomalies in all pipeline commodities and pipe materials. The ability to detect/characterize must progress past simple defects to complex anomalies having dents, gouges, and corrosion characteristics.	Research in this area will develop new or improved technology and assessment processes for identifying and locating critical pipeline defects as well as improving the capability to characterize the severity of such pipeline defects.
Improving Anomaly Repair and Pipe Remediation & Rehabilitation	Addressing reliable methods to repair damaged coatings and pipe defect damage, both from inside and outside the pipe, is critical in bringing pipeline systems back online. Investigation also includes a focus on all pipeline materials and internal liners to promote remediation/ rehabilitation and further the life of legacy systems.	Research in this area will enhance repair materials, techniques or processes, repair tools, and technology for quickly bringing pipeline systems back online.
Improving Design, Materials & Welding/Joining	Addressing improved pipeline materials, design and welding/joining techniques to mitigate or minimize integrity threats for both transmission and distribution piping. Investigation in this area also includes a focus on operation at higher pressures, automation and quality management systems that are frequently factored to address construction activities, girth weld failures, and the effective use of hydrostatic testing.	Research in this area will improve the industry's ability to design and construct safe and long-lasting pipelines using the most appropriate materials and welding/joining procedures for the operating environment.
Improving Safety Systems for Liquefied Natural Gas (LNG) Facilities	Addressing various performance-based risk reduction challenges for LNG facility design, construction, operations, maintenance, and fire protection.	Research in this area will develop new technologies, knowledge, and alternative designs for LNG storage and piping systems.
Improving Safety Systems for Underground Gas Storage (UGS)	Addressing the full lifecycle safety challenges of UGS facilities by improving design and reliability of UGS equipment. This includes not only tubing, packers, and subsurface safety valves but also knowledge enhancement for associated UGS well maintenance practices.	Research in this area will develop new technologies, knowledge, and alternative designs for UGS and piping systems.
Clearing Alternative Fuels for Pipeline	Addressing the prevention and mitigation of unique integrity threats caused by biofuels, hydrogen, and carbon dioxide so that such commodities can be	Research in this area will develop new technologies, knowledge, and methodologies for known challenges.

Transportation & Other Emerging Challenges	safely transported by pipelines. Investigations into new emerging challenges will also be completed.	

The program website, https://www.phmsa.dot.gov/research-and-development/pipeline/about-pipeline-research-development, outlines additional information on the Pipeline Safety R&D Program strategy.

3.0 Research Program Quality

To improve the quality of the Pipeline Safety R&D Program, PHMSA designed and implemented a systematic evaluation process that follows research projects from inception to implementation. This evaluation process contains five steps, each of which helps ensure that project outcomes will be of high quality, relevant to PHMSA's mission, and applied to the appropriate end-users (**Figure** 1).

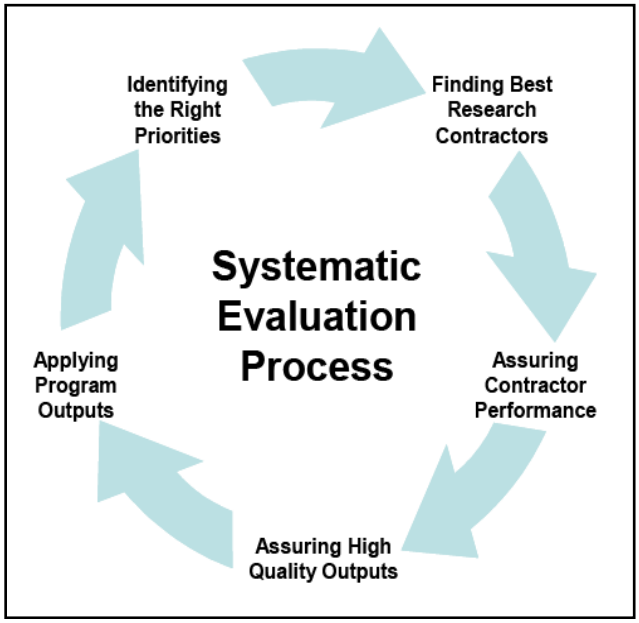


Figure 1: Systematic Evaluation Process

Ensuring the quality of research projects begins with establishing appropriate priorities. This preparatory work, which occurs at joint government/industry R&D forums and other meetings, identifies the necessary priorities and structures to meet end-users' technical needs. Additionally, this work minimizes duplication of programs, leverages funds, broadens synergies, and accounts for ongoing research efforts with other agencies and private organizations. Furthermore, this preparation allows government and industry pipeline stakeholder agreement on the technical gaps and challenges facing future R&D.

Next, the priorities and project design are refined, and a search is conducted to select the most qualified researchers. Then, PHMSA forms a merit review panel—comprising representatives from federal and state agencies, industry, and trade organizations—that independently evaluates

the technical/scientific merit of individual research applications. A consensus rating for each application subsequently is provided to the Selecting Official for consideration to determine which applications are selected.

PHMSA uses trained project managers and its Management Information System to ensure that awarded projects are performing well. The Management Information System not only monitors and tracks contractor performance as projects advance toward completion but also provides the necessary oversight to ensure that contract accounting and specific contractual milestones requirements are followed. Additionally, its design maintains and improves program quality, efficiency, accounting, and accountability actions that are implemented by program managers. PHMSA AORs and TTIs—who are trained, certified, and assigned to each project in accordance with federal acquisition regulations—provide further oversight.

The peer review process is designed to improve research project quality by keeping projects on schedule to achieve their research objectives and milestones. PHMSA defines a successful research project as one that results in a final product that is utilized by end users. PHMSA's pipeline safety research projects have a higher probability of success if the first three steps of the systematic evaluation process are applied effectively.

4.0 Peer Review Panelists

Peer review panelists are chosen based on three criteria: expertise, balance, and independence. The specific panelist selection criteria were derived from the OMB bulletin[8] and input from academia.

The 2020 peer-review panel consisted of academic representatives and one government employee (**Table 2**). Each panelist provided a short biography describing their work history and technical qualifications (**Appendix A**).

Table 2: Peer Review Panelists

No.	Name	Affiliation
1	Vikas Srivastava, Ph.D.	Assistant Professor of Engineering, Brown University
2	Steve Kusy	Office of Energy Projects, Division of LNG Facility Review & Inspections, Federal Energy Regulatory Commission (FERC)
3	Ashraf Bastawros, Ph.D.	Professor, Department of Mechanical Engineering and Material Sciences and Engineering, Iowa State University (ISU)
4	Zhibin Lin, Ph.D., P.E.	Associate Professor, Department of Civil and Environmental Engineering, North Dakota State University
5	Noor Quddus, Ph.D.	Assistant Research Engineer, Texas A&M University Mary Kay O'Connor Process Safety Center
6	Yi Bao, Ph.D.	Assistant Professor, Department of Civil, Environmental and Ocean Engineering, Stevens Institute of Technology
7	Yiming Deng, Ph.D.	Associate Professor, Nondestructive Evaluation (NDE) Laboratory, Department of Electrical and Computer Engineering, Michigan State University

[8] See Footnote 3 on p. 6.

8	Hota GangaRao, Ph.D., P.E., F.ASCE, F.SEI	Director, National Science Foundation (NSF) Center for Integration of Composites into Infrastructure; Director, Constructed Facilities Center, West Virginia University
9	Jeffrey Dull	Petroleum Engineer, U.S. Department of Interior (DOI) Bureau of Safety and Environmental Enforcement (BSEE)

5.0 Panelist Charge

The peer review panelist charge, which specifies expectations of panelist reviews, was provided to each panelist prior to the peer review. Initially developed in December 2005 and first provided to peer reviewers in 2006, it is revised annually as needed. The panelist charge is important because it 1) focuses the review on specific questions and concerns that PHMSA expects the peer reviewers to address and 2) invites general comments on the research to date, which along with the specific comments should focus mostly on whether the scientific and technical studies were applied in a sound manner.

6.0 Peer Review Scope

The underlying objective of the Pipeline Safety R&D Program is to provide the best assessment of each project's performance and address specific criteria without comparing one project to another.

The annual peer review focused on high-level researcher presentations, each of which was scheduled to last 20 minutes and was followed by a 10-minute question-and-answer period. Each project review lasted approximately 2 hours, which provided sufficient time for reviews of project background information and its associated reporting, reviews of an advance copy of the slides, and 30 minutes of review and questioning from the panel. This time also included a post-review period that included follow-up questioning, a consensus review meeting, and analysis of the peer review report.

PHMSA provided the panelists with scorecards that allowed them to rate each project's performance according to the following criteria:

1. Is progress being made toward project objectives and project management for both the budget and the schedule?
2. Is there a plan for technology/knowledge transfer or the dissemination of results, including publications, reporting, and/or patents?
3. How much end-user involvement is incorporated into the scope of work?
4. Is the project work being communicated to other related research efforts?
5. Are the intended results consistent with scientific knowledge and/or engineering principles?
6. Are the intended results presented in such a manner as to be useful for identified end-users?

Each criterion was rated according to the scale listed in **Table 3**; higher overall ratings indicated a higher expectation of project success.

Table 3: Peer Review Rating Scale

Rating	Description	Numeric Score
Very Effective	Provides the clearest method regarding how project will accomplish its purpose. Produces the intended or expected result in a superior manner.	4.5–5.0
More Than Effective	Accomplishes its purpose in a better, clearer, and more distinct manner than a project rated Effective. Produces the intended or expected result in a more-than-satisfactory manner.	3.0–4.4
Effective	Adequate in accomplishing its purpose. Produces the intended or expected result in a satisfactory manner.	1.9–2.9
Ineffective	Does not produce the desired results, is expected to be ineffectual, and lacks the necessary details to support a satisfactory outcome.	0.0–1.8

7.0 Associated Research

Specific research project subject matter will vary from one annual peer review to another; however, the subject matter generally falls within the eight program elements listed in **Table** 1. Technical issues can address metallurgical, structural, technological, and risk-based subjects that are common in the pipeline, LNG, and UGS industries.

The research assessed during the October 2020 review encompassed multiple technological solutions and a focus on general knowledge. **Appendix B** provides a short description of each peer-reviewed project.

8.0 Peer Review Findings

Using the rating scale listed in **Table 3**, all 29 reviewed projects were rated Effective or higher. The average program rating across all evaluation categories was More Than Effective, as was the average subcriteria rating. **Figures 2** through **4** summarize the overall program rating, average rating and score per evaluation criterion, and the ranking and rating of individually reviewed research projects, respectively. **Figure 3** also shows the panel's summary of overall program performance.

Most projects were approximately 30 to 50 percent complete at the time of review, and most project timelines recovered from COVID-19 impacts. During the review, the panelists made several recommendations associated with each project that PHMSA categorized into strengths and weaknesses. The greatest identified project strengths were technology transfer, end-user involvement, and dissemination plans for project results. Conversely, communication of activities with other related projects was indicated as the area most needing improvement.

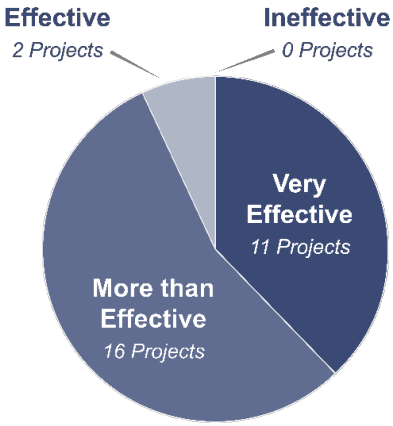


Figure 2: Program Rating Summary

	Review Categories and Sub-criteria	Score	Rating
1	Is progress being made towards project objectives and project management for both the budget and the schedule?	4.2	More than Effective
2	Is there a plan for technology/knowledge transfer or the dissemination of results, including publications, reporting, and/or patents?	4.0	More than Effective
3	How much end-user involvement is incorporated into the scope of work?	4.2	More than Effective
4	Is the project work being communicated to other related research efforts?	4.0	More than Effective
5	Are the intended results consistent with scientific knowledge and/or engineering principles?	4.1	More than Effective
6	Are the intended results presented in such a manner as to be useful for identified end-users?	4.2	More than Effective
	Program Summary	4.1	More than Effective

Figure 3: Average Score and Rating per Evaluation Criteria

Project Title	Contractor	Rating
Data Collection, Normalization and Integration Methods to Enhance Risk Assessment Tools for Decision-Making	Gas Technology Institute	4.9 - Very Effective
External Leak Detection Body of Knowledge	Gas Technology Institute	4.8 - Very Effective
On-Board Power and Thrust Generation for the Explorer Family of Robots for the Inspection of Unpiggable Natural Gas Pipelines	Northeast Gas Association/ NYSEARCH	4.7 - Very Effective
Improved Tools to Locate Buried Pipelines in a Congested Underground	Gas Technology Institute	4.7 - Very Effective
Evaluation of the Efficacy and Treatment of Hazard Mitigation Measures for LNG Facilities	Gas Technology Institute	4.7 - Very Effective
Develop an Evaluation Protocol for Non-LNG Release Hazards - Modeling	Blue Engineering and Consulting Company	4.7 - Very Effective
Consistency Review of Methodologies for Quantitative Risk Assessment	Gas Technology Institute	4.6 - Very Effective
Procedures for Selecting Locating and Excavation Technologies	Operations Technology Development	4.6 - Very Effective
Validation of Remote Sensing and Leak Detection Technologies Under Realistic and Differing Conditions	Operations Technology Development	4.6 - Very Effective
Develop a Risk-Based Approach and Criteria for Hazard Detection Layout	Blue Engineering and Consulting Company	4.6 - Very Effective
Mapping Indication Severity Using Bayesian Machine Learning from Indirect Inspection Data into Corrosion Severity for Decision-Making in Pipeline Maintenance	Texas A&M University	4.6 - Very Effective
Subsurface Multi-Utility Asset Location Detection	Gas Technology Institute	4.4 - More than Effective
Develop Remote Sensing and Leak Detection Platform that can Deploy Multiple Sensor Types	Pipeline Research Council International	4.4 - More than Effective
Improving Subsurface Non-metallic Utility Locating Using Self-Aligning Robotic Ground Penetrating Radar	ULC Robotics	4.4 - More than Effective
River Scour Monitoring System for Pipeline Threat Prevention	Arizona State University	4.3 - More than Effective

Figure 4: Score and Rating for Individual Research Projects (1 of 2)

Project Title	Contractor	Rating
Develop and Demonstrate a Remote Multi-Sensor Platform for Right of Way Defense	Operations Technology Development	4.3 - More than Effective
ORFEUS Obstacle Detection for Horizontal Directional Drilling	Operations Technology Development	4.1 - More than Effective
Modernize the Assessment of River Crossings	Pipeline Research Council International	4.0 - More than Effective
Improve In-Line Inspection Sizing Accuracy	Pipeline Research Council International	3.9 - More than Effective
Validating Non-Destructive Tools for Surface to Bulk Correlations of Yield Strength, Toughness, and Chemistry	Operations Technology Development	3.8 - More than Effective
Program to Advance Computed Tomography for the Development of Reference Standards for Pipeline Anomaly Detection and Characterization	Pipeline Research Council International	3.8 - More than Effective
Improve Dent/Cracking Assessment Methods	Pipeline Research Council International	3.8 - More than Effective
Validate In-Line Inspection Capabilities to Detect/ Characterize Mechanical Damage	Pipeline Research Council International	3.8 - More than Effective
Improving the Reliability, Detection, and Accuracy Capabilities of Existing Leak Detection Systems Using Machine Learning	Pipeline Research Council International	3.7 - More than Effective
Systematize 20 Years of Mechanical Damage Research	Pipeline Research Council International	3.5 - More than Effective
Review the Intent and Safety Impact of Hoop Stress and Percentage of Specified Minimum Yield Stress Boundaries on Natural Gas Transmission and Distribution Pipelines	Gas Technology Institute	3.3 - More than Effective
Reliability of Subsurface Safety Valves	Battelle Memorial Institute	3.1 - More than Effective
Improvements to Pipeline Assessment Methods and Models to Reduce Variance	Gas Technology Institute	2.8 - Effective
Tubing and Packers Life-Cycle Analysis for Underground Gas Storage Applications	Battelle Memorial Institute	2.7 - Effective

Figure 4: Score and Rating for Individual Research Projects (2 of 2)

Figure 4 itemizes the order of project rankings for projects with the same score that have equal rankings.

Appendix B itemize the identified strengths and weaknesses of each panelist-reviewed project; these points were raised consistently by the panelists and are reflected in the scoring of multiple

evaluation categories. Any specific recommendations will be disseminated to researchers and AORs, as necessary, so that individual decisions regarding changes in scope can be determined.

9.0 PHMSA's Official Response to Panelist Findings and Recommendations

The CY 2020 peer reviews were the PHMSA Pipeline Safety R&D Program's 15th structured review. The PHMSA Office of Pipeline Safety, Engineering and Research Division, thanks the panelists for their work, technical support, and critical insights.

PHMSA Office of Pipeline Safety management has reviewed this summary report. PHMSA approves of the CY 2020 reviews, findings, and recommendations provided by the peer review panelists and will work with the R&D program managers and TTIs to implement those findings and recommendations.

The findings and recommendations from the CY 2019 reviews were shared with the researchers and PHMSA staff; however, no contractual actions were taken because those reviews identified no project that required significant changes.

