

## SUCCESS STORY No. 2

### iPIPE Selection of Ingu Solutions

In May 2018, iPIPE held its first technology selection event, hosting seven technology providers from around the world. The technologies presented included novel external leak sensors, advanced drone-based pipeline monitoring, miniaturized smart pigs, and earth-orbit monitoring solutions. iPIPE members openly expressed excitement in the first round of technology choices, saying that they would fund every one if they had the financial resources to do so.

Of these first seven emerging technologies presented, iPIPE selected two technologies for its inaugural efforts to assist in development of new tools for pipeline operators: Satelytics and Ingu Solutions' Pipers®.



Figure 1. Piper sensor.

Ingu Solutions' technology uses miniaturized in-line sensors called Pipers to detect leaks, magnetic features, geometric defects, and deposits that threaten pipeline performance and safety. A Piper is an in-line inspection tool particularly suitable for small-diameter (less than 8-inch-diameter) pipelines. Measurement capabilities include the following:

- Pressure
- Temperature
- Leak detection
- Flow dynamics
- Magnetic features
- Isometry/piggability

### Development Activities with iPIPE

With support from iPIPE members, Ingu Solutions deployed Pipers in 13 unique, active, operating pipeline segments in North Dakota in 2018 and 2019 (see Table 1). This set of challenges provided Ingu Solutions with extensive insight on the myriad permutations of hardware configurations possible, which added greatly to Ingu Solutions' knowledge base and commercial readiness. This set of challenges also helped Ingu Solutions to refine the logistical aspects of Pipers deployment, recovery, data retrieval, and data analysis, thus advancing the technology to commercial readiness. This effort embodied the true spirit of the iPIPE program: codevelopment of promising new technologies.

### Real World, Real Results

The trials conducted by Ingu Solutions in iPIPE member pipelines resulted in improvements in the product and eventual validation of the sensors as a commercially ready tool. During iPIPE deployments, Pipers identified a staged leak (acoustic measurement, Figure 2), mapped subtle magnetic differences in composite pipeline segments (magnetic measurement, Figure 3), identified pipeline joint locations (magnetic measurement), measured approximate XYZ location of pipelines (inertial measurement), and measured thermal profile of the fluids carried (temperature measurement).

Table 1. iPIPE Pipeline Deployments of Pipers

Pipeline Operator	Pipeline Description
Hess Corp.	6", nonmetallic, crude oil
Equinor	8", metallic, crude oil
Equinor	6", nonmetallic, produced water
Goodnight Midstream	6", nonmetallic, produced water
Hess Corp.	6", metallic, high-pressure natural gas
Goodnight Midstream	6", nonmetallic, produced water
Oasis Midstream	4", nonmetallic, produced water
Equinor	8", nonmetallic, produced water
Andeavor	6", metallic, crude oil
Oasis Midstream	6", metallic, crude oil
Hess Corp.	6", metallic, crude oil
Hess Corp.	6", nonmetallic, crude oil
Equinor	8", nonmetallic, produced water

These trials also highlighted potential new uses for Pipers, discovered through close cooperation between Ingu Solutions and iPIPE members. During one deployment, the sensors detected a malfunctioning valve that indicated it was open but was actually nearly closed. Because this was a manual valve with a malfunctioning indicator, this problem may have gone unnoticed for months, resulting in significant costs due to increased net energy consumption required to pump fluids through the nearly closed valve.

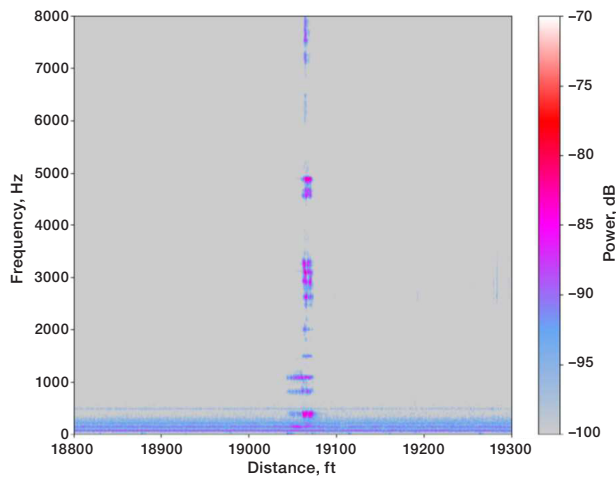


Figure 2. Audio spectrogram indicating leak.

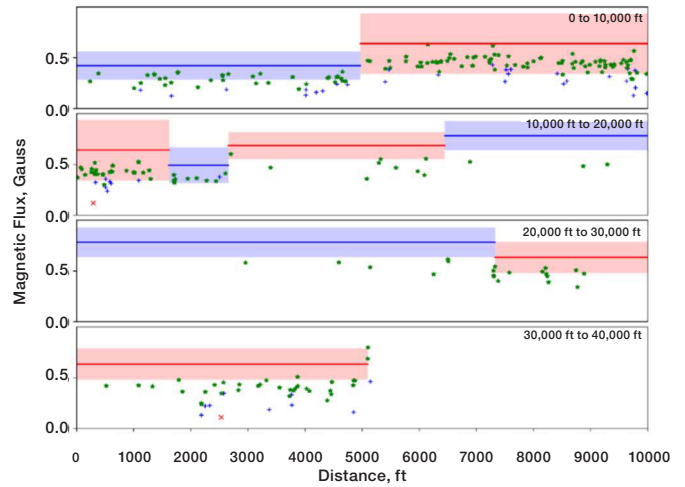


Figure 3. Magnetogram indicating different spools of composite pipeline.

Ingu Solutions also demonstrated exceptional flexibility in the ability to insert and retrieve the sensors from a wide variety of challenging pipeline hardware configurations (Figures 4 and 5).



Figure 4. Deployment of Piper.



Figure 5. Retrieval of Piper.

## iPIPE Development Leads to Commercial Success for Ingu Solutions

Several iPIPE members have now indicated intent to contract commercially for Pipers service as a result of Ingu Solutions' success with iPIPE. iPIPE is proud of this success story: iPIPE is filling the empty slots in the tool belts of pipeline operators.

For more information, please contact Jay Almlie at [jalmlie@undeerc.org](mailto:jalmlie@undeerc.org) or at 701.777.5260

*iPIPE Is Filling Empty Slots in the Tool Belts of Pipeline Operators.*