MULTIPLE SURVEY AND POSITIONING TECHNIQUES FOR MV <I>ASSI EUROLINK</I>

Wreck Monitoring in Dredging Operations

The problems posed by the wrecked vessel *Assi Eurolink* called for unique solutions that have set a new benchmark in the way that similar wrecks are made safe. On 25th January 2003 a collision occurred between the Swedish vessel Seawheel Rhine and a Dutch freighter, the *Assi Eurolink*. The collision was within the shipping lane 'Friesland Junction', about 77 kilometres (48 miles) off the coast of the Dutch island of Terschelling.

The Swedish ship Seawheel Rhine sustained visual damage to her bow above water line, but the ship was able to continue to Hamburg. However, the *Assi Eurolink* sank almost immediately in a water depth of 43 metres causing a problem for the shipping lane.

General Introduction of the Project

With the wreck of the Assi Eurolink on the bottom of the busy shipping channel 'Friesland Junction', the Rijks-waterstaat (Dutch maritime authorities) were faced with two problems:

- 1. Nautical: the presence of the wreck caused a severe restriction to the navigable depth, an initial MBES survey showed the wreck to be at about 25m MLLWS, which is considerably shallower than the guaranteed 29m MLLWS for the shipping lane.
- 2. Environmental: the wreck posed an environmental threat due to the presence of the remaining fuel oil.

In May 2003, after researching different options Rijkswaterstaat decided to dredge along and underneath the wreck in order to lower it until the navigable depth could be obtained.

Preparations

Soon after taking the decision to lower the *Assi Eurolink* wreck, geotechnical investigations were performed to assess the seabed and soil conditions; this by the RV Zirfaea (Rijks-waterstaat) in combination with TNO-NITG and Fugro. An integral part of the wreck burial was the requirement to safely remove the oil and fuel from the wreck. Noordhoek Offshore was involved in this phase of the project that took place in September and November of 2003. Almost all the remaining oil was recovered during these operations and extensive ROV and diver inspections were executed and recorded to video. These extensive ROV and diver surveys provided useful information for determining an optimum location for the planned survey sensors. The earliest possibility for the dredging operation following the winter storms was spring 2004. Boskalis undertook this work using their newly built (April 2004) suction hopper dredger Prins der Nederlanden. The vessel is equipped with a long (85m) trailing suction pipe on her starboard side and an underwater pump and short (55m) suction pipe on the port side. An additional advantage of this ultra-modern dredger is that it is equipped with a sophisticated DP/DT (Dynamic Positioning/ Dynamic Tracking) system, enabling accurate dredging operations.

Required Survey Data

The survey departments of Rijkswaterstaat Directie Noordzee, Boskalis and Noordhoek worked closely together to provide the project engineers with the data required for adequate project planning and preparation. The following information was required during the different phases of the project:

- survey of the seabed around the wreck and monitoring of changes that occurred during the months prior to the actual lowering
 operations
- · assessment of wreck condition and potential movements due to currents, tides and other sources
- monitoring of stability and movements of the wreck during dredging operations
- progress monitoring of dredging work (volumetric).

Pre-dredging Surveys

The pre-surveys were carried out by Rijkswaterstaat using Zirfaea, equipped with multibeam, singlebeam, sonar and mechanical sweeping (bar sweeping) capabilities. The wreck of the *Assi Eurolink* had broken in two when it sank, but during the storm season (2003/ 2004) the front section had moved significantly; some sections had even collapsed.

As a result, several detached parts were scattered round the main wreck, constituting a potential hazard during the dredging operations.

Survey Data

The processing of pre-survey data occurred jointly between Rijkswaterstaat and Boskalis and the result proved to be very useful. From the most recent multi-beam data and using original ship's drawings, a 3D model was fitted to the dataset using AutoCad. This model was used in the Boskalis software to perform the dredging.

Monitoring

For accurate and safe dredging operations it is necessary to make use of sophisticated underwater monitoring equipment. The equipment used in this project can be divided into two groups.

- equipment used to monitor the exact location of the wreck during the entire operation
- equipment that functions as a warning system in case of sudden movements of the wreck.