The panel indicated that some actions can be taken to further enable research projects and achieve contractual milestones (**Appendix B**). Some examples involve seeking additional subject matter experts involved with projects, increasing coordination with related projects funded by PHMSA, and further promoting knowledge transfer activities. These are common recommendations to most projects; PHMSA strives to implement improvements throughout the research project lifecycle. Once the summary report is posted publicly, PHMSA will accept the panel's findings and recommendations and communicate these suggestions to the reviewed projects.

PHMSA will continue refining the annual peer review process, as needed, by incorporating feedback submitted by the researchers and peer review panelists. Additionally, PHMSA will disseminate other specific panelist recommendations to researchers, AORs, and TTIs. PHMSA acknowledges the comments received during these reviews as an opportunity to continually improve.

PHMSA looks forward to continuing to leverage the active participation of all its stakeholders as it seeks to improve the safety of the nation's pipeline transportation system and protect people and the environment.

APPENDIX A

Peer Review Panelist Biographies

Vikas Srivastava, Ph.D.

Dr. Vikas Srivastava currently is a tenure-track assistant professor at the Brown University School of Engineering, Providence, Rhode Island.

Dr. Srivastava received his Bachelor of Technology from I.I.T. Kanpur, his Master of Science from the University of Rhode Island, and his Ph.D. in Mechanical Engineering from the Massachusetts Institute of Technology. After earning his Ph.D. in 2010, he worked at ExxonMobil Upstream Research and ExxonMobil Corporate Strategic Research in various roles, including Senior Technical Professional Advisor – Mechanics of Materials; Mechanics Team Lead, Marine Team Lead; Fitness for Service Research Area Lead; and Worldwide Deepwater Drilling Coordinator. He also served as an Advisory Board Member for the DeepStar Industry Consortium on high pressure, high temperature subsea systems. He has significant industry experience, specifically in the areas of high-speed turbo machinery and fluid film bearings.

Dr. Srivastava joined Brown University as Assistant Professor of Engineering in the fall of 2018. His research focus is on the role of solid mechanics in engineering structures. He has active research programs on accurate nondestructive testing crack characterization and fracture modeling for steel pipelines, and experimentally studying and modeling failure of polyethylene in chemical and thermal environments.

Steve Kusy

Steven “Steve” Kusy graduated from Stevens Institute of Technology, Hoboken, New Jersey, with a Master of Engineering in Engineering Management and a Bachelor of Engineering in Mechanical Engineering. Upon graduating, he was successfully qualified by the U.S. Department of the Navy as a nuclear test engineer to provide power plant operations and maintenance on A4W reactors. Mr. Kusy subsequently transferred to FERC, where he has now been for over 7 years, to work on safety and reliability reviews and inspections at LNG facilities. Currently, he is the LNG senior compliance manager within the Division of LNG Facility Review and Inspections.

Ashraf Bastawros, Ph.D.

Dr. Ashraf Bastawros is a T.A. Wilson Professor of Aerospace Engineering at ISU, Ames, Iowa. He also holds courtesy appointments with the mechanical engineering as well as material sciences and engineering departments at ISU. He is an associate of Ames National Laboratory—a U.S. Department of Energy (DOE) facility—since 1999. He received his Bachelor of Science in Mechanical Engineering in 1988 and his Master of Science in Mechanical Engineering in 1991 from Cairo University, Egypt. Additionally, he received a Master of Science in Applied Mathematics in 1995 and a Ph.D. in Solid Mechanics in 1997 from Brown University. Until 1999, he was a postdoctoral fellow at Harvard University, Cambridge, Massachusetts, where he worked with John Hutchinson and Anthony Evans, two of the pioneers of fracture and failure analysis.

APPENDIX A

Peer Review Panelist Biographies

Dr. Bastawros has nearly 30 years of experience in the areas of fracture and failure analysis of complex material systems; size effects on the electromechanical, chemomechanical, and thermomechanical response of dense and cellular materials with application to reliability of pipeline safety; electronic packaging; the mechanics of micro- and nano-manufacturing; surface finishing; and fractal analysis of fractured surfaces.

Dr. Bastawros has authored and coauthored over 100 technical publications in journals and conference proceedings. He is the recipient of the NSF Career Award and ISU Young Engineering Faculty Research Award. He has managed research grants of over $11 million from government agencies and industry. He chaired the prestigious 47th Annual Meeting of the Society of the Engineering Science held at ISU. Additionally, he was the chair of the fracture and failure committee at the American Society of Mechanical Engineers (ASME) from 2009 to 2012 and the associate editor for the ASME Journal of Engineering Materials and Technology from 2011 to 2018. As an educator, he has nurtured and mentored several undergraduate and graduate students as well as junior faculty in the area of the mechanics of materials.

Zhibin Lin, Ph.D., P.E.

Dr. Zhibin Lin is a tenure-track associate professor in the Department of Civil and Environmental Engineering at North Dakota State University, Fargo, North Dakota. He received his Ph.D. from the University of Wisconsin-Milwaukee.

Dr. Lin has over 14 years of experience in advanced materials and structural health monitoring. His current research focuses on corrosion mitigation and weldment, development of coating and characterization, structural health monitoring, and damage detection. He has published over 30 conference papers and presentations as well as over 30 peer-reviewed journal papers. He co-authored a book titled, “Solid and Structural Analysis with the Finite Element Method.” His research has received awards from the DOT, PHMSA, Minnesota State Department of Transportation, North Dakota (ND) State Department of Commerce, National Natural Science Foundation of China, ND State Department of Transportation’s Transportation Innovations Program (TRIP), ND Established Program to Stimulate Competitive Research (EPSCoR), and the ND National Aeronautics and Space Administration (NASA) EPSCoR. He also served as a panelist for NSF.

Currently, Dr. Lin is the secretary of American Concrete Institute Committee 523; a member of Subcommittee 447, Finite Element Analysis of Reinforced Concrete Structures; and a member of Subcommittee 446, Fracture Mechanics of Concrete.

Noor Quddus, Ph.D.

Dr. Noor Quddus is an assistant research engineer in the Mary Kay O’Connor Process Safety Center at Texas A&M University, College Station, Texas. He received his Ph.D. from the University of Alberta, Edmonton, Alberta, Canada. Before joining the Center, he was Associate Professor at Bangladesh University of Engineering and Technology, Dhaka, Bangladesh.

APPENDIX A

Peer Review Panelist Biographies

Dr. Quddus has over 10 years of experience in the areas of safety and risk assessment as well as computational modeling. His research interest lies in applying mathematical tools—such as computational fluid dynamics, machine learning, fuzzy logic, and game theory—to solve safety engineering problems. His current research focuses are hazardous material transport and storage as well as incident data analysis, causal modeling, and incident investigation in process industries. He has published over 25 peer reviewed journal articles, over 40 conference papers and presentations, and over 20 technical reports. He led several projects funded by the Transportation Research Board (TRB), Federal Railroad Administration (FRA), BSEE, PHMSA, and World Bank.

Currently, Dr. Quddus is a member of the technical advisory committee at the Mary Kay O'Connor Process Safety Center and the technical committee for the International Symposium on Process Safety. Additionally, he is the vice chairman of the steering committee for the Instrumentation and Automation Symposium.

Yi Bao, Ph.D.

Dr. Yi Bao is a tenure-track assistant professor in the Department of Civil, Environmental and Ocean Engineering at the Stevens Institute of Technology. He received his Ph.D. from the Missouri University of Science and Technology, Rolla, Missouri. Before joining Stevens Institute of Technology, he was a research fellow at the University of Michigan-Ann Arbor and a guest researcher at the National Institute of Standards and Technology (NIST), Gaithersburg, Maryland.

Dr. Bao's research interests include structural health monitoring (SHM); electromagnetic and acoustic NDE; smart and high-performance materials; machine learning; innovative structural design and rehabilitation; three-dimensional (3D) printing; and multiscale, multiphysics simulations. His research team develops novel distributed fiber optic sensor network and data analytics for monitoring, understanding, and improving pipeline safety and functionality. He has published over 80 peer-reviewed journal papers. He has received funding from the DOT, PHMSA, New Jersey Department of Transportation, NIST, DOE, Department of Defense (DOD), and NSF as well as private companies.

Currently, Dr. Bao serves on the editorial boards of the Journal of Bridge Engineering and the Journal of Shock and Vibration. He serves as a panelist and reviewer for the DOT, NSF, NIST, DOE, and New Jersey Sustainability Program as well as over 30 scientific journals. He received Outstanding Reviewer Awards from the Journal of Bridge Engineering, Journal of Physics D, Materials Letters, and others.

Yiming Deng, Ph.D.

Dr. Yiming Deng is an associate professor at the NDE Laboratory in the Electrical and Computer Engineering Department at Michigan State University, East Lansing, Michigan. His research interests include electromagnetic and acoustic NDE; SHM for multiscale, multiresolution, and multiparameter damage diagnostics and prognostics; applied electromagnetics; acoustics; and

computational modeling. His research team is developing novel NDE/SHM actuators, sensors, and sensing systems that involve multiphysics simulations for understanding imaging physics. He and his team also are conducting experimental validations and actuator/sensor prototyping that will have a wide range of engineering applications to ensure safety, security, reliability, and sustainability. Additionally, these validations and prototypes will have applications to defense, critical energy, and transportation infrastructures.

Dr. Deng is an associate editor of the Institute of Electrical and Electronics Engineers (IEEE) Transactions on Reliability, Materials Evaluation, and Reliability and Maintainability (RAMS) Proceedings. He serves as a panelist and reviewer for the DOT, NSF, DOE, and DOD National Defense Science and Engineering Graduate (NDSEG) Program with the American Society for Engineering Education (ASEE) as well as over 30 scientific journals. He is a senior member of IEEE and a member of the American Society for Nondestructive Testing, Inc. (ASNT), for which he was the 2010 and 2017 faculty grant award winner.

Hota GangaRao, Ph.D., P.E., F.ASCE, F.SEI

After joining West Virginia University, Morgantown, West Virginia, in 1969 as an assistant professor, Dr. Hota attained the rank of Maurice & JoAnn Wadsworth Distinguished Professor at the Statler College of Engineering and Mineral Resources in the Department of Civil and Environmental Engineering. He became a fellow of the American Society of Civil Engineers (ASCE) and the Structural Engineering Institute (SEI). He has directed the Constructed Facilities Center since 1988 as well as directed the Center for Integration of Composites into Infrastructure. Both centers are cosponsored by the NSF.

Through many interdisciplinary activities, Dr. Hota has worked to advance the state-of-the-art of fiber reinforced polymer (FRP) composite materials and their applications to infrastructure systems. He has demonstrated success by field-implementing his research findings and technical innovations for construction and rehabilitation of a wide spectrum of engineering systems in West Virginia, Ohio, Pennsylvania, Alaska, and other states. In addition to the application of FRPs for highway and railroad structures, he has utilized FRP composites for corrosion-resistant storage buildings and economical modular housing. Recently, Dr. Hota has been involved with innovations of naval vessels, prefabricated pavements, utility poles, high-pressure gas pipes, sheet piling, and natural fiber-reinforced composites.

Dr. Hota has published textbooks, book chapters, and over 400 technical papers on a wide range of subjects in refereed journals and proceedings. He has received 12 patents and many national awards; He has advised over 300 Master of Science. and Ph.D. students. His pioneering accomplishments have been covered by CNN; ABC World News Tonight; KDKA, Pittsburgh, Pennsylvania; PBS West Virginia, and many others.

Jeffrey R. Dull

Mr. Dull graduated from West Virginia University with a Bachelor's in Petroleum and Natural Gas Engineering. He is a petroleum engineer with BSEE's Office of Strategic Operations,

APPENDIX A

Peer Review Panelist Biographies

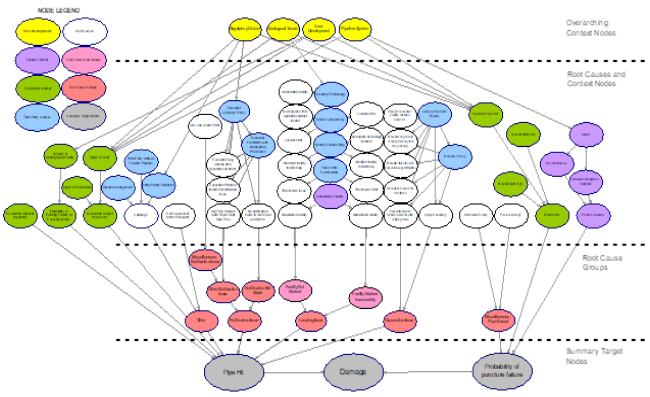
Facilities and Pipelines Section in the Pacific Outer Continental Shelf (OCS). Mr. Dull is considered an asset due to his expertise in offshore oil and gas facilities and pipelines. Mr. Dull's 10+ years of experience includes leading and performing engineering analysis and reviews of requests submitted by oil and gas transportation industry operators, including applications to design, install, maintain, inspect, repair, and ultimately decommission oil and gas facilities and pipelines. Mr. Dull conducts technical reviews and evaluations of operator permits, applications, plans, and plan revisions to ensure compliance with operating regulations and other directives, with the objective of maintaining a safe and pollution-free environment. He is considered a valuable contributing member on national teams that are developing proposed rules and policies associated with BSEE OCS oil and gas operations to ensure appropriateness to the management of offshore operations. Mr. Dull works collaboratively and efficiently with other federal, state, and local government agencies—particularly the Bureau of Ocean Energy Management Headquarters and other BSEE regions—to provide timely communications and expedite bureau actions.

APPENDIX B

Peer-Reviewed Project Summaries and Panel Reviewer Comments

(In order, as shown in Figure 4)

Data Collection, Normalization and Integration Methods to Enhance Risk Assessment Tools for Decision-Making



Picture courtesy of Gas Technology Institute

Project Fast Facts	
Research Award Recipient	Gas Technology Institute
Agreement #	693JK31910002POTA
Fiscal Year Start	2019 (09/30/2019)
Fiscal Year End	2022 (12/29/2021)
PHMSA Funding	$1,161,597
Click here to visit the public project page.	

Project Description

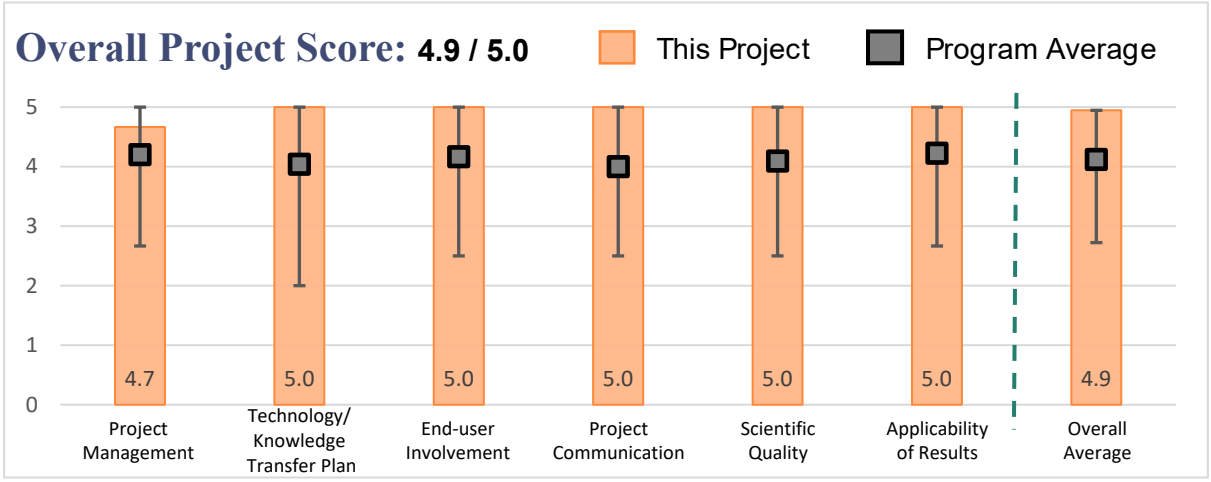
This project will apply machine learning (ML) and modeling to effectively evaluate pipeline integrity data and assist in making informed decisions about pipeline operator systems.

Strengths

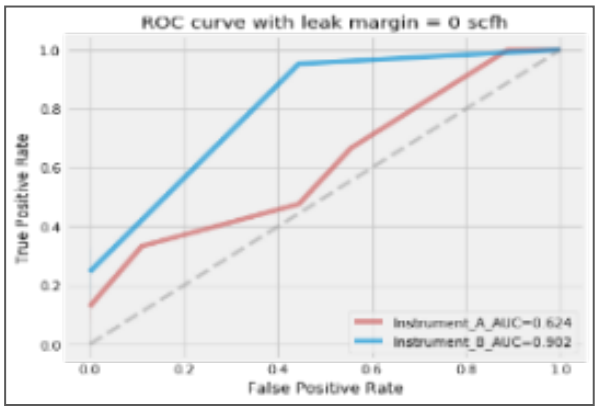
The research project scope incorporates astounding end-user involvement; 15 to 20 utility operators attend quarterly coordination calls that provide an opportunity for interaction and a review of completed items. This interaction supports leveraging industry data that will enrich the project. The project includes a comprehensive plan to communicate project results to end-users by sharing information with involved industry companies at American Gas Association technical conferences and with Operation Technology Development member companies, which also are co-sponsoring this project. Additionally, journal papers are being prepared for publication by the academic institutions participating in the project; the applied results will be presented at the appropriate industry forums. Commercial software incorporating the methods developed will be introduced into the marketplace upon completion of the project.

