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Smart Tools for Traditional Jobs

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SYNOPSIS

Even in the traditional world of salvage operations and ocean towage: modern techniques are used today.

- The preparations for ocean tows include in-depth motion analysis, environmental studies, etc;
- During all major salvages the salvage master is accompanied by a naval architect (complete with state-of-the-art software programmes).

The missing link is often the verification of calculated motions, strength and a vessel's condition through monitoring and measuring. Real-time motion/condition monitoring on board a casualty or on a tug is at last now easily available and is used as a decision support tool to control the operation. Theoretical values can quickly be compared with real values and the logging of all data provides documented proof of the execution of a project.

Communication has become easier to the extent that, without modern telecom facilities (mobile phones, internet, Iridium satellite phones, etc) the work has become difficult to do.

This paper will describe a range of techniques that are used these days and the emphasis will be on modern 'motion, condition, position and environmental' monitoring equipment. The case studies are related to recent salvage operations.

INTRODUCTION

Modern monitoring equipment available today:

- Easy-to-install (motion) monitoring equipment;
- Quick Response kits, that are easy to transport and install;
- Telemetry that enables condition monitoring at a distance (salvage tug, shore-based control centre);
- Independent power supply via solar cells or wind generators to guarantee continuous monitoring, even on 'dead-ships';
- A tool to provide the salvage master and naval architect with all the information they need to monitor the condition of a casualty and the fluctuating forces, either internal (cargo discharging, pumping) or external (wind, waves, tugs);
- A tool to verify that the motions/changes that have been calculated actually happen (or not, and why);
- A tool that records all of the above for future evaluation and reporting purposes;
- With modern telecom facilities the information from the salvage site can be made available onshore (periodical reports) almost in real-time;
- A powerful tool to satisfy the needs for accurate information from authorities, insurers and other third parties.

This paper will give various examples where and how monitoring equipment was used and gives a brief explanation about past and future developments, including a brief description of tow-monitoring techniques and potential.

