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January 29, 2025

Mr. Jordan Kannianen
Deputy Executive Director
North Dakota Industrial Commission
State Capitol – 14th Floor
600 East Boulevard Avenue, Department 405
Bismarck, ND 58505-0840

To Mr. Kannianen:

Subject: Quarterly Progress Report Entitled "iPIPE 1.0: intelligent Pipeline Integrity Program," Contract No. G-046-88; UND Project – Fund 43500-UND0022445; EERC Funds 23121 and 24817

Attached is the quarterly progress report on the subject project for the period of October 1, 2024 – December 31, 2024.

If you have any questions, please contact me by phone at (701) 777-5402 or by email at amcrae@undeerc.org.

Sincerely,

DocuSigned by:
Austin McRae
2CF0ADBF88C44D7...

T. Austin McRae
Oilfield Operations Specialist

TAM/rlo

Attachment

c: Brent Brannan, North Dakota Industrial Commission
Erin Stieg, North Dakota Industrial Commission

iPIPE – INTELLIGENT PIPELINE INTEGRITY PROGRAM

Quarterly Progress Report

(for the period of October 1, 2024 – December 31, 2024)

Prepared for:

Jordan Kannianen

North Dakota Industrial Commission
600 East Boulevard Avenue, Department 405
State Capitol, 14th Floor
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Contract No. G-046-88

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January 2025

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EXECUTIVE SUMMARY

The following is a quarterly report for activity conducted by the intelligent Pipeline Integrity Program (iPIPE), led by the Energy & Environmental Research Center, for the North Dakota Industrial Commission's Oil and Gas Research Program. The goal of iPIPE is to advance technologies that reduce the frequency and duration of pipeline releases.

iPIPE welcomed its newest member, South Bow, the spin-off of TC Energy's liquids business.

Technical activity in Quarter (Q) 4 2024 focused on one remaining project: dedicated space-based hyperspectral imaging.

Orbital Sidekick (OSK) is a company that provides unmatched resolution for hyperspectral imaging from space to identify right-of-way threats and hydrocarbons including methane. OSK vertically integrates satellite technology to better serve commercial clients.

iPIPE supported OSK in the first launch of its Aurora satellite via SpaceX rideshare in 2021. The learnings from the Aurora program were applied to the development and launch of a full satellite constellation. OSK's GHOSt—Global Hyperspectral Observation Satellite—constellation launched and commissioned the first three satellites in 2023. The fourth and fifth GHOSt satellites were launched on March 4, 2024, with more robust design elements based on the prior work. The number of satellites required for the full constellation will be based on the performance of the first five.

OSK established broad functionality of the satellites in the first half of 2024, which includes capturing, downlinking, and processing hyperspectral imagery and resolving bottlenecks. The work during Q3 concentrated on determining technical limits and pushing efficiencies. OSK worked with external partners to conduct controlled-release experiments designed to establish a methane detection limit. OSK also completed the first of ten data captures at the end of Q3. Further efficiencies were achieved in Q4, which include aligning satellite pointing techniques to eliminate ground swath overlap and pointing and tasking to directly follow pipeline routes. OSK is presently working to complete the second data capture. Leak detection and quantification refinement are also continuing.

The OSK subcontract was extended to the end of 2025 to accommodate up to ten data captures over an area of interest (AOI) defined by iPIPE. OSK is working toward the second data capture, which includes Bakken and Permian AOIs. Although OSK has made significant strides to improve the data capture rate over the past quarters, it is likely OSK will not achieve the remaining captures by the end of this year. A project extension into 2026 is anticipated.

iPIPE – INTELLIGENT PIPELINE INTEGRITY PROGRAM
Quarterly Progress Report
October 1, 2024 – December 31, 2024

BACKGROUND

During a May 2017 meeting with North Dakota pipeline operators, Governor Doug Burgum challenged industry to apply advanced technologies to eliminate pipeline leaks in North Dakota. In response to the governor's challenge, industry chose a proactive path and engaged in a 3½-year program, led by the Energy & Environmental Research Center (EERC), to advance the development and application of emerging technologies to prevent and detect pipeline leaks. The intelligent Pipeline Integrity Program (iPIPE) assists in the development of multiple emerging technologies to prevent and detect pipeline leaks by engaging technology providers to refine not-yet-commercial products specifically for pipelines in North Dakota and demonstrate technology. This goal is supported by accomplishment of the following objectives:

- Select the most promising emerging (near-commercial) technologies for demonstration.
- Assist technology providers in refining their products.
- Demonstrate multiple technologies on pipelines.
- Document results of technology demonstrations.
- Facilitate the adoption of technologies into North Dakota pipeline operations.