Weaknesses

None noted.



External Leak Detection Body of Knowledge



Picture courtesy of Gas Technology Institute

Project Fast Facts	
Research Award Recipient	Gas Technology Institute
Agreement #	693JK31810005
Fiscal Year Start	2018 (08/01/2018)
Fiscal Year End	2021 (07/31/2021)
PHMSA Funding	$399,821
Click here to visit the public project page.	

Project Description

This project will develop a recommended practice to detect leaks externally on natural gas transmission lines that will increase the safe operation of the national natural gas transmission pipeline network by standardizing practices across operators. Additionally, early detection of leaks will ensure that safety measures are in place before a leak becomes a safety hazard.

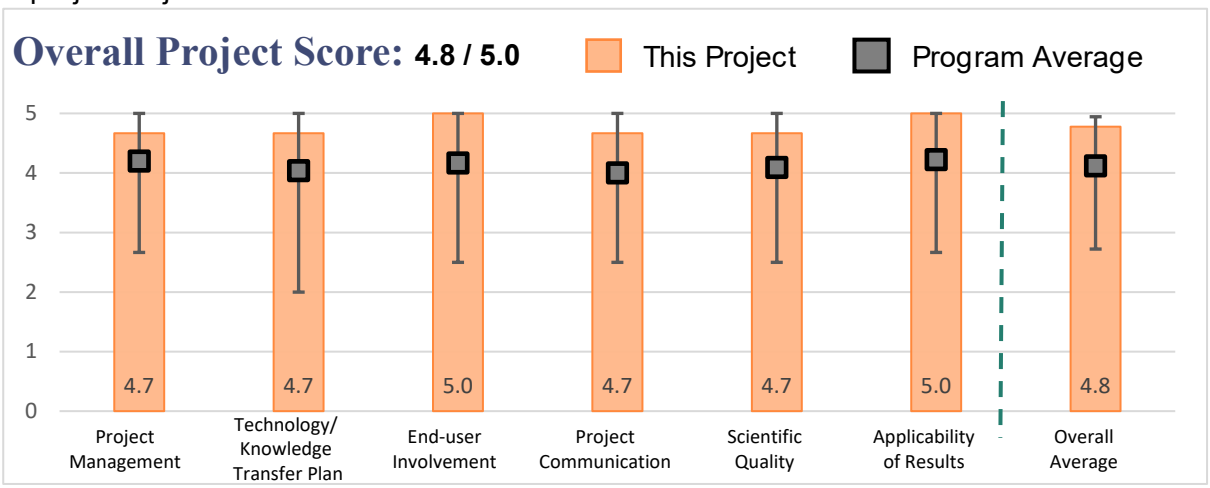
Strengths

The project is highly organized, and the project staff are managing their tasks well because this project provided detailed information about how each relevant leak factor will be addressed. The project is on schedule and making progress towards achieving its objectives by providing many examples of how data from completed tasks support project objectives.

There is a comprehensive plan to disseminate project results to end-users through papers/presentations planned at two industry events and with industry project participants. Additionally, there is end-user involvement into the work scope; eight utility operators attend quarterly coordination calls that provide an opportunity for interaction and a review of completed. Furthermore, project supports leveraging industry data that will enrich the project. The format of project results is well matched to end-user needs because the results will be formatted similarly to industry safety management system standards.

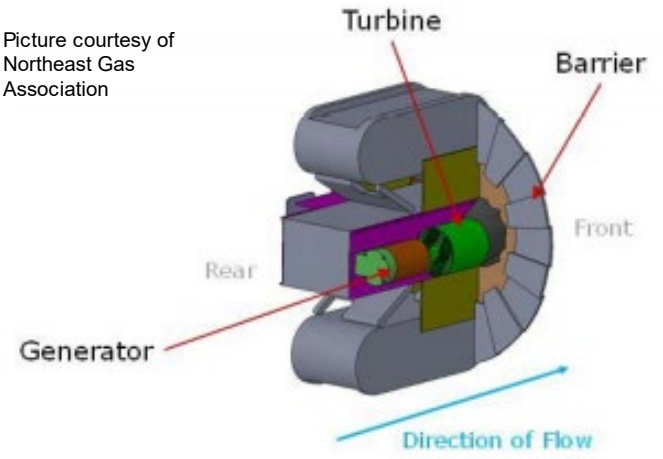
Weaknesses

There is a suggestion to expand the literature search to ensure that as many technology solutions as possible are factored.



On-Board Power and Thrust Generation for the Explorer Family of Robots for the Inspection of Unpiggable Natural Gas Pipelines

Picture courtesy of Northeast Gas Association



Project Fast Facts	
Research Award Recipient	Northeast Gas Association
Agreement #	693JK31810002
Fiscal Year Start	2018 (08/01/2018)
Fiscal Year End	2021 (04/30/2021)
PHMSA Funding	$898,795
Click here to visit the public project page.	

Project Description

This project will develop, test, and commercialize an on-board electric power generation and thrust generation system for in-line, live inspection of unpiggable natural gas pipelines. The researcher plans to extend battery life and increase the inspection distance of this inspection tool.

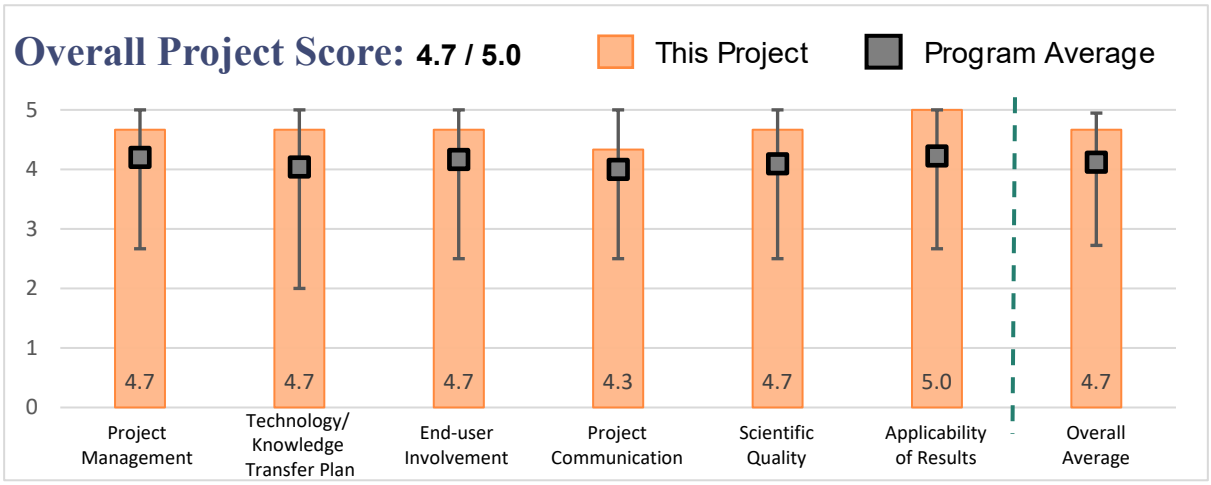
Strengths

The project, which provided information on completed project tasks and examples of results to date, is on schedule and making progress towards achieving its objectives

There is strong end-user involvement into the work scope based on the project interfacing with a 25-member operator consortium and regular meetings with end-users involved with the project. The format of project results is well matched to end-user needs because of the strong interaction with operator end-users.

Weaknesses

None noted.



Improved Tools to Locate Buried Pipelines in a Congested Underground

Picture courtesy of Gas Technology Institute

Project Fast Facts	
Research Award Recipient:	Gas Technology Institute
Agreement #	693JK31810009
Fiscal Year Start	2018 (08/01/2018)
Fiscal Year End	2021 (10/31/2020)
PHMSA Funding	$502,000
Click here to visit the public project page.	

Project Description

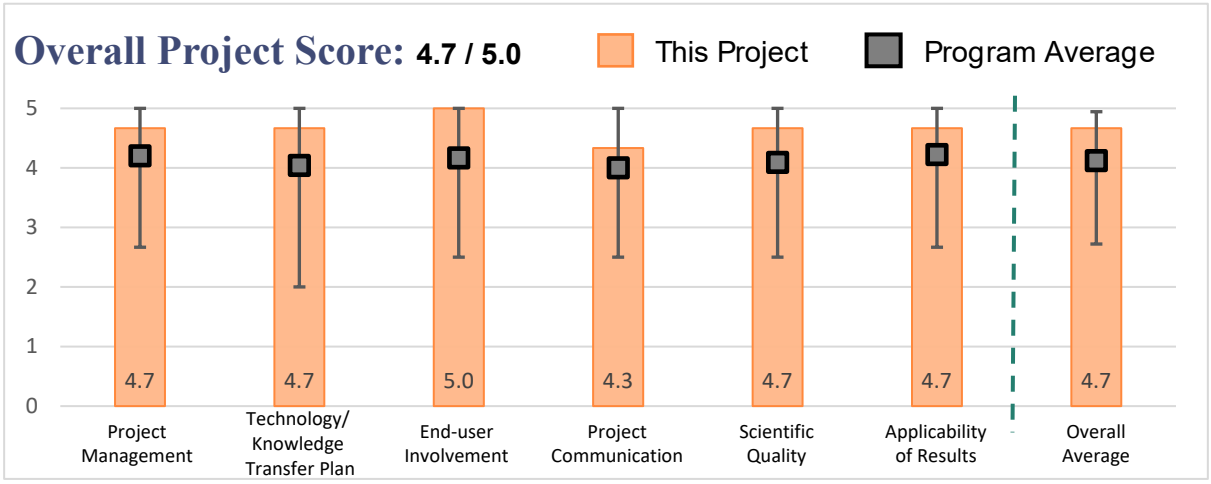
This project will develop and commercialize a geospatial probe for mapping existing buried utilities via insertion of the probe into live natural gas pipelines. This probe will be capable of mapping live underground pipes three-dimensionally and will provide accurate utility locations. Additionally, this project will create a cloud-based system to collect and store data so that the data can be easily accessible to the utilities.

Strengths

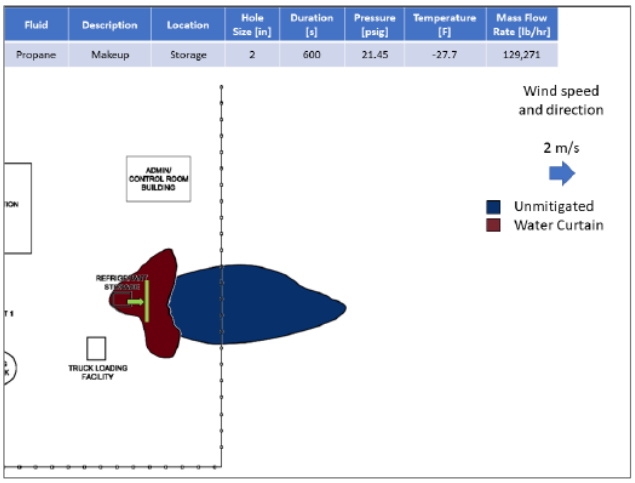
There is strong end-user involvement into the work scope and the leveraging of prior/ongoing related work. Details about the multiple operators involved and about how the researcher is sharing project information with other ongoing projects and technology service providers were provided through frequent coordination meetings.

Weaknesses

There is a suggestion to expand the distribution of project results with more publications.



Evaluation of the Efficacy and Treatment of Hazard Mitigation Measures for LNG Facilities



Picture courtesy of Gas Technology Institute

Project Fast Facts	
Research Award Recipient	Gas Technology Institute
Agreement #	693JK31910003POTA
Fiscal Year Start	2019 (09/30/2019)
Fiscal Year End	2021 (01/31/2021)
PHMSA Funding	$319,707
Click here to visit the public project page.	

Project Description

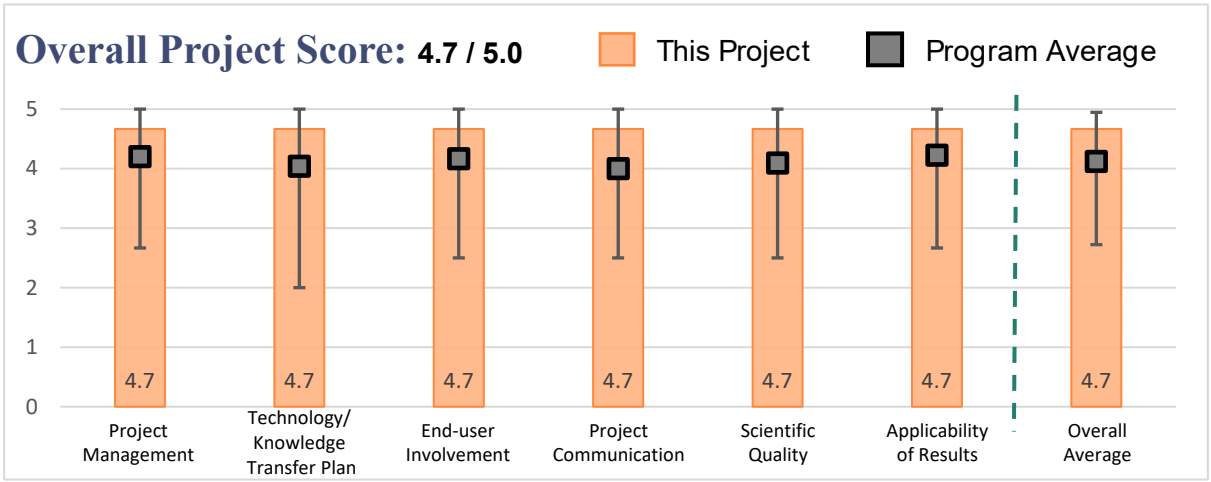
This project will develop a standardized and detailed methodology that utilizes the thermal radiation and vapor dispersion models that are currently approved by PHMSA. This research methodology will enable operators to calculate thermal radiation and vapor dispersion distances arising from the use of hazard mitigation measures that are commonly employed at liquefied natural gas (LNG) facilities but not currently recognized under 49 Code of Federal Regulations (CFR) Part 193.

Strengths

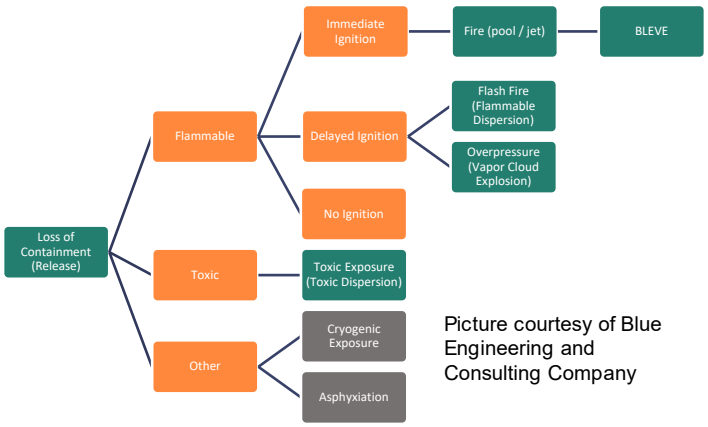
There is excellent end-user involvement into the work scope and the leveraging of prior/ongoing related work. The presentation illustrated details about the five facility operators providing insight and data to the project and how the project is sharing data with nine other related LNG research projects. Because of this effort, the results to date are highly relevant to regulator and industry needs. There is a comprehensive plan to disseminate project results to end-users via planned presentations and papers to industry conferences. The plan also incorporates sharing project results.

Weaknesses

There is a suggestion to expand the distribution of project results with more publications.



Develop an Evaluation Protocol for Non-LNG Release Hazards - Modeling



Picture courtesy of Blue Engineering and Consulting Company

Project Fast Facts	
Research Award Recipient	Blue Engineering and Consulting Company
Agreement #	693JK31910009POTA
Fiscal Year Start	2019 (09/30/2019)
Fiscal Year End	2021 (07/31/2021)
PHMSA Funding	$472,844
Click here to visit the public project page.	

Project Description

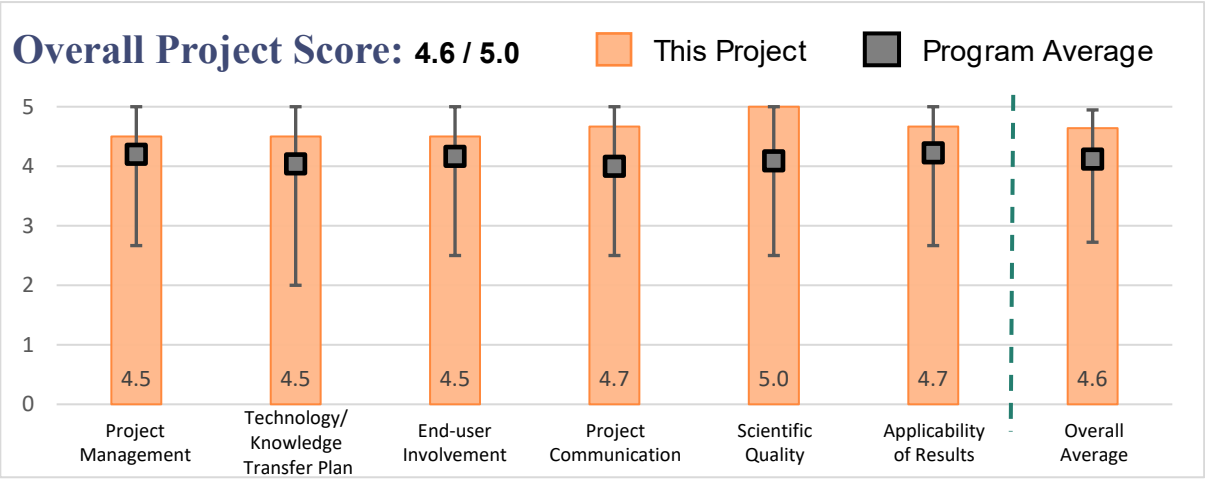
This project will develop a protocol for the evaluation of models used to quantify the different types of hazards associated with LNG facilities. The protocol will include a set of relevant and well-defined empirical data to evaluate a model.