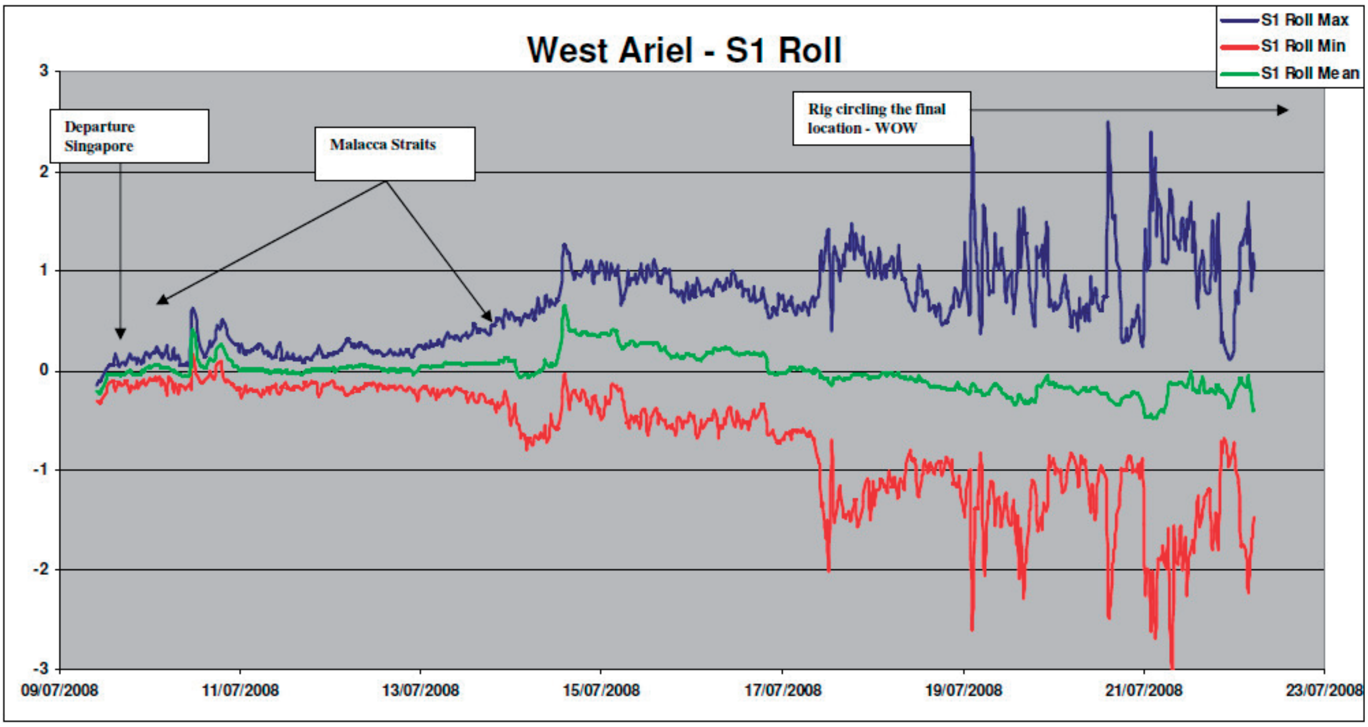
LIMITING CONDITIONS DURING TOWS

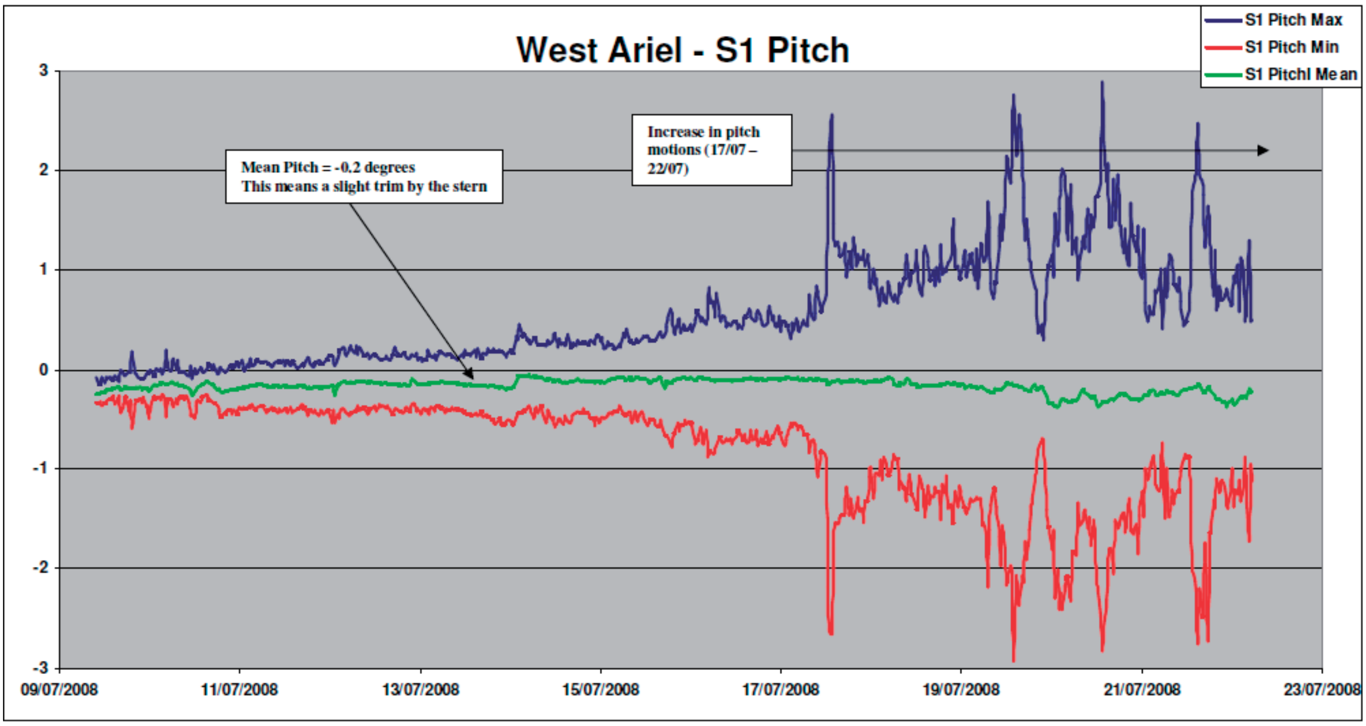
During the preparations for a towed transport, the limiting conditions are often derived from motion response calculations and usually expressed in a limiting wave height (Hs) or in roll/pitch angles and periods.