Multiple demonstrations of emerging technologies on working pipelines will simultaneously assist technology providers in refining designs, pave a path toward full commercialization in the North Dakota market, prepare pipeline operators to adopt the new tools, and improve pipeline integrity.

Members of the industry-led consortium that provided funding for iPIPE 1.0 include DCP Midstream, Enbridge, Energy Transfer Partners, Equinor, Goodnight Midstream, Hess Corporation, Marathon Petroleum Logistics (MPLx), Oasis Midstream, ONEOK, TC Energy, and Whiting Petroleum.

The following quarterly report summarizes the program activities from October 1, 2024, through December 31, 2024.

ACCOMPLISHMENTS DURING REPORTING PERIOD

- Program-level activities
  - New member: South Bow
    - iPIPE welcomed South Bow as its newest member. South Bow is a spin-off of TC Energy's (TC's) liquids business. The former TC liquids group was the original representative to iPIPE. As iPIPE evolved from liquids focus to a broader focus, the gas group within TC has joined. iPIPE today includes both gas interests and liquids interests of various operators.

  - Program management
    - Routine activity includes financial and subcontract management.
  - Program meetings
    - On October 17, November 21, and December 19, 2024, iPIPE held monthly member meetings to update all members on program status. The membership voted to extend the Orbital Sidekick (OSK) subcontract through 2025.

- Technology selection
  - The EERC continues to engage with companies from around the globe offering emerging technologies. Additional technology providers were sought through iPIPE 3.0.

- Demonstration execution – OSK
  - OSK continued to develop and refine the data capture and spectral analysis capabilities of the five GHOSt—Global Hyperspectral Observation Satellite—satellites in orbit. This included optimizing swath widths and data capture tasking prioritization. OSK implemented a more efficient methodology to capture data over large areas, which included line scanning over longer linear segments and improved satellite tasking prioritization.
  - OSK has completed the first data capture in accordance with the subcontract. iPIPE is monitoring improved data collection speed as the project progresses.
  - OSK reported no detections over the iPIPE area of interest. OSK has provided methane detections in the range of 300–550 kg/hr and continues to work toward a detection limit of 100 kg/hr.
  - OSK and iPIPE continued to meet biweekly throughout the quarter to discuss progress and upcoming events.

- Demonstration execution – Satelytics Phase IV
  - Satelytics completed its analysis of land movement detection using a current stereo pair of images and stereo pairs-generated historical data.
  - The independent EERC evaluation report for this task has been drafted and is under internal review.

- Demonstration execution – Pipeline-Risk
  - Pipeline-Risk delivered its final report, completed constructing a risk-learning system for gathering lines, and demonstrated its abilities using member-provided data.
  - The independent EERC evaluation report is being drafted.

- Demonstration execution – TOKU
  - TOKU has completed its demonstration of pipeline-monitoring equipment, analysis of leak simulation data, and refinement of algorithms and has submitted its final report.
  - The independent EERC evaluation report for this task has been drafted and is under internal review.

PROJECT AND FINANCIAL INFORMATION

Table 1 presents the budget and expenses incurred by the program to date. The total program value is $9,404,075. The awarded oil and gas research program funding is $2,600,000.

Table 1. iPIPE Project Costs as of December 31, 2024

		Budget	Expenses	Remaining Balance
NDIC Share – Cash		$2,600,000	$2,513,592	$86,408
Industry Share – Cash		$2,577,000	$2,431,712	$145,288
		$5,177,000	**$4,945,304**	**$231,696**
In-kind Contributions:	**Members**			
	DCP		$60,500	
	Enbridge		$126,436	
	Equinor		$153,230	
	Goodnight		$37,135	
	Hess		$228,093	
	MPLx		$17,936	
	Oasis		$40,069	
	ONEOK		$5,000	
	Whiting		$9,042	
	TC Energy		$0	
	Energy Transfer		$0	
			$677,441	
In-kind Contributions:	**Technology Providers**			
	Satelytics		$1,713,450	
	Direct-C		$185,867	
	Ingu		$88,266	
	OSK		$1,321,061	
	TOKU		$190,990	
	Pipeline Risk		$50,000	
			$3,549,634	
NDIC Contribution	**Industry-Cash**		**In-kind**	**Total Match Funding**
$2,600,000	$2,577,000		$4,227,075	**$6,804,075**
Total Project				
$9,404,075				

The remaining expenses include the OSK subcontract at $231,696, of which $86,408 include NDIC funds.

A project schedule is provided in Figure 1.

FUTURE ACTIVITIES

The planned activities for the next quarter are detailed below:

- Program-level activities
  - The EERC will work with consortium members and stakeholders to continue iPIPE on its successful path beyond the original timeline with iPIPE 3.0.
  - iPIPE will continue ongoing discussions while starting new ones with potential program members.
  - The EERC is likely to submit a project extension later in 2025 to allow completion of the OSK subcontract and finish all ten data captures.