Strengths

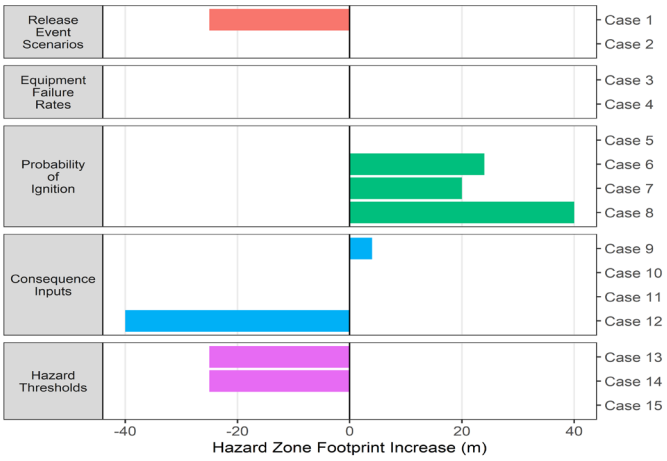
There is strong end-user involvement into the work scope and the leveraging of prior/ongoing related work. Details were provided about the five facility operators and other federal regulators involved with guiding the project. The project also is sharing data with four other related LNG research projects; the project results to date are highly relevant to the regulator and industry needs. There is a comprehensive plan to disseminate project results to end-users through planned web-based symposiums by a standards organization's technical committee.

Weaknesses

There is a suggestion to expand the distribution of project results with more publications.



Consistency Review of Methodologies for Quantitative Risk Assessment



Picture courtesy of Gas Technology Institute

Project Fast Facts	
Research Award Recipient	Gas Technology Institute
Agreement #	693JK31810006
Fiscal Year Start	2018 (08/01/2018)
Fiscal Year End	2020 (07/31/2020)
PHMSA Funding	$858,587
Click here to visit the public project page.	

Project Description

This project will develop a methodology and set of guidelines to establish consistency, guidance, and best practices when performing quantitative risk assessments of LNG facilities. The project will demonstrate these guidelines on two representative existing LNG facilities: peak shaving and export.

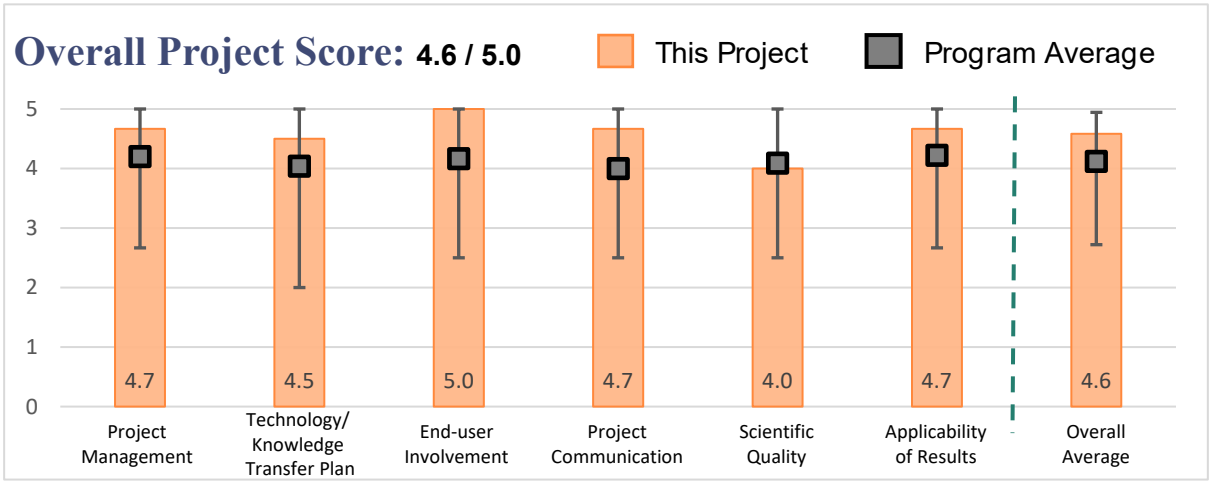
Strengths

The project is well executed and producing results. Details were presented about which project tasks were completed, and examples were provided of results to date.

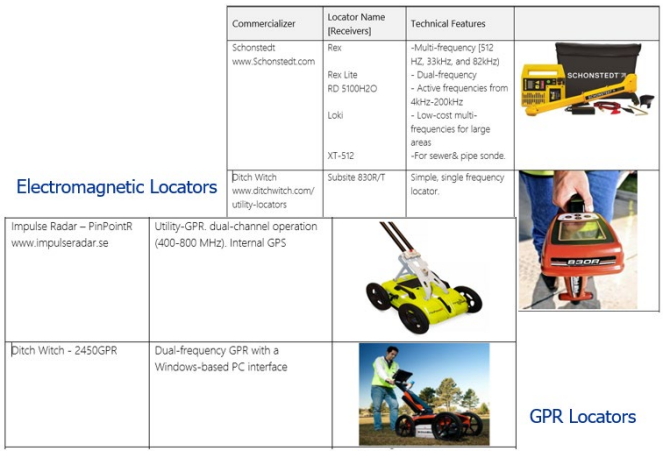
There is excellent end-user involvement into the project work scope and the leveraging of prior/ongoing related work. Details were provided about the seven facility operators and other federal regulators providing input on the project. The project also is sharing data with four related LNG research projects.

Weaknesses

There is a suggestion to expand the distribution of project results with more publications.



Procedures for Selecting Locating and Excavation Technologies



Picture courtesy of Operations Technology Development

Project Fast Facts	
Research Award Recipient	Operations Technology Development NFP
Agreement #	693JK31910005POTA
Fiscal Year Start	2019 (09/30/2019)
Fiscal Year End	2021 (09/30/2021)
PHMSA Funding	$495,000
Click here to visit the public project page.	

Project Description

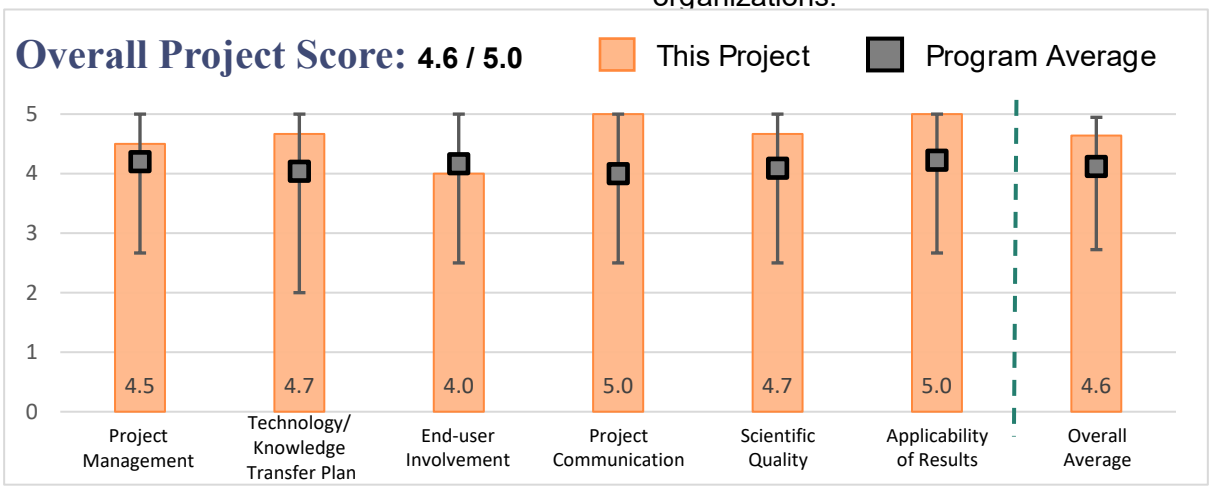
The project will investigate underground utility locating and excavating technologies and practices, as well as new systems for pipeline encroachment notification. The project will develop a web-based program and database to identify and address high-risk excavations. The project also will develop a situational awareness framework intended to provide information on underground utilities, site characteristics, and high-risk features of the excavation sites.

Strengths

The project presented a detailed plan with utilities collecting records on excavation damage incidents, including complementing a review of PHMSA records that will support a root-cause analysis. Prior/ongoing related work is being leveraged, and a comprehensive plan is in place to disseminate project results to end-users. The project presented information about how the prior work informs the current project and the multiple avenues for presentations and papers to industry events.

Weaknesses

There is a suggestion to seek further end-user involvement into the work scope execution because the project presented only high-level details without a specific list of involved companies or organizations.



Validation of Remote Sensing and Leak Detection Technologies Under Realistic and Differing Conditions

Pictures courtesy of Operations Technology Development

Project Fast Facts	
Research Award Recipient	Operations Technology Development NFP
Agreement #	693JK31910006POTA
Fiscal Year Start	2019 (09/30/2019)
Fiscal Year End	2022 (12/31/2021)
PHMSA Funding	$500,000
Click here to visit the public project page.	

Project Description

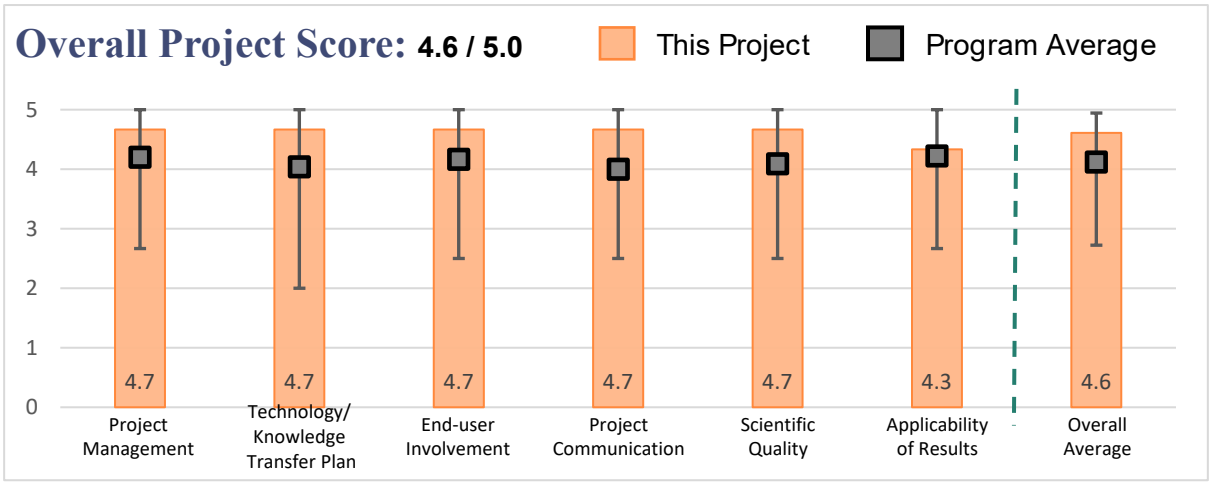
The project will develop and implement a sensor validation framework focused on pipeline leaks verified through ground-truthing measurement, performing surface observations and measurements of various properties of the ground, and simulated integrity threats. The framework will incorporate field settings with different infrastructure, terrain, and land cover challenges, from rural to suburban to urban.

Strengths

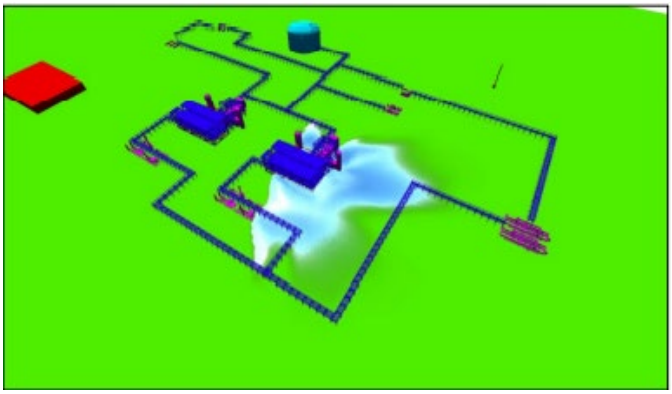
The project seems to be on schedule since details were provided about which tasks were completed and which tasks remain incomplete. There is strong end-user involvement into the work scope, leveraging of prior/ongoing related work, and a comprehensive plan to disseminate project results to end-users. Details were presented on how the seven operators were involved with providing insight and data, on how nine related research efforts are influencing this project; and on how the multiple papers will be published.

Weaknesses

There is a suggestion to conduct additional demonstrations to further validate the sensors from the chosen platform. Because limited information was provided, it is recommended to provide a high focus on calibrating and testing the involved technologies under high-vegetation right-of-way scenarios.



Develop a Risk-Based Approach and Criteria for Hazard Detection Layout



Picture courtesy of Blue Engineering and Consulting Company

Project Fast Facts	
Research Award Recipient	Blue Engineering and Consulting Company
Agreement #	693JK31910008POTA
Fiscal Year Start	2019 (09/30/2019)
Fiscal Year End	2021 (06/30/2021)
PHMSA Funding	$310,544
Click here to visit the public project page.	

Project Description

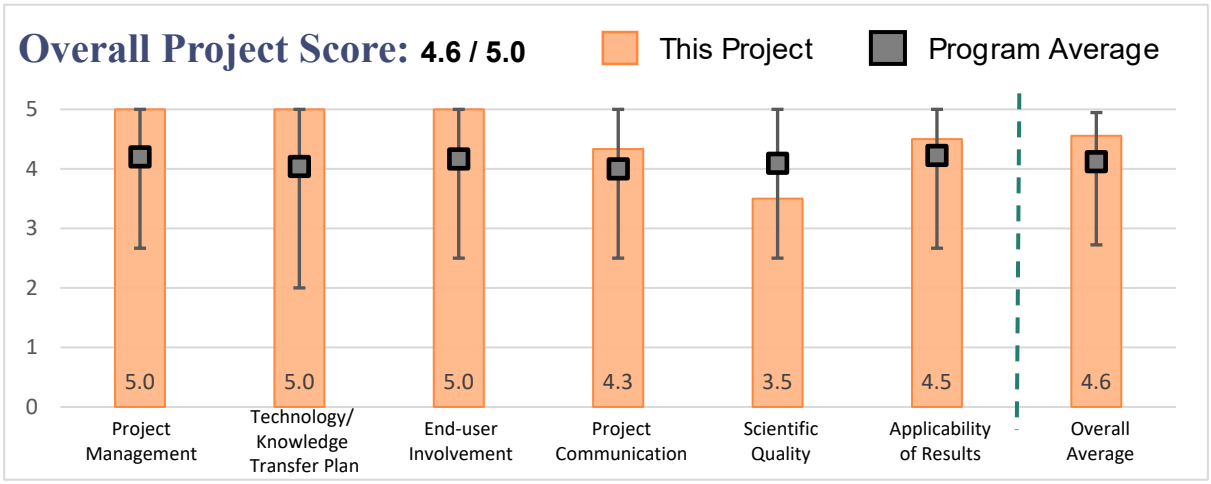
This project will develop a risk-based approach and criteria for hazard detection layouts at LNG facilities. The detector types best suited to serve different areas common to most LNG facilities will be identified and guidance will be provided on optimizing detector locations.

Strengths

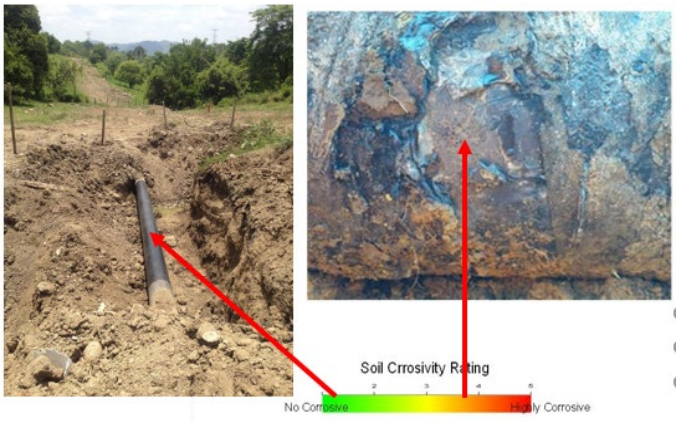
There is strong end-user involvement ~~into~~ on the work scope. The project stated that 11 operators, regulators, manufacturers, and standards organizations were involved with providing insight and data showing how the researcher is leveraging work from three related projects. This provides evidence to how project results will have high relevance to regulator and industry needs. There is a comprehensive plan to distribute project results to end-users through the researcher's network and through two industry conference paper submissions.

