



# Nodal Seismic Technology Raises the Bar for Seismic Data Acquisition

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It's a given that the ever-optimistic E&P folks continue to hone in on increasingly complex drilling targets, often in unfavourable environments - whether out of choice or necessity. In lockstep with this activity, the technology development experts continue working diligently to provide the innovative tools needed to best evaluate the myriad kinds of reservoirs under scrutiny.

As a result, operators seemingly refuse to be daunted by adverse situations, such as infrastructure-congested marine seabeds and ultra-deep structural traps beneath salt bodies of various configurations.

**The ZMarine nodal systems each require only two vessels: a node management vessel and a dual source shooting vessel**

Continuing advances in seismic data-related technology in particular are key to initiating new plays. A timely example is subsalt plays where the salt wreaks havoc with the seismic waves that propagate through the earth when using the long-popular narrow azimuth streamer technology for data collection. The distorted seismic signals cause inferior images of subsalt reservoirs.

Many of the industry's imaging problems can be traced to the use of relatively inflexible cable systems, which historically have been the accepted method for most seismic data collection.

Bulky, high maintenance cables are expensive and difficult-to-manoeuvre and require frequent troubleshooting. This can delay production and add to the cost of their already high-dollar application.

Today, seismic data service providers and their clients have options.

Cable-free nodal seismic technology systems are rapidly becoming the acquisition method-of-choice to circumvent many of the problems and hindrances indigenous to cable applications, and to acquire exceptional quality seismic data.

FairfieldNodal™, née Fairfield Industries, which has a 35-year history in providing seismic data acquisition services, including processing, is positioned at the forefront of nodal seismic technology.

Using its Z<sup>®</sup>Technology, the company has developed and manufactured a trio of entirely cable-free nodal seismic data acquisitions systems: Z Land<sup>®</sup>, Z700<sup>®</sup> (ZMarine system designed to operate at depths of 0-1,200 metres) and Z3000<sup>®</sup> (deepwater ZMarine system capable of operating as deep as 3,000 metres).

These Z<sup>®</sup> systems record seismic data via autonomous, self-contained cable-free nodes. Because there are no cables, there is no expensive troubleshooting to cause delays and hinder productivity.

Each Z<sup>®</sup> Technology system is mechanically different to accommodate the environment where it is designed to work, but the systems all share a number of essential characteristics:

- Autonomous
- Exceptionally reliable
- Continuous recording
- Cable-free
- Self-contained sensing and recording units
- Negligible footprint

The ZMarine nodal systems each require only two vessels: a node management vessel and a dual source shooting vessel. Operating the systems requires approximately 25 per cent fewer crew members than a conventional ocean bottom cable (OBC) operation.

Each ZMarine autonomous node is a self contained, four-component recording system, which collects data while deployed on the seabed. When coupled to the seabed to acquire data, the absence of a hard link between units overcomes noise issues common to cable systems, enhancing vector fidelity.

**An exemplary tool for wide azimuth (all azimuth) seismic data acquisition, providing complete coverage - even in heavy infrastructure environments**

In the case of Z3000<sup>®</sup>, the nodes are distributed on the seafloor using a remotely operated vehicle (ROV), which has long been a reliable industry workhorse. Once deployed, the autonomous, self-contained nodes record seismic data continuously for up to sixty days in a virtually noise-free environment before they are retrieved via the ROV.

The Z700<sup>®</sup> nodal units are deployed and retrieved via rope technology using a surface vessel. They can record data continuously for fifteen days.



FairfieldNodal node operations working in close proximity to deep water obstructions.

The innovative deck handling system designed specifically for Z3000<sup>®</sup> is managed by a single crew member who oversees up to 1,200 nodes each weighing 200 pounds. The nodes are handled by an automated system, which eliminates the need for overhead swinging cranes.

Once the ZMarine nodes are retrieved to the node handling vessel, the recorded seismic data are downloaded and subjected to QC. The node batteries are recharged for redeployment on the seabed.

The design of the ZMarine nodal systems enables any receiver geometry. This makes them an exemplary tool for wide azimuth (all azimuth) seismic data acquisition, providing complete coverage - even in heavy infrastructure environments.

Nodal systems provide superior reservoir images compared to streamer via:

- Enhanced signal and reduced noise
- Better attenuation of multiples through PZ combination
- Improved bandwidth
- Positional accuracy

The Z3000<sup>®</sup> nodal seismic system's ability to cost effectively acquire true all azimuth seismic data by recording in all directions makes it ideal for application in

subsalt environments, which are relatively commonplace, particularly in the deepwater environs in the Gulf of Mexico (GOM). All azimuth illumination is essential to accurately image reservoirs that are partially obscured by salt bodies or other velocity complications.

Z3000<sup>®</sup> was first used for commercial application in 2005 in the GOM at the BP-operated Atlantis Field. The purpose of the Atlantis programme was to acquire wide azimuth data to overcome imaging problems related to the illumination of subsalt structures.

The Atlantis effort entailed deployment - and retrieval - of nodes coupled to the seabed at 1,628 locations spread over 240 kilometres at water depths between 1,400 and 2,200 metres. Z3000<sup>®</sup> successfully acquired superior quality data needed to image beneath the salt.

Infill areas provide another opportunity for application of the ZMarine systems. Platforms often are placed over the main part of a field, and streamer vessels ordinarily can't acquire seismic data successfully in these particular locales.

Supplementing these type programmes with nodes enables the streamer vessels to simultaneously record both streamer and node data, which can be merged in the data processing phase so the field is geophysically transparent.

It is noteworthy that the infill segment

of a Z3000<sup>®</sup> survey automatically becomes a 4-D, i.e., time lapse, survey. This is due to accurate positioning of the nodes, which is indigenous to the Z3000<sup>®</sup> system owing to ROV deployment.

Node placement using ROVs ensures both positional accuracy and repeatability, which is a necessary prerequisite for high quality 4-D seismic. Every ROV-enabled node survey as a by-product is a 4-D baseline survey.

This was strikingly evident at Atlantis.

The difference between the ROV's estimate of position when the nodes were deployed and later retrieved was five metres or less for 75 per cent of the nodes. Given that the water depth was close to 2,200 metres, this was a concrete validation of the effectiveness of node positioning via ROV.

In 2007, FairfieldNodal™ conducted a Z3000<sup>®</sup> wide azimuth OBS node acquisition programme at the Shell-operated Deimos Field in about 1,000 metres of water in the Mississippi Canyon area of the GOM. The successful 3-D nodal programme included a small scale 2-D node repeatability study at the same location and water depth.

The published (Hays, et al, SEG 2008) study clearly demonstrated that OBS data acquired with autonomous nodes exhibit excellent repeatability.

The market for time lapse seismic applications is expanding beyond the now-common practice of monitoring fluid movement in the reservoir. Given the always-uncertain commodity price movements, time lapse seismic increasingly is being viewed very favourably by operators as a reservoir management tool to maximise economic return on their assets. Seismic surveillance has already proved to be a valuable means for reservoir management in North Sea fields.

Nodal seismic technology overall has quickly proved to be a superior technology for a wide variety of applications, and many industry experts predict that the use of cable-free autonomous nodal seismic systems will soon become commonplace in the industry. ■

### Contact information

For more information please visit:  
[www.fairfieldnodal.com](http://www.fairfieldnodal.com)