

# A SOLUTION FOR PROBLEMATIC INFRASTRUCTURE

## Anti-masking DGPS for DP Vessels

In 2000, Dutch Offshore Construction Company Heerema Marine Contractors (HMC) converted the anchored heavy-lift vessel Balder into a multi-purpose deepwater-construction vessel operating on DP. During conversion it was realised that reliable and stable DGPS input into the DP system would be essential whilst working in deep water.

Prior experience with DGPS on HMC crane vessels showed that out-ages due to masking were frequently experienced and a conventional set-up would not provide the required stability and reliability. A straightforward multi-receiver solution was likely to provide the reliability but would not provide the desired stability due to constellations differences at each receiver. Selecting the receiver with the most SVs in view was likely to cause undesirable position jumps.

### Masking Issues

In the early '90s, when GPS was still in its infancy (for civil users), stand-alone GPS would provide positioning only for several hours per day. Some navigation software packages offered the facility to mix lines of position from several sources. This enabled accurate positioning on a combination of systems without each individual system receiving sufficient lines of position to calculate a position individually. This concept of mixing lines of position applied to pseudo-ranges from multiple receivers rather than using the receiver's embedded position calculation became the basis of the conceptual design.

### Survey Solutions

The main DGPS service providers, both conventional-differential and satellite-differential, were requested to put forward their technical solutions. Several promising proposals were received, of which that from Thales Geosolutions was chosen. The proposal offered by this company best captured HMC's immediate requirements whilst also being able to meet the tight installation schedule. The system was installed on the Balder and met the reliability and stability criteria.

Based on this successful implementation, a second system was ordered for the Thialf two years later. Thales Geosolutions had by then been acquired by Fugro, so the system was further developed for dual-frequency receivers (to mitigate ionospheric distortion) by Fugro Intersite, based on Starfix.Plus corrections.

### Working Concept

The heart of the system is the RxV (Receive and Verify) program. This was developed to monitor pseudo-ranges of DGPS reference stations. It was subsequently adapted and developed to perform quality control on the pseudo-ranges of all DGPS receivers installed on the vessel (six in total). For the program to work, local antennae offsets and vessel motion are established and local pseudo-range corrections applied to the raw pseudo-ranges. For this reason, heading and attitude sensors were interfaced to enable calculation of these local range corrections. In addition to the three gyros and three MRUs that are part of the vessel DP system, an additional gyro was installed in the starboard crane to correct the variable offset of the GPS antennae installed on the crane's A-frame. Redundancy of differential corrections is ensured by the installation of two Spot beam receivers and an Inmarsat demodulator.

### DP Input

The system is set up to meet Class-3 DP regulations. Three independent computers calculate vessel position using pseudo-ranges from any of the receivers. The system provides the DP computers with two DGPS strings and is also capable of providing a single DGPS input to the Back-up DP computer in case of calamities. A user-friendly display (Figure 4) was developed to allow DP operators and surveyors to swiftly assess system status. Although initially developed as a system for DP input, the system also provides the survey systems on both vessels with DGPS. The DP and survey systems are galvanically separated but, like the DP system, survey also benefits from the reliability and stability furnished by the package. The accuracy obtainable with the system is very much identical to a standard DGPS service based on an unobstructed single receiver.

### **Future Upgrades**

With GPS, Glonass and Galileo, or any combination thereof, promising accuracies beyond the need of DP systems and most likely beyond the installation capabilities of any offshore contractor, the system is subject to regular re-evaluation. At present, however, addition of Glonass (and/or Galileo) will not provide the same degree of masking resistance as that provided by the current system.

### **Concluding Remarks**

The system is not only a reliable DP reference, it may also function as a vessel's primary navigation system, providing full MultiFix IV facilities for QC. The system is a very useful solution where (dynamic) obstructions hamper GPS antennae being installed at an optimally obstruction-free location.