Weaknesses

There is a suggestion to show the utility of the two-dimensional (2D) modeling tools and highlight scenarios wherein derived results are of the same order as the three-dimensional (3D) model (without the need for the complex 3D mesh development and extended solution time). It is understood that it may be difficult to assess the efficacy of the hazard detectors. It is also suggested that assessing real-world vapor dispersion incidents and gas detection performance may provide additional insight into why gas detectors either notify or fail to detect nearby releases, which may assist in developing hazard detection layout criteria.



Mapping Indication Severity Using Bayesian Machine Learning from Indirect Inspection Data into Corrosion Severity for Decision-Making in Pipeline Maintenance



Pictures courtesy of Texas A&M University

Project Fast Facts	
Research Award Recipient	Texas A&M University
Agreement #	693JK31910018POTA
Fiscal Year Start	2019 (09/30/2019)
Fiscal Year End	2021 (09/29/2021)
PHMSA Funding	$310,000
Click here to visit the public project page.	

Project Description

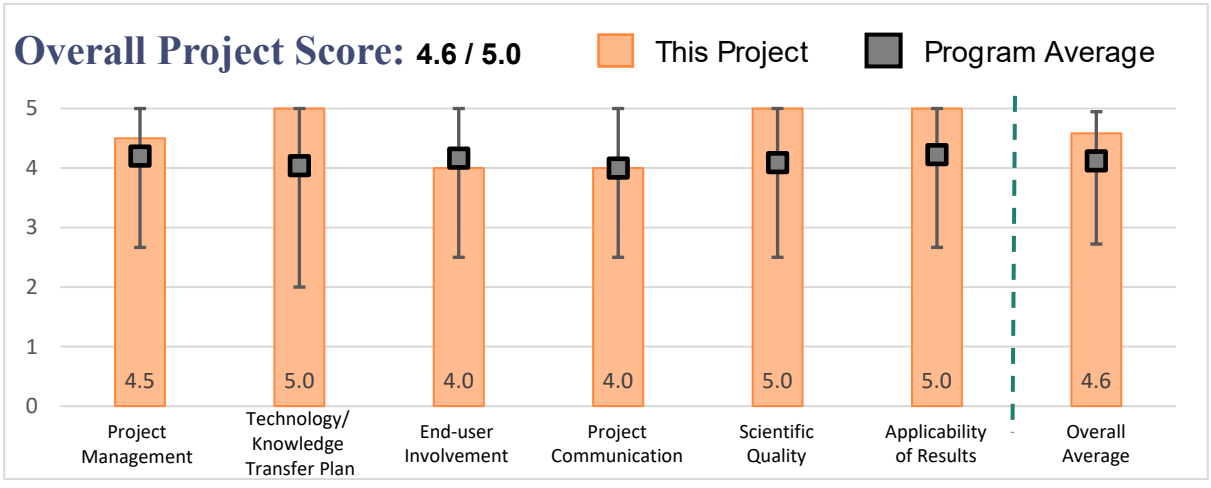
This project will provide industry with a fast, reliable, and accurate tool that determines corrosion severity and real corrosion rates. This will be conducted via adapting current direct assessment practices to supplement the survey technologies with a slightly broader database of environmental data.

Strengths

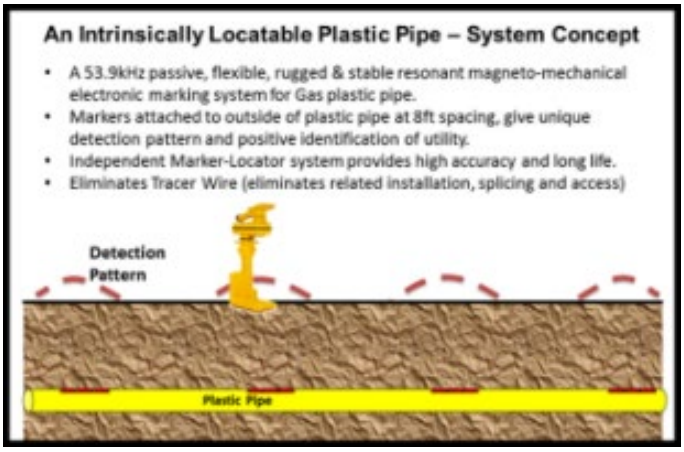
There is a sound plan to distribute project results to end-users through two paper submissions to an industry conference and journal, and through a web-based workshop that will be planned as part of the project.

Weaknesses

There is a suggestion to expand the distribution of project results targeting additional operators beyond those operators involved in the project. Additionally, there is a recommendation to include additional end-users into the work scope because the information presented about the appropriate level of involvement was unclear.



Subsurface Multi-Utility Asset Location Detection



Picture courtesy of Gas Technology Institute

Project Fast Facts	
Research Award Recipient	Gas Technology Institute
Agreement #	693JK31910004POTA
Fiscal Year Start	2019 (09/30/2019)
Fiscal Year End	2023 (03/31/2023)
PHMSA Funding	$1,028,122
Click here to visit the public project page.	

Project Description

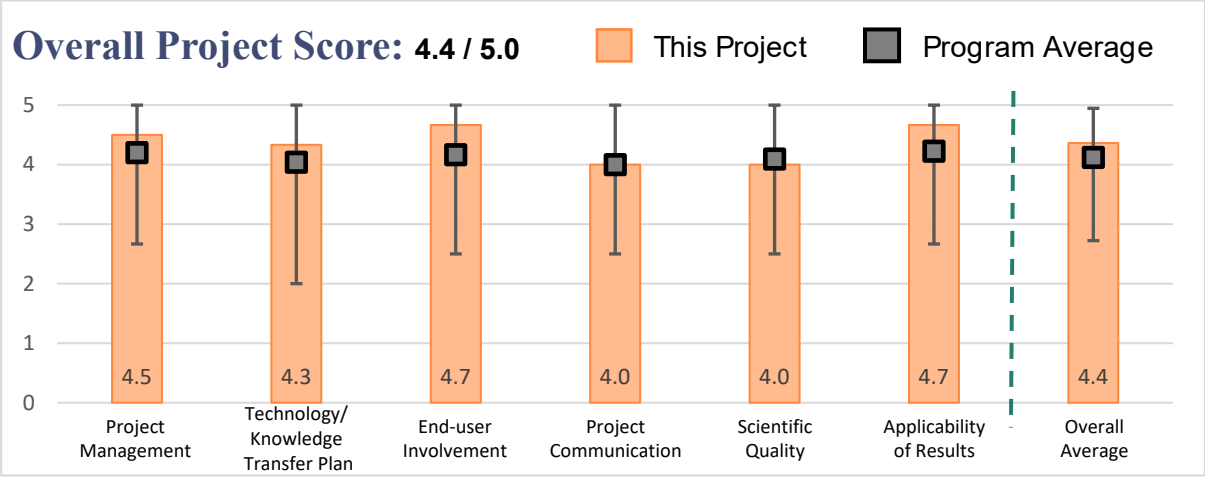
This project will develop technology to mitigate excavation damage to underground pipelines by installing a marker at early stages of production for plastic pipe. A marker attached by the plastic pipe manufacturer at the time of production obviates most risks associated with current methods of locating plastic pipe. The goals are to define/test the marker capability, the attachment design, and the manufacturing qualifications; and to complete installation/testing with two major gas utilities.

Strengths

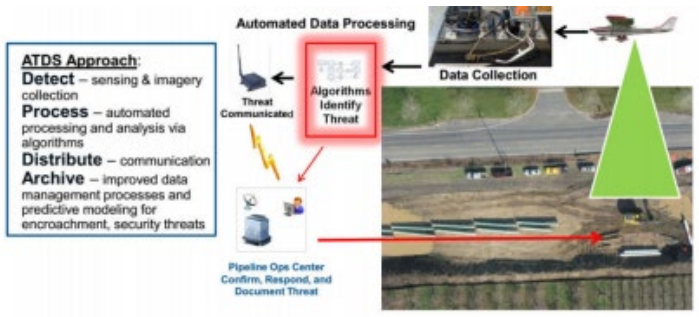
There is a robust end-user involvement into the work scope, and the researcher communication to other related efforts is conducted frequently. This was evident from the involvement of pipeline operators, pipe manufacturers, and asset locating service providers. The current work was clearly built using other related efforts. The format of results is well matched to end-user needs as seen from the presented information and from end-user involvement and insight.

Weaknesses

There is a suggestion to ensure that the validation of the proposed technology be comprehensively documented when developing project final reporting.



Develop Remote Sensing and Leak Detection Platform that can Deploy Multiple Sensor Types



Picture courtesy of Pipeline Research Council International

Project Fast Facts	
Research Award Recipient	PRCI
Agreement #	693JK31910016POTA
Fiscal Year Start	2019 (09/30/2019)
Fiscal Year End	2021 (09/29/2021)
PHMSA Funding	$307,881
Click here to visit the public project page.	

Project Description

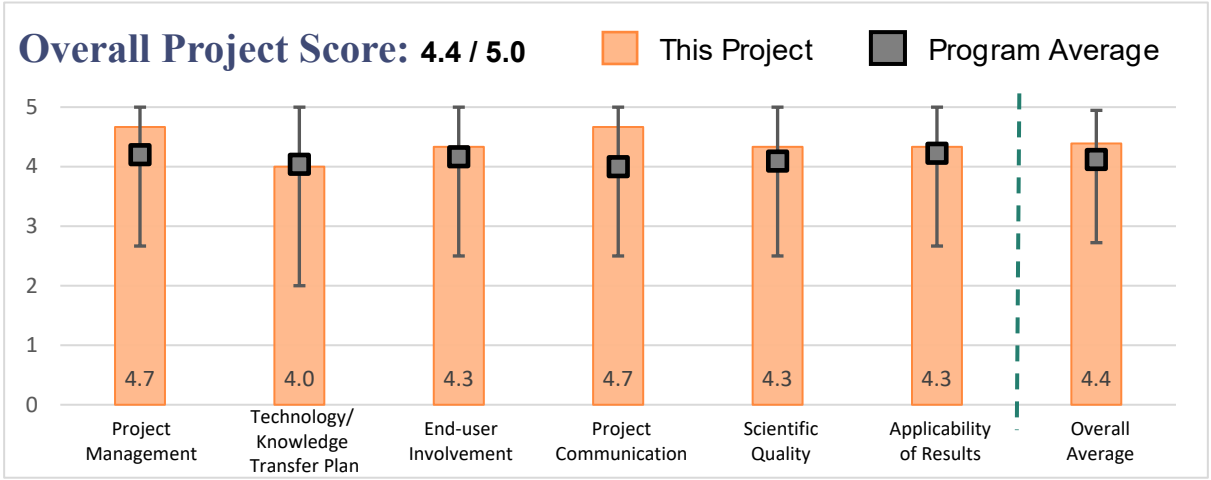
This project will validate the performance of a complete end-to-end system that operates on a long-range, long-endurance unmanned aircraft over hundreds of miles of pipeline right-of-way (ROW). The result will provide automated, multi-threat ROW monitoring and surveillance through remote sensing systems.

Strengths

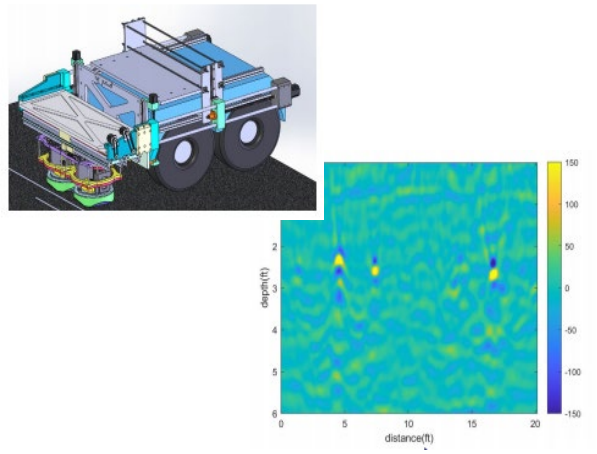
There is strong end-user involvement into the work scope and frequent communication with other related efforts. This is indicated by monthly meetings with several pipeline operators involved with the project.

Weaknesses

There is a suggestion to expand the distribution of project results targeting additional operators beyond those operators involved in the project.



Improving Subsurface Non-Metallic Utility Locating Using Self-Aligning Robotic Ground Penetrating Radar



Picture courtesy of ULC Robotics

Project Fast Facts	
Research Award Recipient	ULC Robotics
Agreement #	693JK31910017POTA
Fiscal Year Start	2019 (09/30/2019)
Fiscal Year End	2022 (12/31/2021)
PHMSA Funding	$393,690
Click here to visit the public project page.	

Project Description

This project will develop a precommercial prototype robotic system to improve locating underground utilities. This will be achieved by improving image quality and location data using self-adapting antenna configurations that increase the probability of detection.

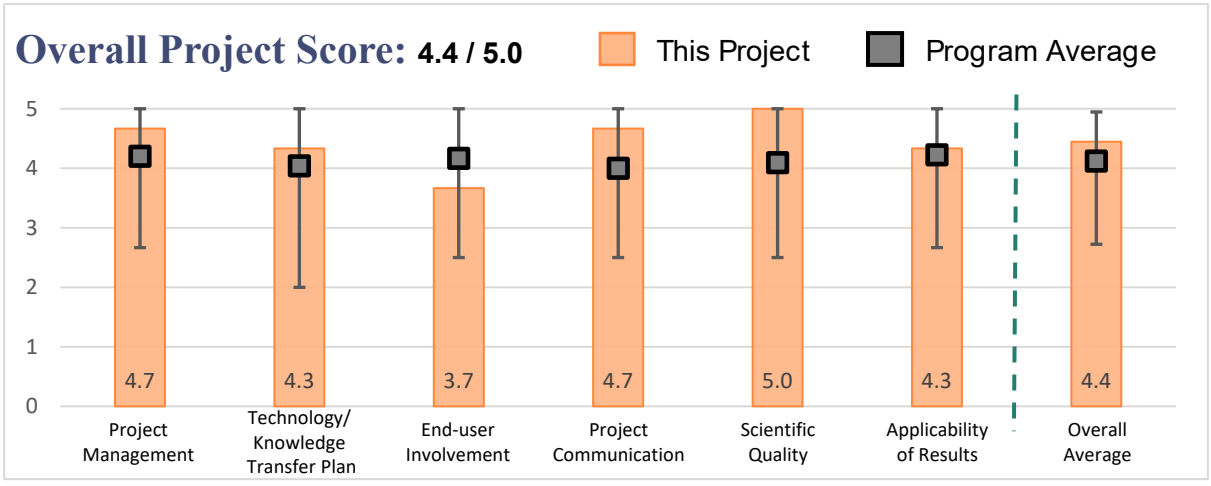
Strengths

There is strong end-user involvement into the work scope as well as a sound plan for field demonstrations and distribution of project results. The information provided during the peer review illustrated a strong partnership to industry operators through planning of several field demonstrations.

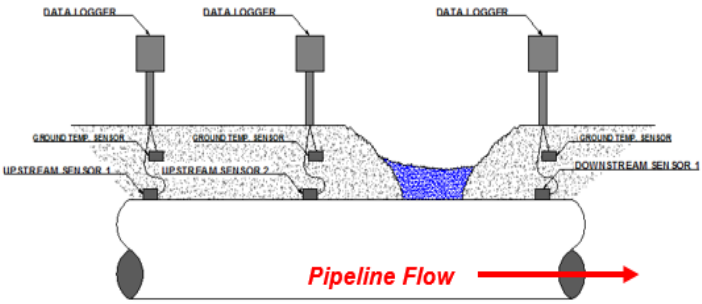
The format of project results is well matched to end-user needs as a result of strong industry coordination and participation within the project.

Weaknesses

There is a suggestion to ensure that there are sufficient demonstrations and data collection to validate technology effectiveness. There also was a recommendation to expand the distribution of project results with more publications.



River Scour Monitoring System for Pipeline Threat Prevention



Picture courtesy of Arizona State University

Project Fast Facts	
Research Award Recipient	Arizona State University
Agreement #	693JK31810011
Fiscal Year Start	2018 (09/06/2018)
Fiscal Year End	2021 (08/31/2021)
PHMSA Funding	$400,000
Click here to visit the public project page.	

Project Description

This project will develop a river scour monitoring system that can determine the degree of scour in a riverbed. The system will thereby alert pipeline operators when the amount of cover over a pipeline is reduced.