The real limitations during such manoeuvres are forces on the cargo and/or wave slamming. Forces are best expressed in terms of acceleration. During a tow, and especially during unmanned tows, the motions of the tow are observed visually and the actual wave height is more often than not calculated wrongly.

Tows can now be equipped with motion sensors, local storage of the motion data, telemetry to the tug and a simple display that provides the master of the tug with actual motion information.

A power supply from solar cells is sufficient for an unlimited service. Such systems have been used successfully as decision support tools to ensure that all motions remain within the permitted levels and that corrective action (heading/speed control) is carried out to prevent damage.The motion and position data can be transmitted via email and regular (daily) reports can be made on the progress of the tow.





Figures 1 and 2: The graphs above are a part of a daily progress report and show typical motions during a tow with a large jack-up rig.

LIMITING CONDITIONS DURING SALVAGE CASES

In the salvage industry one thing is sure: nothing is ever the same.

Salvage cases range from:

- A 'simple' engine breakdown in open water requiring a salvage tug;
- Collision without the danger of sinking;
- Collisions with danger of sinking or major environmental pollution;
- Grounding, with or without the danger of environmental pollution;
- Wreck removals.

In most cases the structural integrity (or the loss of structural integrity) of the casualty will be evaluated. The major salvage companies have in-house naval architects and state-of-the-art software programmes to model vessels and provide the necessary information to the salvage master and owners and/or authorities for the salvage plans. However, a number of questions must be put in order to achieve an accurate working computer model of the casualty:

- Is the structural integrity of an intact vessel still correct (age, fatigue, historical damage, correct input, etc)?
- Is the assumed (underwater) damage correct?
- Is there risk of additional flooding of compartments or deterioration of the damage?
- Is the assumed/provided weight distribution of the vessel correct?

In addition a number of other factors have to be taken into account to determine the total risk of a salvage operation. This includes weather conditions, the soil conditions during grounding, the nature of the cargo, risk of hazards to the salvage crew and more besides.

A range of 'Smart Tools' is currently available which provides information about the vessel and the environment, helping the salvors and any other interested parties in the decision-making process.

Existing motion and hull-integrity monitoring systems are the detailed in the following chapters. These systems are often complemented by position and/or environmental monitoring sensors. The various methods for data communication are explained.

Figure 3: **MSC Napoli**.

Figure 4: **Pedopo**.

MOTION AND HULL-INTEGRITY MONITORING

Today the structural integrity of a casualty and the changes in conditions can be displayed, recorded and verified by using state-of-the-art sensor technology.

Siri Marine has developed a high quality motion sensor and dedicated software to monitor, display and record the condition of a vessel. The sensor is placed in a durable stainless steel housing to protect it against the harsh environment of salvage at sea. Subsea sensor applications are also provided.

Each sensor is connected to a control PC with dedicated display/logging software. The data communication connections can be either hard-wired or wireless, depending on the situation on site.

A single sensor configuration displays roll/pitch/heave motions and, more importantly, the changes in these values. In a multiple sensor configuration the structural integrity (and essentially the changes in these values) are displayed and recorded, thus visualizing and recording the deflection and torsion of a vessel. Heave motions in various parts of a vessel give a perfect indication of the ground reaction over the length of a vessel.

All sensor data is recorded in 25Hz log files and 30-minute statistics. The statistics files are small and can be emailed to an onshore location for further evaluation and reporting purposes.

Motion sensor units are pre-assembled in their own watertight cases and contain a sensor, wireless transmitter, battery and solar cell. These units can be placed on a casualty without the need for external power supply and the control PC can be positioned at a distance (bridge, salvage tug, onshore control room, etc).

ADDITIONAL SENSORS DATA

The Siri Salvage System has been devised to accept a range of other instrument information:

- GPS / DGPS;
- Heading data;
- Wind data;
- Wave height data.

In combination with motion sensors, therefore, complete information on the casualty and its environmental conditions can be presented on a single PC. The data is stored in a unique format to facilitate post-processing and reporting.

QUICK RESPONSE AND DURABILITY

The need for a fast response during salvage operations is obvious, as is the requirement for tough equipment that can withstand the sometimes harsh environment of a salvage job.

