By Land, Sea and Air, Unmanned Vehicles Focus on New Ways to Conduct Pipeline Inspections

By Gail Jansen

Unmanned systems in the oil and gas industry are starting to take center stage, particularly with respect to subsea explorations, with even more developments set to be unveiled within the next few years.

Take Robotic Drilling Systems, formerly Seabed Rig, of Norway. Its completely autonomous unmanned drill floor is already in the forward testing stages, thanks to a partnership with NASA where developments from the autonomous Mars Curiosity rover were shared to bring the robotic tools the company was developing to an autonomous level — a system that may soon replace manned drilling rigs around the world.

It is this sort of buy-in for robotic systems in oil and gas applications that has recently pushed companies to learn how exactly unmanned vehicles can fit and what role they will play both now and in the future. To date, the majority of that role seems to lie with pipeline maintenance and inspections, whether by land, by sea or by air.

Crawling Along

Crawling vehicles in oil and gas pipeline applications are somewhat limited in terms of distance because they are tethered, but a number of such systems are currently being deployed to assist in detailed inspections. Outfitted with sophisticated camera systems to allow still shots or video of pipelines, crawlers have the added benefit of being able to not only perform external inspections of pipelines looking for leaks, as well as weld and seam integrity, but also internal inspections as well.

Inuktun's modular Versatrax 150 robotic crawler, one of the company's remote inspection robots. Photo couresy Inuktun.

British Columbia-based Inuktun builds crawlers capable of getting in spaces otherwise not easily accessed, whether they be vertical risers, J-tubes or other less straight forward configurations. That small size limits their onboard autonomy, says Brian Storie of Inuktun's European division.

Even so, pipeline crawlers can present an advantage when are used in combination with other inspection devices propelled through UAVs or AUVs, he says.

"In the case of a subsea pipeline," Storie says, "the robotic crawler would be taken down in one of the manipulators on the ROV. It would swim to wherever the location was and then deposit the magnetic crawler at a point where it can then drive into an area that otherwise would not be accessible by these big working class ROVs.

"Those are the kinds of inquiries that we're seeing and demonstrating can be done," Storie says.

While the use of land-based crawlers in pipes of various sizes and capacities is becoming more commonplace, Storie says as an industry there is still a need to bring awareness to those in the oil and gas industry that subsea solutions utilizing crawlers are also available, and that there are many benefits that crawlers can provide.

Reaching New Depths

While awareness of the usefulness of crawlers may still be needed, subsea technology developments with AUVs are not only widely known in the industry, the vehicles are also being extensively used. That's a situation, according to analysts, that will only continue

to grow with oil companies and their suppliers expected to invest a significant amount of dollars into new technologies over the next few years as they look to capitalize on the rich fields that lie beneath the ocean floor in the most cost-effective manner possible.

Specifically, the industry is using AUVs as a way of building and mapping undersea pipelines routes, as well as maintaining, inspecting and repairing established subsea pipeline systems.

Leading the way among the many AUVs currently in production and operation is the collaboration between SeeByte and Subsea 7 to create the industry's first autonomous inspection vehicle. Through software innovations provided by SeeByte that allow for advanced control capabilities, the new Subsea 7 AIV is a milestone development that shows promise in life-of-field projects by offering up a low-risk inspection system.

"At its very core, SeeByte creates advance software that's used for managing unmanned and remote assets," says Nicole Irvine, global sales coordinator for SeeByte.

"It's an easy-to-use, plug-and-play software tool that makes piloting an ROV a much simpler task, enabling semiautonomous, preprogrammed ROV missions to be planned and implemented," Irvine says. "Through this software, SeeByte aims to eliminate the difficulties faced by operators and to make their work safer, quicker and more accurate."

Included on the Subsea 7 AIV is an acoustic imaging system by BlueView Technologies, providing the AIV with forward-looking navigation and tracking sonar as well as the company's ultra-high-resolution MicroBathymetry sonar for three-dimensional tracking and mapping of pipelines that helps to reduce costly delays due to poor visibility and slower scan times. With BlueView's real-time scanning capabilities, the time saved paired with increased visibility can turn into a cost savings measure throughout the length of the inspection.

Both BlueView Technologies' navigation and SeeByte's software solutions can be found on a number of similar commercial projects. For SeeByte, its additional partnerships with SMD and VideoRay ROVs have made its software accessible to work-class and mini-ROV users industry wide — a widespread use that shows just how important underwater systems are becoming for the oil and gas industry.