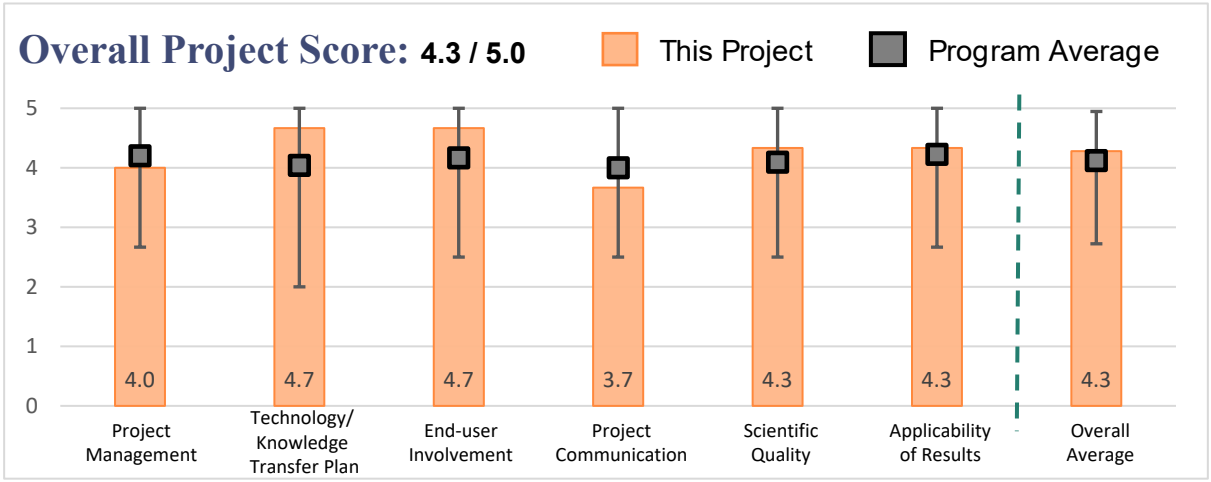
Strengths

The project recovered adequately from schedule delays. There is strong end-user involvement into the work scope with participation by three major transmission pipeline operators.

There is also a comprehensive plan to disseminate results to end-users through submitting papers to four industry conferences.

Weaknesses

There is a suggestion to clarify final reporting if this solution truly is an early warning system and expand the distribution of project results with more publications.



Develop and Demonstrate a Remote Multi-Sensor Platform for Right-of-Way Defense

Picture courtesy of Operations Technology Development

Project Fast Facts	
Research Award Recipient	Operations Technology Development NFP
Agreement #	693JK31910007POTA
Fiscal Year Start	2019 (09/30/2019)
Fiscal Year End	2021 (09/30/2021)
PHMSA Funding	$439,000
Click here to visit the public project page.	

Project Description

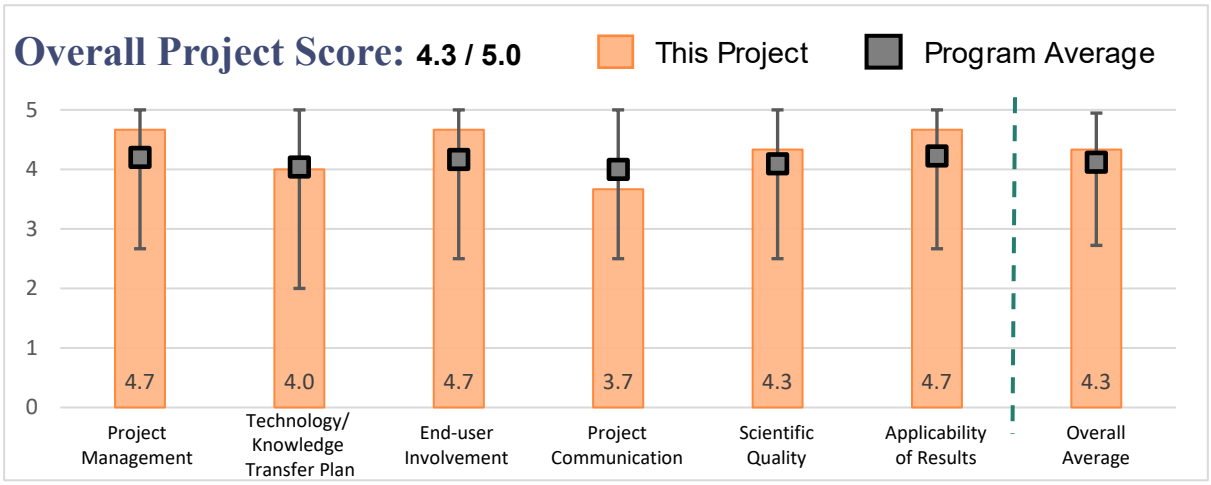
This project will develop a pre-commercial prototype robotic system that will improve the ability to locate underground utilities. This will be achieved by improving image quality and location data using self-adapting antenna configurations that increase the probability of detection. Two robotic carts will autonomously align themselves to each other and to the buried utilities to locate both metallic and nonmetallic pipelines.

Strengths

The project is making adequate progress with completing milestones since details were provided about completed and uncompleted tasks. There is ample end-user involvement into the work scope via the participating pipeline operators and a good plan to disseminate project results to end-users through two planned presentations at industry events.

Weaknesses

There is a suggestion to expand the distribution of project results targeting additional operators beyond those operators involved in the project.



ORFEUS Obstacle Detection for Horizontal Directional Drilling

Picture courtesy of Operations Technology Development

Project Fast Facts	
Research Award Recipient	Operations Technology Development NFP
Agreement #	693JK31810010
Fiscal Year Start	2018 (09/01/2018)
Fiscal Year End	2023 (02/28/2023)
PHMSA Funding	$993,970
Click here to visit the public project page.	

Project Description

This project will produce a field-proven, market-ready obstacle location technology for use in horizontal directional drilling (HDD) applications. ORFEUS is a technology aimed at developing a safe, cost-effective "look-ahead" obstacle detection system for HDD equipment. This project seeks to further develop technology to bring forward a commercially viable product for identifying obstacles in and around the path of an HDD rig, thereby reducing third-party damage to underground utilities.

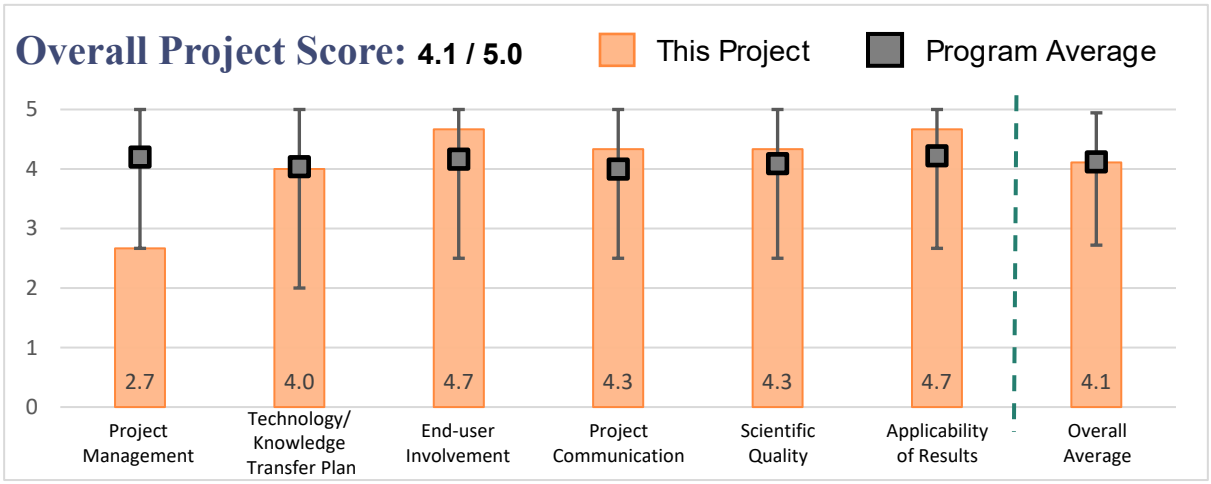
Strengths

The project recovered satisfactorily from schedule delays.

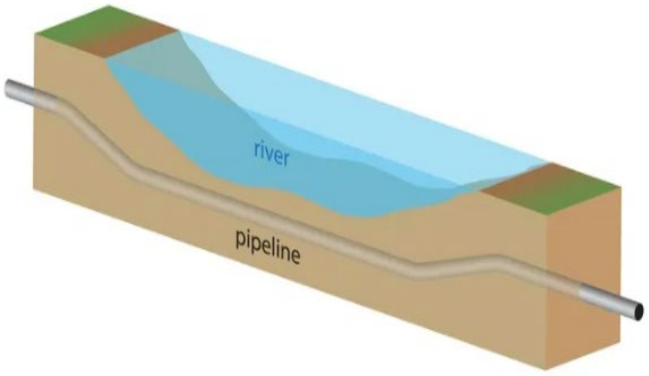
There is strong end-user involvement into the work scope from domestic and international pipeline operators and pipe installation contractors. There is also a robust plan to disseminate project results to end-users through targeted web briefings and via a service provider company ready to commercialize the technology. The format of project results is well matched to end-user needs given the diverse end-user involvement.

Weaknesses

There is a suggestion to conduct both urban and rural demonstrations.



Modernize the Assessment of River Crossings



Picture courtesy of Exponent

Project Fast Facts	
Research Award Recipient	Pipeline Research Council International (PRCI)
Agreement #	693JK31810012
Fiscal Year Start	2018 (09/28/2018)
Fiscal Year End	2021 (09/30/2021)
PHMSA Funding	$386,204.50
Click here to visit the public project page.	

Project Description

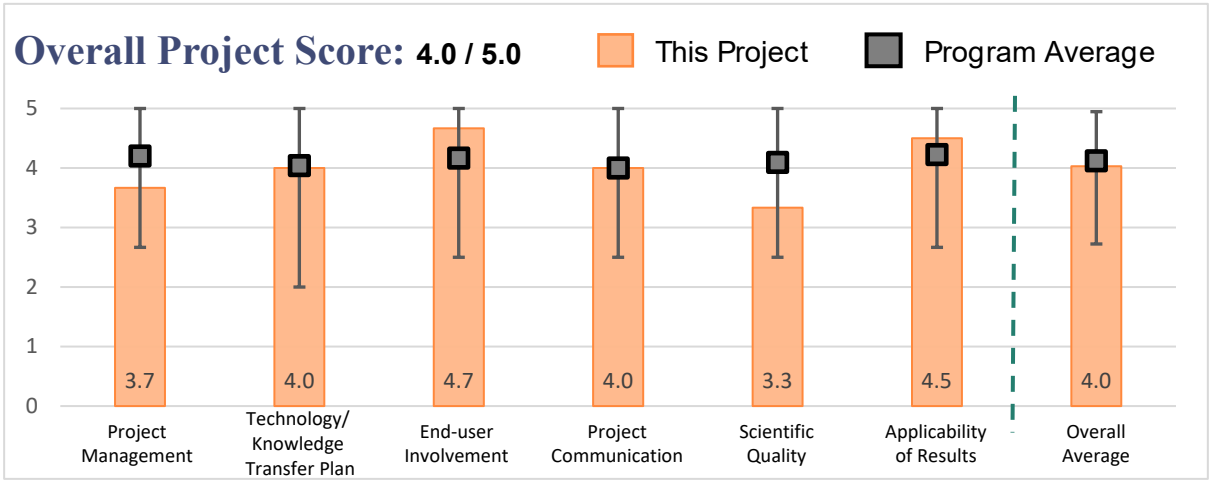
This project will supplement guidance from American Petroleum Institute (API) Recommended Practice 1133: Guidance for Onshore Hydrocarbon Pipelines Affecting High Consequence Floodplains. Additionally, this project will expand and improve the capabilities of existing tools that are available for pipeline river crossing assessments and monitoring.

Strengths

The project recovered satisfactorily from schedule delays. There is strong end-user involvement into the work scope by many participating pipeline operator members from PRCI. There also is a comprehensive plan to disseminate project results to end-users through technical meetings with the operators and through submitting papers at industry conferences. The project results are highly relevant to end-user needs given the wide operator participation.

Weaknesses

There is a suggestion to expand the distribution of project results by targeting additional operators beyond those operators involved in the project.



Improve In-Line Inspection Sizing Accuracy

Picture courtesy of PRCI

Project Fast Facts	
Research Award Recipient	PRCI
Agreement #	693JK31910012POTA
Fiscal Year Start	2019 (09/30/2019)
Fiscal Year End	2022 (03/31/2022)
PHMSA Funding	$725,000
Click here to visit the public project page.	

Project Description

This project will investigate the probability of detection by the current state-of-the-art inline inspection (ILI) tools for immediate conditions where the industry strives for 100% detection of critical integrity conditions.

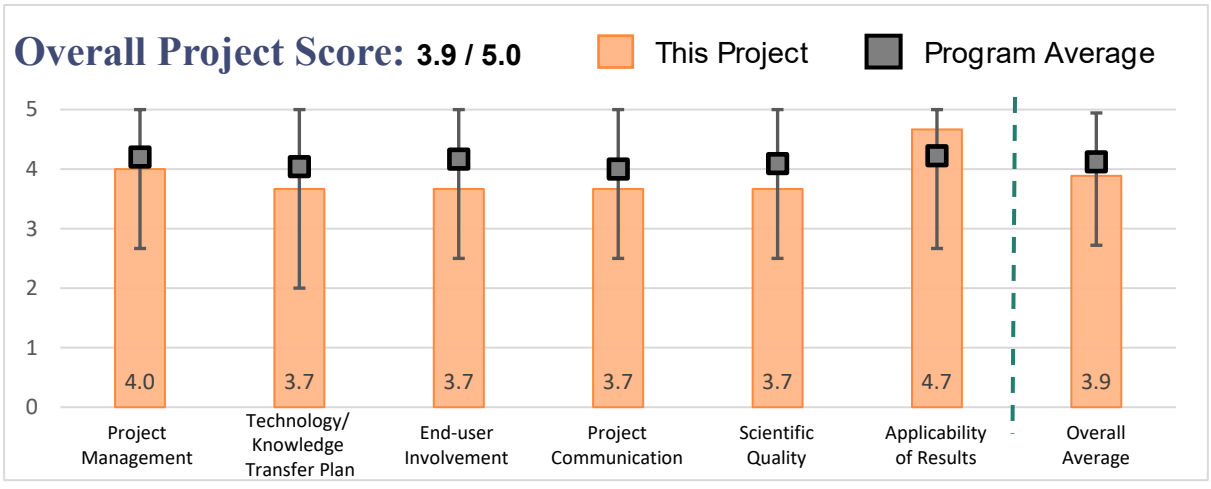
Strengths

The project recovered from schedule delays. Ample progress has been made toward completing milestones since details were provided about completed and uncompleted tasks.

There also is high end-user involvement into the research by the many participating pipeline operators and ILI company members from PRCI.

Weaknesses

There is a suggestion to expand the distribution of project results by targeting additional operators beyond those operators involved in the project and enhance coordination with other related efforts.



Validating Non-Destructive Tools for Surface to Bulk Correlations of Yield Strength, Toughness, and Chemistry

Pictures courtesy of Operations Technology Development

Project Fast Facts	
Research Award Recipient:	Operations Technology Development NFP
Agreement #:	693JK31810003
Fiscal Year Start	2018 (08/01/2018)
Fiscal Year End	2021 (07/31/2021)
PHMSA Funding:	$489,515
Click here to visit the public project page.	

Project Description

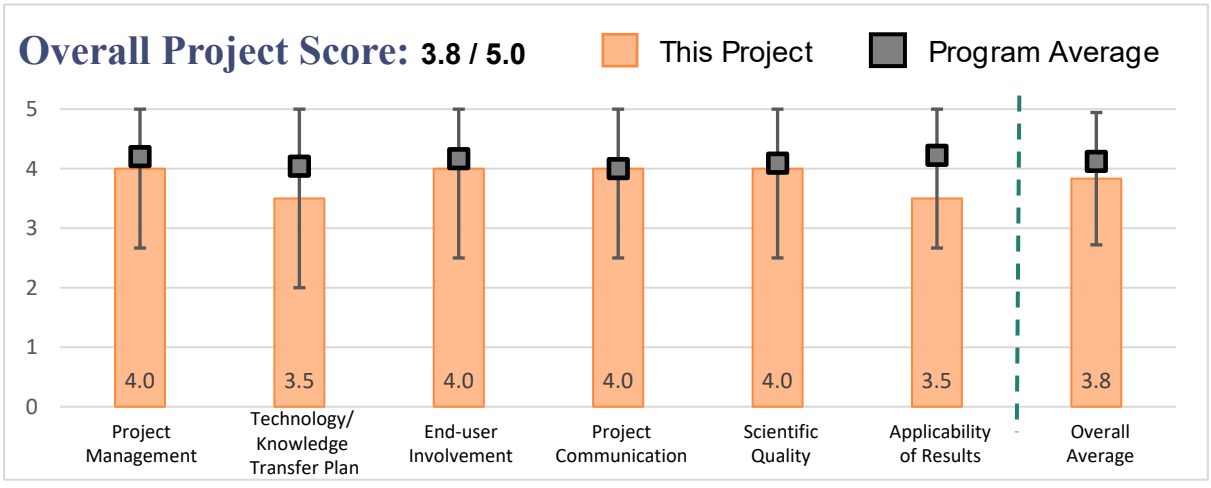
This project will examine nondestructive surface testing through micro-indentation and micro-machining methods for material property confirmation.