Noordhoek mobilised an USBL system, consisting of a combination of omni-directional beacons (Compatts) and directional beacons, mounted with an acoustic release for retrieval at project completion. During the installation it was decided that only the stern part of the vessel would be equipped with beacons, as the front section had moved and collapsed and only minimal dredging work was required around this front section.

Dredging operations are not ideal environments for underwater acoustics. Noise levels inherent to dredging work (suction pumps) are very high and sub-sea beacon acoustic signals are often thus not registered by the USBL system onboard the dredging vessel. On this particular site, other sources of interference were also determined: reflections from the wreck, and expected reflections on the very flat bottom of the dredger, especially in a shallow water environment.

Accelerometer motion sensors (Tri-axial sensors for measurement of rotation and axial movement) were specifically developed, designed and built by Noordhoek engineering division, Seatec Underwater Systems BV; one sensor on each wreck section (front and stern). Data output and power supply to each sensor was via a heavy marine cable linked to a navigation buoy marking the site. Data output was sent via radio telemetry to the dredging vessel.

The stainless-steel sensors were fitted to mounting plates which were then riveted to the wreck by Noordhoek divers.

Installation of Sensors

The following constraints were present, making the location of the sensors extremely important:

- optimum output (accuracy) within a bandwidth of 90 degrees. Prior to the installation the project team had to predict the most
 probable movement of each wreck section in order to choose the location and inclination of the sensors prior to dredging operations.
 Note that the stern part of the wreck had an initial inclination of 37 degrees over portside. It was expected that this part of the wreck
 would roll over during the burial operation
- the cable route from the sensor to the base of the navigation buoy had to allow for sufficient slack to avoid stresses on the cable if and when the wreck moved. The required slack had to be placed in a corridor approximately 10 metres wide. This was a no-go zone for the suction pipe of the dredger
- the motion sensors had to be orientated in the gross direction of the wreck axis for correct interpretation of the measured movements (rotational and axial) and correct input into the Boskalis 3D system
- . the sensors had to be placed at a location away from potential mechanical impact during wreck movements
- the sensors should ideally end 'on top' for interventions/repairs and possible retrieval.

The installation of the sensors and cables was a diver operation, completed within a very short time, with ROV (eyeball) support. A systemintegrity test was performed after connection of the cable to the prepared buoy. Power supply, data link telemetry unit with antenna and interfacing facilities were mounted on the navigation buoys on-shore and placed on location by Rijkswaterstaat.

Sensor Data Output

The acquired data was logged onto two systems. The USBL data was checked for quality and processed into the format required for the visualisation system on board the Prins der Nederlanden. The motion sensor data was logged onto a separate system and reformatted for export to the dredging visualisation system. Both in the survey room and on the bridge, a visual and sound alarm was installed. As soon as any significant motion was detected the screen flashed red and an alarm sounded.

Survey of Progress

During dredging operations the dredger was fitted with all the necessary survey equipment, eliminating the need for a dedicated survey vessel. A Simrad EM 3000 was fitted to the port side suction pipe and the USBL transducer was fitted to the starboard suction pipe. The regular MBES surveys gave a good impression of the progress of the work and the behaviour of soil conditions surrounding the wreck. Interruptions to obtain USBL measurements and MBES survey were acceptable to the dredging process. The MBES surveys, which took more time, were undertaken only after significant shifting of the wreck.

Results and Conclusions

The system on board the dredger Prins der Nederlanden enhanced the level of confidence for the project team. The motion sensors provided continuous data on wreck movement and increased the safety of the dredging operation. Rijkswaterstaat decided to perform a mechanical sweep over the project site to confirm the MBES data. Water depth at the site is now back at more than 31m MLLWS. Through open communication and thorough project preparation on the part of Rijkswaterstaat, Boskalis and Noordhoek, the equipment was designed, built and installed on board and on the wreck in only three weeks. The project team in charge of the dredging and survey operations managed to execute the wreck burial in just two weeks, aided by excellent performance of the newly built dredger Prins der Nederlanden and exceptionally good weather conditions. The project was a success for all parties involved and has paved the way for how future wreck activities might be handled.

https://www.hydro-international.com/content/article/wreck-monitoring-in-dredging-operations