Subsea 7's AIV autonomous inspection system. Photo courtesy Subsea 7.

"It is clear that the future of smart software will see UUVs used for fully autonomous inspections, in deeper operations and in harsher environments," says Irvine. "And SeeByte intends to lead the way through our innovating smart technologies to continue to make subsea operations more efficient, safe and cost effective."

Air Stalled

Less utilized are the similar applications that unmanned aircraft systems could be performing for land-based pipelines.

While ground- and sea-based unmanned systems are readily accepted by both end users and regulators, UAS still have miles to go before they can offer oil and gas companies benefits similar to those provided by their underwater counterparts — tangible benefits, that can include increased safety both on and off the ground, to more efficient inspections. Gary Shane of TCQ Consulting has spent the last seven years actively seeking these benefits.

Since 2006, Shane has been working on projects for both BP and Pipeline Research Council International that look to use UAS for patrolling pipeline right-of-ways. For the frontrunners looking into UAS technology for their pipeline inspections, what stands in their way is what Shane sees as the unmanned air industry's two most foremost hurdles: the need for more refined sensor technologies and the need for new non-line-of-sight regulations.

"The biggest challenges technology-wise lie in getting the algorithms developed and the sensors developed such that they can report by exception," Shane says. "In other words, they can send an alarm once they detect a hazard while the plane is in flight and only report the hazard to the point where there are no false alarms. What we don't want is to have a human watching the camera as the plane flies along for six to eight hours at a time, because then they'd get 'guard syndrome' where they would blink and miss something."

What the oil industry is seeking, says Shane, is to be able to use small unmanned aircraft as a way to patrol oilfields, particularly in remote areas such as Alaska, as a way of detecting unauthorized excavation equipment and possible leaks.

Before those benefits can be realized though, says Shane, current sensor technologies need to be refined to create sensors that are neither too heavy nor too large to fly on UAS, and sense-and-avoid systems are needed to satisfy the stringent requirements of aviation regulators such as the U.S. Federal Aviation Administration.

"We fly several hundred miles at a time in one straight line, essentially," Shane says, "and a lot of times we will pass anywhere from five miles to a couple of hundred feet from the end of a runway of a small airport.

"What we can't have is the airplane flying through Class G airspace and even that close to an airport without some sort of sense-and-avoid technology being on board," he says.

And while Shane says he knows that it's an issue that is

actively being research at this point in time through both the commercial marketplace and academia, the solutions are still not yet in production, something he feels could be at least two years away.

Technology aside, where Shane sees the real problem in implementing UAS systems for pipeline inspections lies in the air regulatory process, for allowing UAS flights to be non-line of sight. Without that, the ability to fly unmanned pipeline inspections becomes next to impossible.

"Where we have the ability to fly in smaller, remote areas, we could probably stay within line of sight," says Shane. "An oilfield that's about 20 miles square could possibly be inspected and still maintain some visual contact with the aircraft by use of a spotter and still be able to stay within air regulations. But it's when we get into the linear flights that it gets next to impossible."

To Shane and the businesses he consults for, the tangible benefits of using UAVs to patrol pipelines are immense, especially when contemplating the ability to increase the number of patrol inspections currently being done from weekly to daily.

"Current regulations require pipeline inspection patrols every two weeks," says Shane. "Most pipeline holders, BP included, try to fly at least once a week. But if a leak develops the day after an inspection, it could take up to a week before that leak is discovered. The intent when we started this project was to fly inspections every day with UAVs to improve our ability to catch any issues."

Yet without the proper sensors onboard, even daily inspections by unmanned vehicles would still be subject to human errors.

"Remote sensing from an unmanned aircraft, at least for what we're trying to do, is not an easy fix, and it's going to take time to develop the technology and make it more acceptable to the regulators," he says.

"The pipeline industry is, for the most part, regulated by the federal government," explains Shane. "So if we're going to replace a human eye with a machine, if it's an unmanned aircraft with a sensor, then we have to prove to our regulator that that machine is just as good as a human. And so for this to really be completely accepted by everyone involved, that takes time. You have to show repetitive, successful completions of your flights and detections to get your regulators to accept a non-human observation."

Gail Jansen is a freelance writer living in Canada.