Strengths

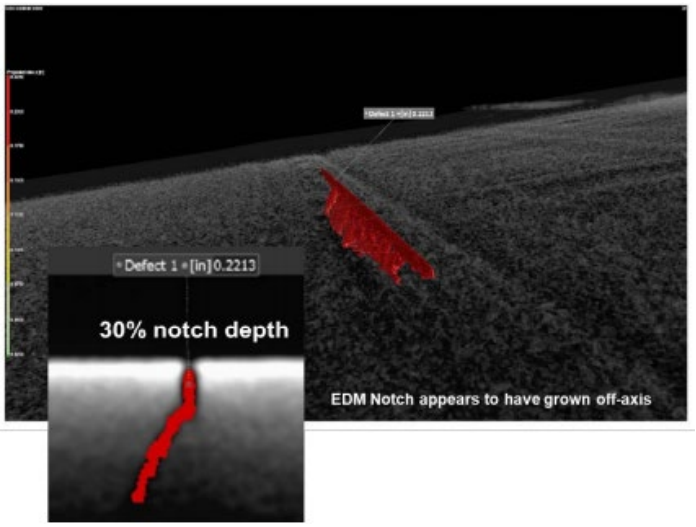
Good progress is being made with completing milestones from the many examples given. The results will be distributed to end-users through planned webinars and published papers. Strong scientific correlation with the collected field data was noted from the presented information.

Weaknesses

There is a suggestion to expand the distribution of project results targeting additional operators beyond those operators involved in the project.



Program to Advance Computed Tomography for the Development of Reference Standards for Pipeline Anomaly Detection and Characterization



Picture courtesy of PRCI

Project Fast Facts	
Research Award Recipient	PRCI
Agreement #	693JK31910010POTA
Fiscal Year Start	2019 (09/30/2019)
Fiscal Year End	2022 (11/29/2021)
PHMSA Funding	$500,000
Click here to visit the public project page.	

Project Description

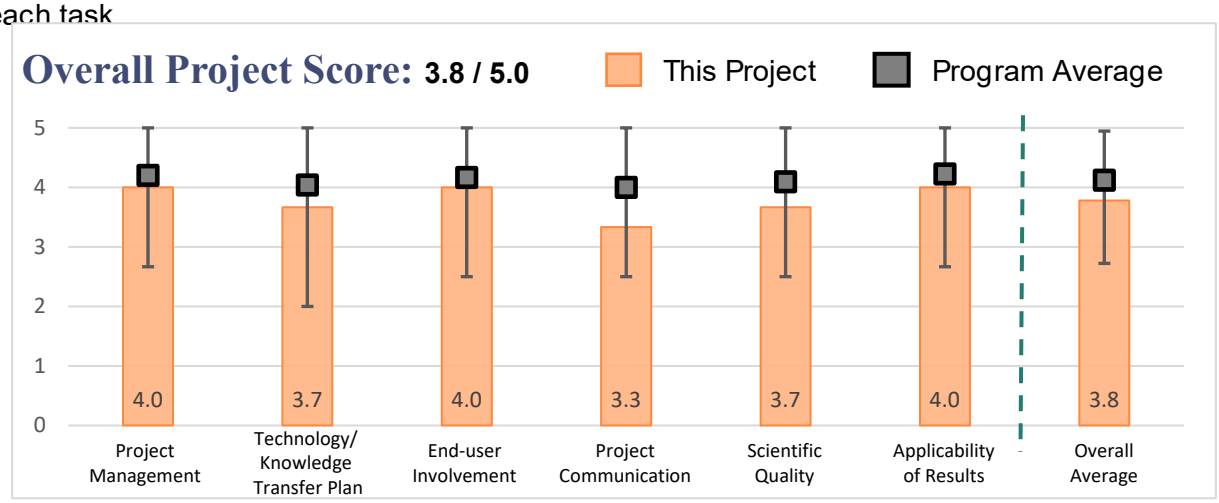
The project will validate data and develop a process confirming the use of Computed Tomography as a nondestructive evaluation (NDE) technology system that can be used for measuring crack and seam anomalies in pipe steels.

Strengths

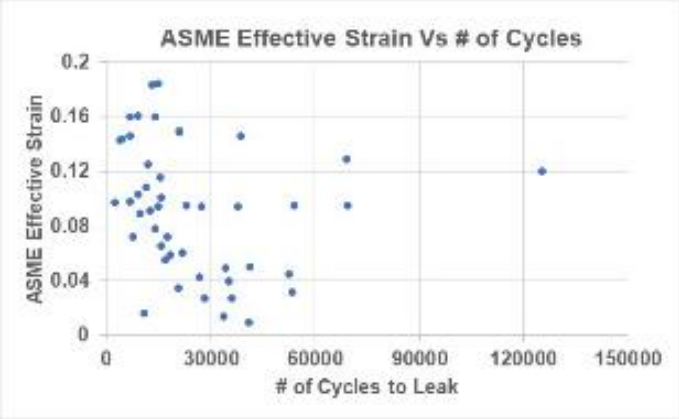
Significant progress is being made on completing milestones, and the plan to disseminate results to end-users was executed. Several details were presented to illustrate which tasks were completed and not completed, and how each task supports the stated objective. Two high-profile industry events are targeted to disseminate project results.

Weaknesses

There is a suggestion for the final report to clearly describe the process to create and utilize synthetic anomalies compared to the results gathered on real samples. There is also a suggestion to expand the distribution of project results by targeting additional operators beyond those operators involved in the project.



Improve Dent/Cracking Assessment Methods



Picture courtesy of PRCI

Project Fast Facts	
Research Award Recipient	PRCI
Agreement #	693JK31910011POTA
Fiscal Year Start	2019 (09/30/2019)
Fiscal Year End	2021 (09/29/2021)
PHMSA Funding	$353,084
Click here to visit the public project page.	

Project Description

This project will enhance previously developed industry assessment methods, improving the industry's ability to support pipeline mechanical damage integrity assessment and management. This project also will consider the variability of the assessment tool validation to define appropriate fatigue life safety factors.

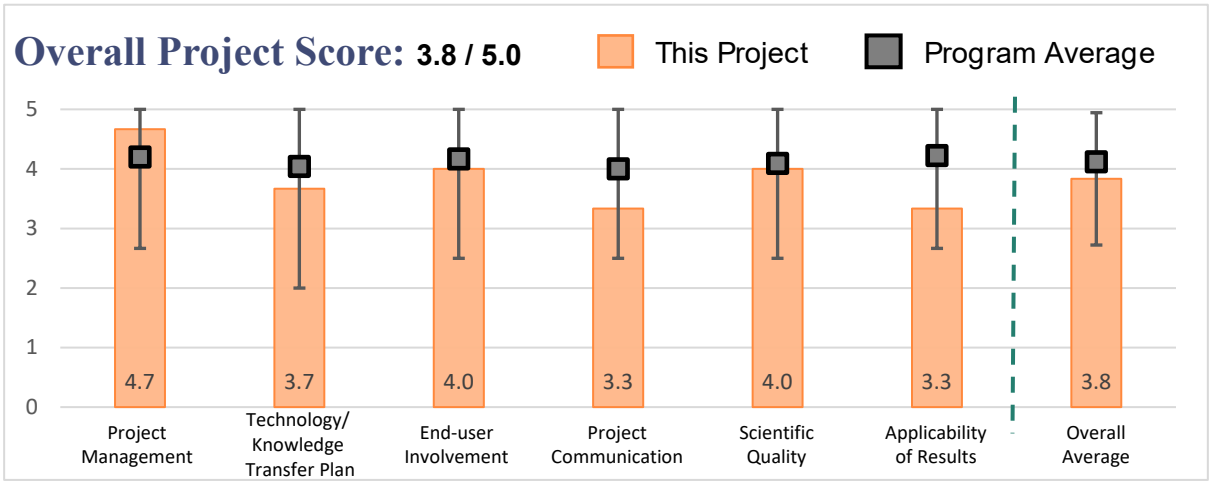
Strengths

Significant progress is being made toward project milestones completion. There is strong end-user involvement into the work scope and a detailed plan to disseminate results.

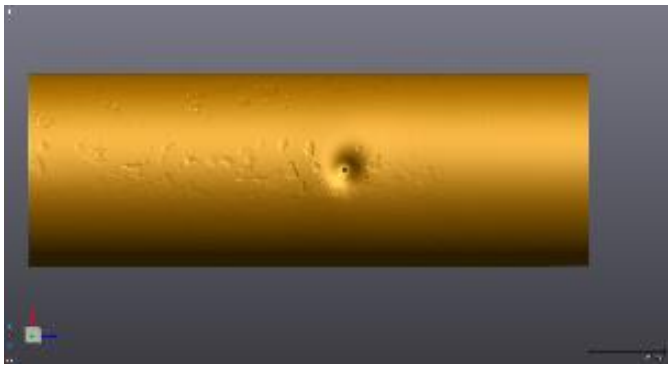
Significant data were presented that illustrated progress in completing tasks and supporting project conclusions. Several pipeline operators and subject matter experts (SMEs) are participating within the project scope. Two industry events are targeted for dissemination of project results.

Weaknesses

There is a suggestion to put more emphasis on the format of results to support end-user needs.



Validate In-Line Inspection Capabilities to Detect/Characterize Mechanical Damage



Picture courtesy of PRCI

Project Fast Facts	
Research Award Recipient	PRCI
Agreement #	693JK31910014POTA
Fiscal Year Start	2019 (09/30/2019)
Fiscal Year End	2022 (03/31/2022)
PHMSA Funding	$1,397,722
Click here to visit the public project page.	

Project Description

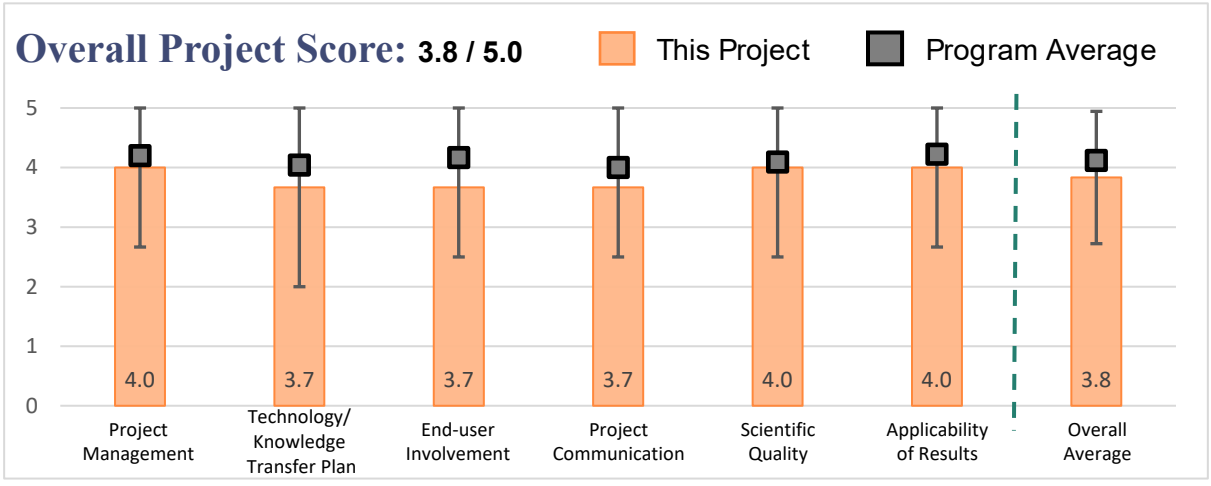
This project will expand what is known about ILI system performance to detect and characterize corrosion, welds, gouges, and crack/crack field features interacting with dents. Understanding current performance of ILI systems will support technology enhancements and identify requirements for new technologies.

Strengths

Significant progress is being made on milestone completion, as shown by the data presented for each task and by how each step supports the project objective. The detailed plan ~~to~~ includes disseminating results to end-users through targeted presentations with participating companies and via submitting papers at two industry conferences. There is strong interaction with end-users involved with the work scope, and a demonstration of how pipeline operators, ILI companies, and organizations will support the tasks associated with the research project.

Weaknesses

There is a suggestion to put more emphasis on the format of results to support end-user needs.



Improving the Reliability, Detection, and Accuracy Capabilities of Existing Leak Detection Systems Using Machine Learning

Picture courtesy of SIGMA

Project Fast Facts	
Research Award Recipient	PRCI
Agreement #	693JK31910015POTA
Fiscal Year Start	2019 (09/30/2019)
Fiscal Year End	2021 (08/31/2021)
PHMSA Funding	$177,717
Click here to visit the public project page.	

Project Description

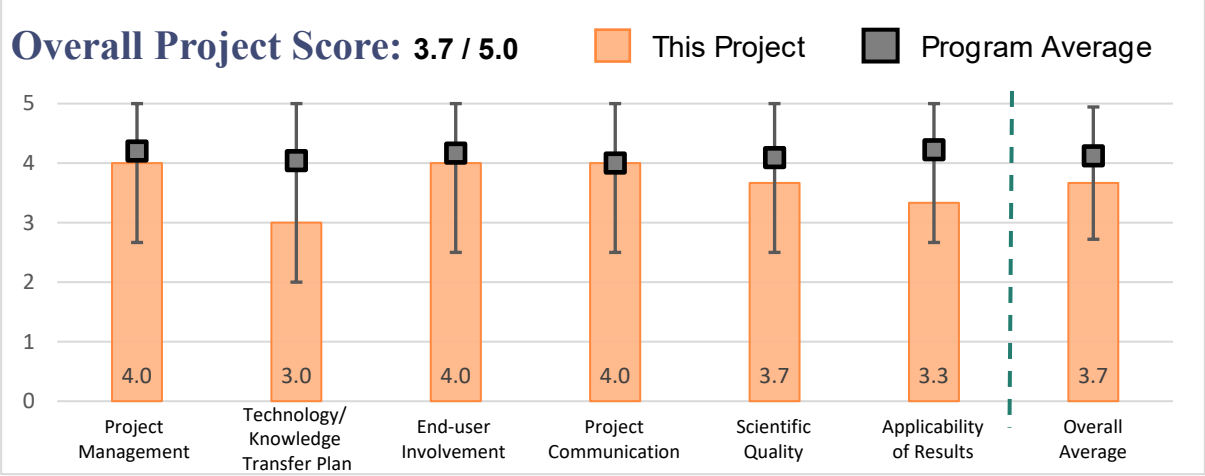
This project will develop an ML-based system capable of detecting hazardous liquid leaks shown in pipeline computational pipeline monitoring (CPM) data. Such a system will improve leak detection below the detection threshold of current CPM data assessment.

Strengths

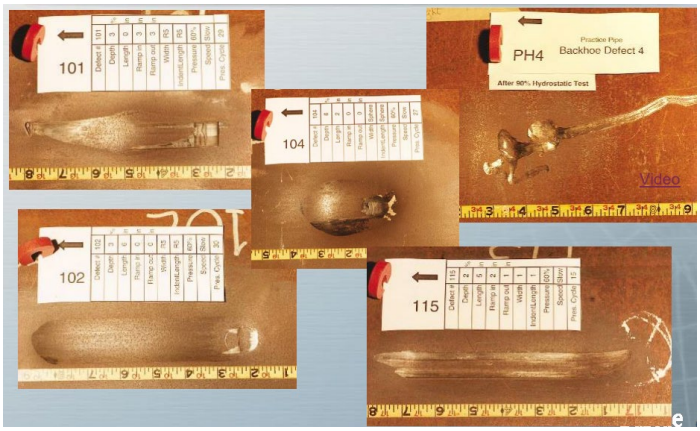
The presented information and scope illustrates that the project exhibits a sound application of ML using industry-supplied data.

Weaknesses

There is a suggestion to finalize the plan to disseminate project results. There also is a recommendation to consider expanding coordination with any related research efforts and the data set used for the ML portion of the analysis.



Systematize 20 Years of Mechanical Damage Research



Picture courtesy of Battelle Memorial Institute

Project Fast Facts	
Research Award Recipient	PRCI
Agreement #	693JK31910013POTA
Fiscal Year Start	2019 (09/30/2019)
Fiscal Year End	2022 (03/31/2022)
PHMSA Funding	$393,783
Click here to visit the public project page.	

Project Description

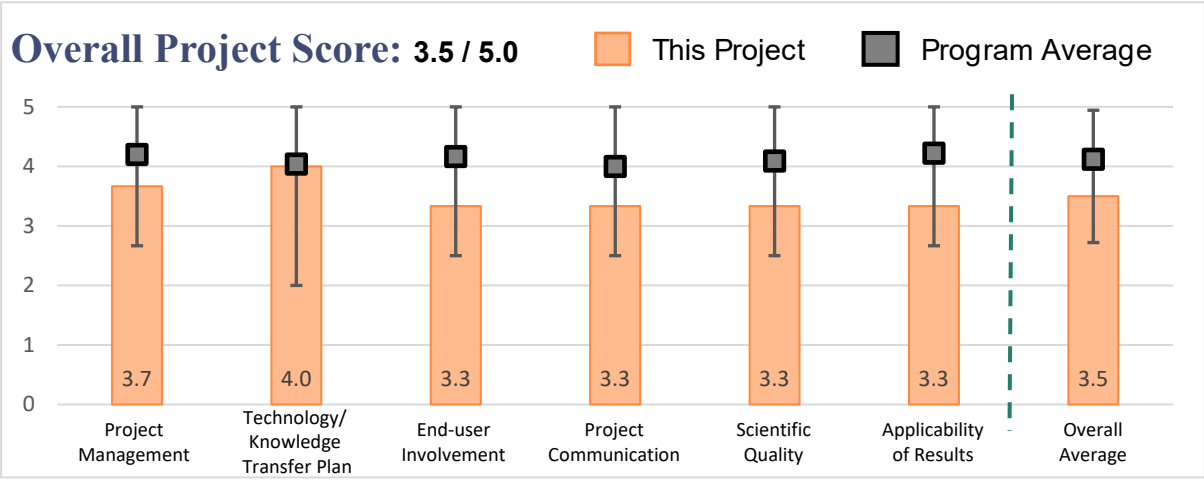
This project will summarize work supporting what is currently known about mechanical damage, with a focus on formation, behavior, detection, characterization, assessment, management, remediation, repair, and recommended practices and standards. The summary will provide a consolidated review of previous research over the past 20 years, including requisite bibliographic references, and characterize achievements as well as opportunities for improvement.

