PanGeo Subsea

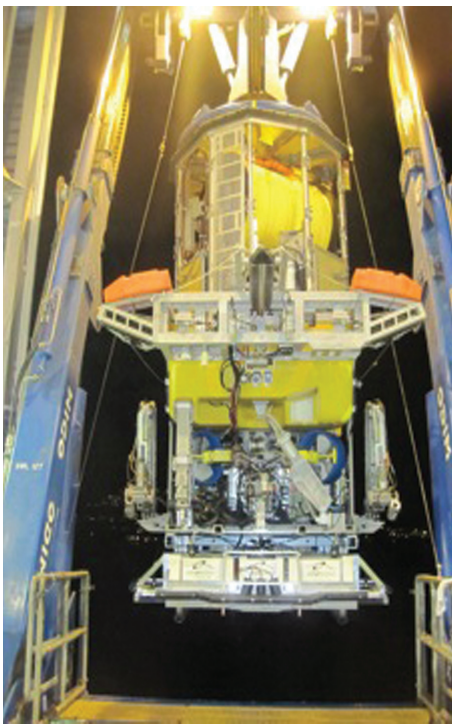
Locating N. Sea Buried Pipelines

By Andrew Safer

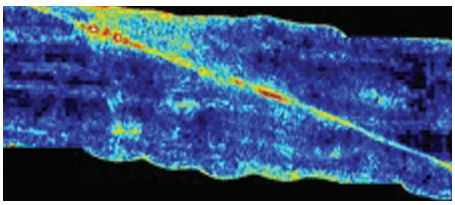
In a decommissioning project in the North Sea in May, St. John's-based PanGeo Subsea's Sub-Bottom Imager (SBI) detected a buried pipeline at depths as great as 4.5 meters beneath the seabed. "This was well beyond the ability to image pipelines using any other technology," said Gary Dinn, PanGeo's vice president of technology development, comparing it to a magnetometer which typically has a maximum range of two meters.

The SBI is an acoustic survey tool that utilizes an array of five hydrophones with 40 channels to create a 5-metre deep by 5-metre wide volumetric image of the area beneath the seafloor. The tool detects variations in acoustic impedance in the sedimentary layers. Whereas the SBI doesn't directly differentiate between compact sands, a boulder, or an object, PanGeo interprets the data by taking into account additional geological, geometric, and survey information.

The tool's inaugural application on a pipeline decommissioning project took place on a site that had been in use for 30 years, located 200 miles southwest of Stavanger between the Norwegian and UK sectors of the Ekofisk field, the oldest field in the North Sea. Operator ConocoPhillips had established a requirement that the sub-seabed be cleared of all man-made objects to a depth of 2 meters, in preparation for the installation of a new platform.



SBI on DOF ROV during deployment.



70cm pipeline buried 3m.

PanGeo's team of three staff from the St. John's office and one staff from their Aberdeen office deployed the SBI, mounted on a Hercules work-class ROV, from a pipelay vessel to a depth of 80 meters. The SBI flew 3.5 meters above the seafloor, imaging the sub-seabed. The debris removal operation included a 200-meter length of 30-inch concrete clad pipe and a 200-meter length of two 4.5-inch bundled pipes (10 inches in total width) in the 250 meter-by-250-meter area that was surveyed.

The 30-inch pipe was located using existing maps, but the 4.5-inch bundled pipes were not located where the as-given coordinates indicated they would be. It is assumed that this positional inaccuracy was due to the historical database not being updated as performance and repeatability of surface and subsurface positioning systems continually developed over the years since the pipe was laid. When PanGeo's team flew the SBI along the as-given route they didn't detect the bundled pipe, but when they reviewed the data they saw that the SBI had imaged a section of the pipe that had crossed the original survey line. This showed up in a mosaic they created from the survey gridlines which had been set 4 meters apart.

"We found the entire length of 4.5-in. bundled pipe in the next pass," said Jody Pynn, PanGeo senior systems engineer, who attributed this to the SBI's ability to create a 3D image of a given area. "We were getting immediate feedback from the excavation crew that they found what we said was going to be there," said Gary Dinn. "That was proof of the success." The pipe was located as far as

Reprinted with Permission from the October 2011 edition of Marine Technology Reporter - www.seadiscovery.com

12 meters away from the as-given coordinates, and was buried up to 4.5 meters beneath the seabed—3.5 meters deeper than indicated on the map. Remarking on the pipe's distance from the as-given location, Dinn said, "You could spend a lot of vessel time trying to look for things in that sort of distance. The dredging tool causes a lot of seabed disturbance so you can't see what you're doing until the soil settles." He figures the SBI saved several days of vessel time at a cost between £100,000 and £160,000 pounds per day.

As the SBI flies over a given area, an 8-meter-wide swath of the sub-seabed is coarse rendered in real time, and then in post-processing, PanGeo renders the data to a 5 by 5 by 5 centimeter meter image composed of voxels roughly 1/3 the size. This fine rendering enables the detection of smaller objects. Using this process, PanGeo was able to detect a 7.5 centimeter electrical cable with a smaller steel cable attached to it 1.5 meters beneath the seabed.

The operator had also requested that PanGeo attempt to locate a life-of-field seismic array with 19- and 35-mm diameter cables linked together with hydrophones that had been buried beneath the seafloor. "It was highly unlikely that we could see the cables (with the SBI)," said Alex Fleming, PanGeo vice president global operations, "but the hydrophones were of sufficient size. We knew where it was laid, so when we flew over a small test section, we didn't see it in real time, but we saw the hydrophones in post-processing. The client was extremely happy with the operation."

The Sub-Bottom Imager utilizes three technologies — non-linear acoustics, near-field coherent array processing (multichannel arrays), and synthetic aperture sonar — to image the sub-seabed in 3D. The non-linear acoustics component was developed by Dr. Jacques Guigné in Paradise, Newfoundland in the early 1990s. Its first application was in an underwater probe the Department of Fisheries and Oceans used to gauge the effects of trawling on fish habitats on the seafloor offshore Newfoundland. The technology was also used to detect mines and unexploded ordnances in the seabed. The SBI, the next iteration of Guigné's acoustics technology, was developed after PanGeo Subsea was founded in 2006 following the merger of Guigné International Limited and Pan Maritime Energy. In demonstration projects, the SBI has imaged through a rock dump covering a pipeline in the North Sea and detected a 13-cm buried cable between Norway and the Netherlands. Following repair work, it verified the cable had been buried at approximately 1 meter. PanGeo's vice president, technology development said that the SBI worked successfully both when the cable was energized and when it was not energized. He noted that a magnetometer isn't operable when the cable is live.

The SBI is also suited for pre-engineering route surveys for buried pipelines and arctic applications requiring pipeline burial due to ice scour, including determining the depth at which the pipeline must be buried, said Dinn.