- Technology selection
  - The EERC will remain engaged with and on the lookout for providers of relevant, promising, emerging technology as iPIPE continues.

- Demonstration execution – OSK
  - The rate of data capture is expected to continue to increase. iPIPE will continue to monitor progress and assist where possible.
  - GHOSt 6 is still tentatively scheduled for launch in the near future. The additional satellite will ideally increase data capture frequency.

- Demonstration execution – Satelytics Phase IV
  - The EERC will complete and distribute its independent review of this project. This will complete the project.

- Demonstration execution – Pipeline-Risk
  - The EERC will complete and distribute its independent review of this project. This will complete the project.

- Demonstration execution – TOKU
  - The EERC will complete and distribute its independent review of this project. This will complete the project.

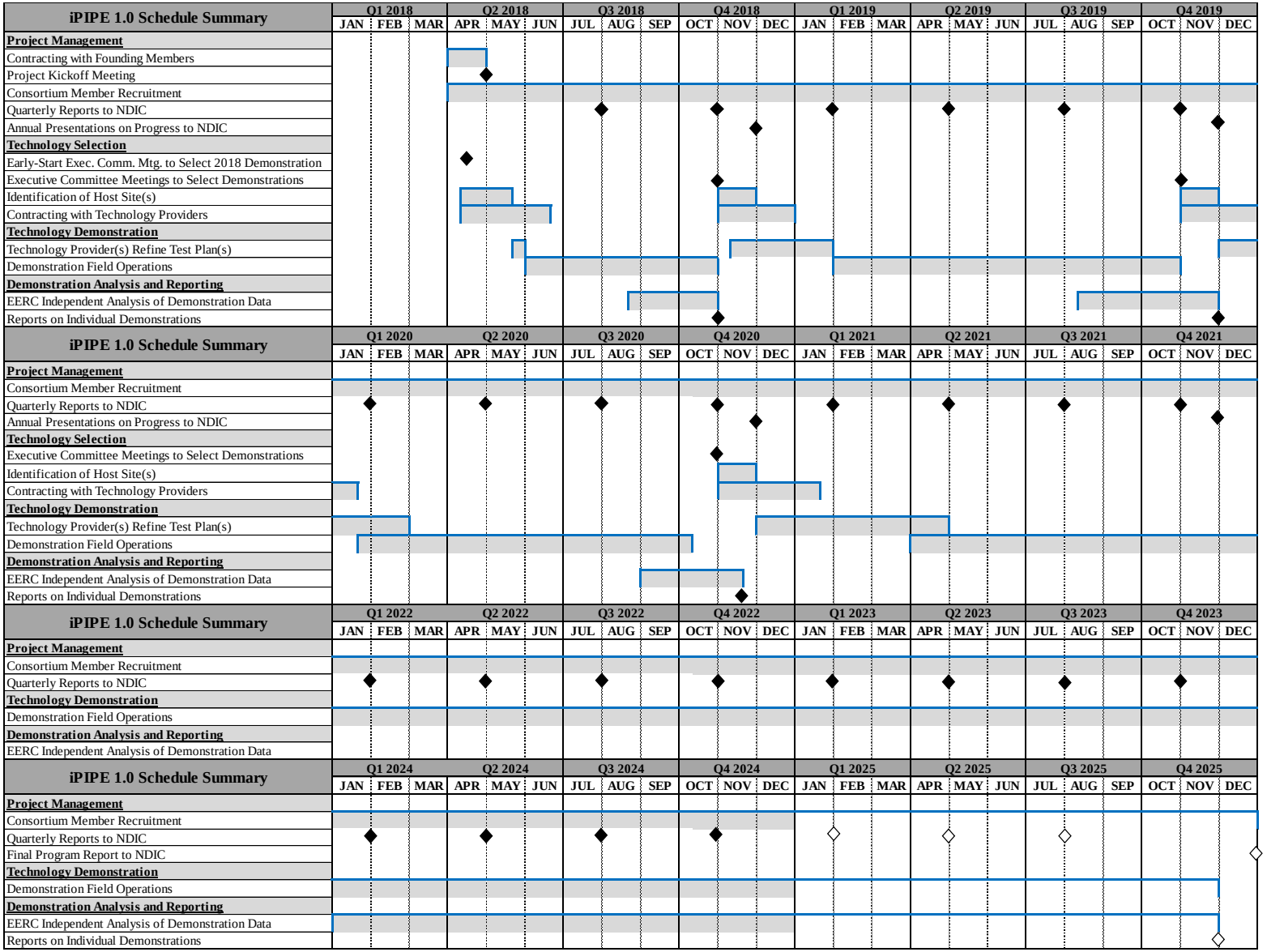

Figure 1. Project progress.