Strengths

There is a comprehensive plan to disseminate project results to relevant standard organizations so that research results can strengthen the standards.

Weaknesses

There is a suggestion to expand the distribution of project results beyond project involved companies. There also is a recommendation to seek academic review of collected information. Additionally, it is difficult to ascertain how the project scope is being communicated.



Review the Intent and Safety Impact of Hoop Stress and Percentage of Specified Minimum Yield Stress Boundaries on Natural Gas Transmission and Distribution Pipelines


gti

FINAL REPORT
GTI PROJECT NUMBERS 22645 / 22667
OTD PROJECT NUMBER 4.20.a
DOT WP#785
DOT/PHMSA CONTRACT NUMBER: 693JK31910001POTA

Review the Intent and Safety Impact of Hoop Stress and Percentage of Specified Minimum Yield Stress Boundaries on Natural Gas Transmission and Distribution Pipelines

Date Submitted
March 31, 2021

Submitted To
U.S. DOT/PHMSA
Operations Technology Development, OTD

Project Manager / Administrative Contact
Kristine Wiley
GTI
847.768.0910
kwiley@gti.energy

Principal Investigator / Technical Contact
Daniel Ersoy
Element Resources, LLC
847.343.9755
dersoy@elementresourcesllc.com

Authors (Technical Team)
Daniel Ersoy, Keith Leewis, Jason Skow, Khalid Farrag

GTI
1700 S. Mount Prospect Rd.
Des Plaines, Illinois 60018
www.gti.energy

gti

Picture courtesy of Gas Technology Institute

Project Fast Facts	
Research Award Recipient	Gas Technology Institute
Agreement #	693JK31910001POTA
Fiscal Year Start	2019 (09/30/2019)
Fiscal Year End	2021 (09/29/2021)
PHMSA Funding	$431,902
Click here to visit the public project page.	

Project Description

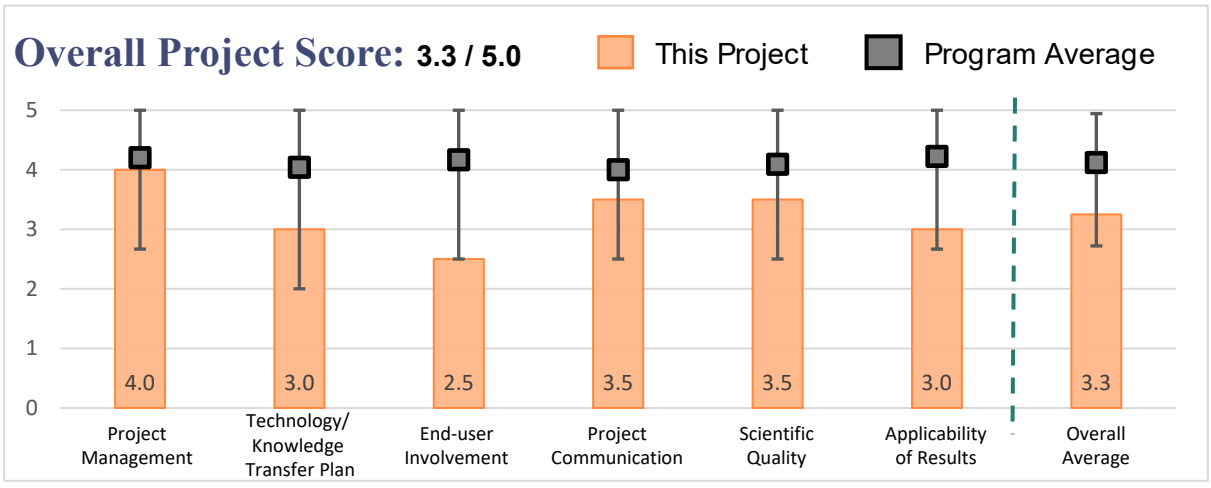
This project will provide pipeline operators with a simple set of criteria to be used when a system is governed by either Title 49 CFR Part 192, Subpart O (Gas Transmission Pipeline Integrity Management) or Subpart P (Gas Distribution Pipeline Integrity Management) requirements that are risk-consistent. The criteria must be realistic, simple, and accurate (i.e., physics-based).

Strengths

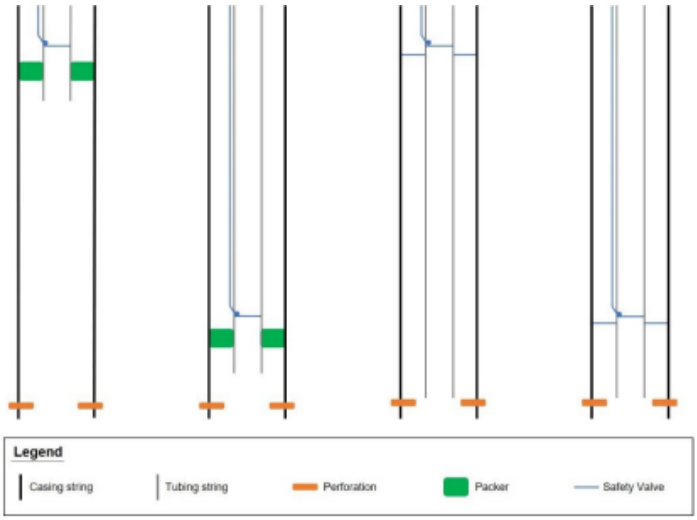
The project presented a detailed summary of the completed tasks to date and seems to be on schedule for delivery.

Weaknesses

There is a suggestion to expand the distribution of project results beyond project involved companies, include additional end-users into the work scope, and put more emphasis on the format of results to support end-user needs.



Reliability of Subsurface Safety Valves



Picture courtesy of Battelle Memorial Institute

Project Fast Facts	
Research Award Recipient	Battelle Memorial Institute
Agreement #	693JK31810016
Fiscal Year Start	2018 (09/28/2018)
Fiscal Year End	2020 (09/30/2020)
PHMSA Funding	$749,080
Click here to visit the public project page.	

Project Description

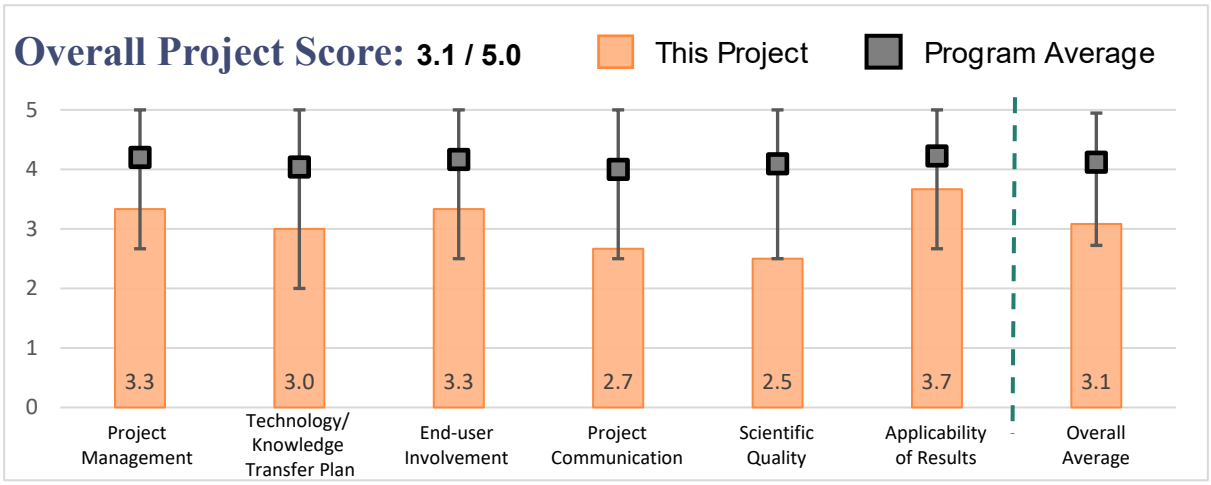
This project will assess the role of subsurface safety valves in improving underground gas storage safety. This project will use relevant literature, interviews with SMEs, individual occurrence reports, and available databases to quantify the performance of subsurface safety valves across a range of deployments.

Strengths

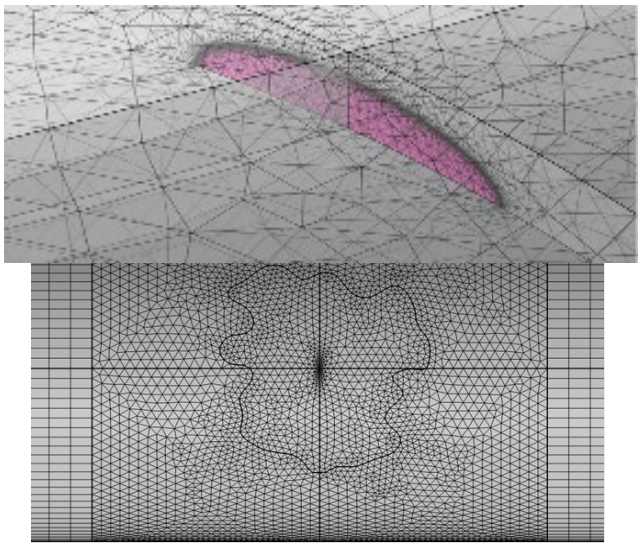
There is a comprehensive plan to disseminate project results to end-users as indicated by workshops held, planned papers, and journal articles.

Weaknesses

The presentation was vague in addressing several review criteria. There are suggestions to describe how final reporting improved on this project and clearly describe how the application of the tasks identified in this project can help improve some of the challenges identified.



Improvements to Pipeline Assessment Methods and Models to Reduce Variance



Pictures courtesy of Gas Technology Institute

Project Fast Facts	
Research Award Recipient	Gas Technology Institute
Agreement #	693JK31810001
Fiscal Year Start	2018 (08/01/2018)
Fiscal Year End	2021 (07/31/2021)
PHMSA Funding	$1,619,065
Click here to visit the public project page.	

Project Description

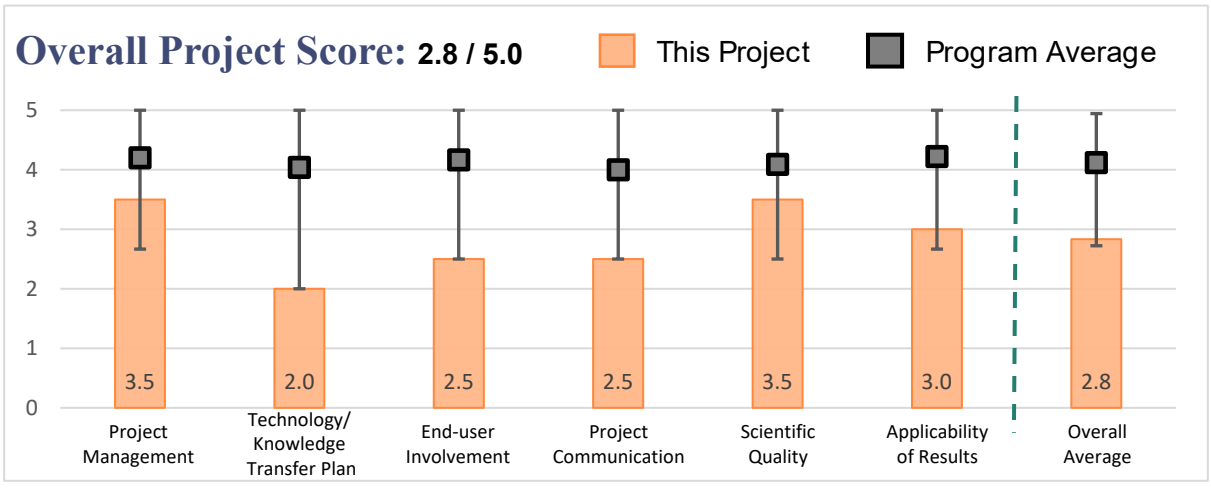
This project will develop, validate, and demonstrate improved assessment methods and models that lower the variance of model outputs when assessing the impact of interactive threats. This project will provide general knowledge, models, and methods pertaining to the assessment of overlapping defects in natural gas pipelines that are currently unavailable.

Strengths

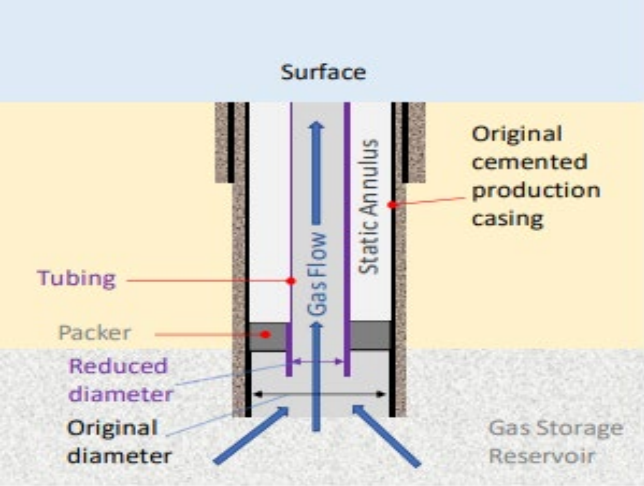
The project, although early in its investigations, has a high potential to better address the peer review criteria in the future and address noted safety challenges.

Weaknesses

It was difficult to assess this project because many decisions addressing several criteria have not yet been made. There is a suggestion to expand competitive sensing methods as alternative options of compiling data for analysis.



Tubing and Packers Life-Cycle Analysis for Underground Gas Storage Applications



Picture courtesy of Battelle Memorial Institute

Project Fast Facts	
Research Award Recipient	Battelle Memorial Institute
Agreement #	693JK31810015
Fiscal Year Start	2018 (09/28/2018)
Fiscal Year End	2020 (09/30/2020)
PHMSA Funding	$785,513
Click here to visit the public project page.	

Project Description

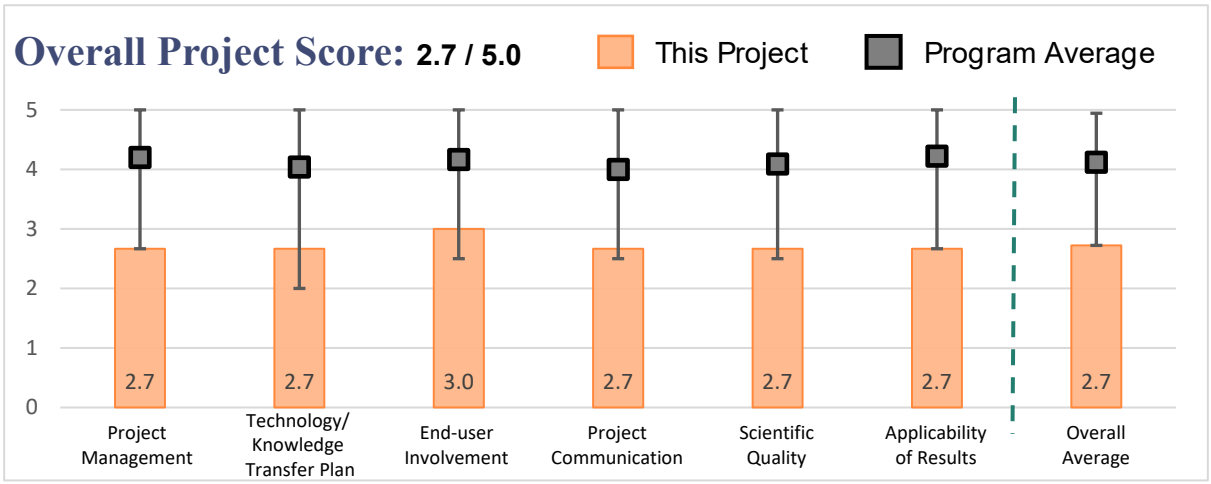
This project will establish a lifecycle analysis of tubing and packing well-entry impacts. It also will establish recommendations for improvements to both tubing and packing assembly designs and alternative coatings.

Strengths

There is a comprehensive plan to disseminate project results to end-users as indicated by workshops held, planned papers, and journal articles.

Weaknesses

The presentation was vague in addressing several review criteria. Additionally, it was cumbersome to differentiate the contribution of this project from the other projects on underground gas storage. There is a suggestion to expand end-users involved into the work scope and put more emphasis on the format of results to support end-user needs.



APPENDIX C

Peer Review Coordinator (PRC)

The PRC organizes, coordinates, monitors, and facilitates the annual peer review panel and is the main contact for panelists, the researchers involved in the peer review, and public inquiries. The PRC was Mr. Robert Smith of PHMSA.

Robert Smith
R&D Manager
Department of Transportation
Pipeline and Hazardous Materials Safety Administration
Office of Pipeline Safety
Phone: (919) 238-4759
Email: robert.w.smith@dot.gov