Dedicated salvage sets are located in strategic places. The units are packed in customised watertight cases, all of which are suitable for accompanied airline luggage, allowing for a very short mobilisation period and ease of installation on site. Requirements for a salvage operation are never the same and the units are therefore modular so that selected parts can be mobilised to the site. These may include wireless sensor units, hardwired sensor units, a satellite communication unit, GPS or heading sensors, environmental sensors, etc.

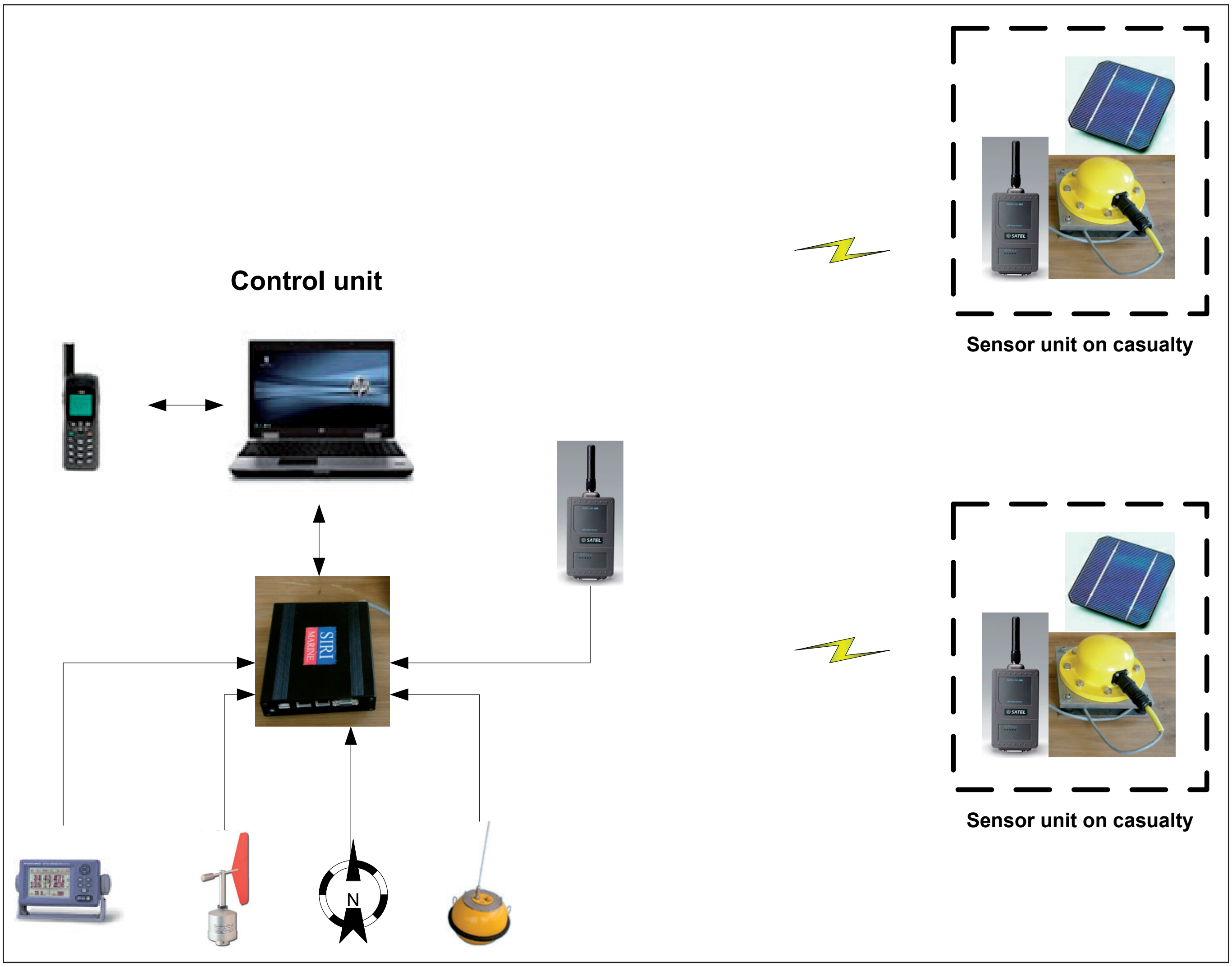


Figure 5: This illustration shows a typical configuration with two remote/wireless motion sensors plus various environmental/position instruments and a dedicated irridium satellite communicator to email information to shore.

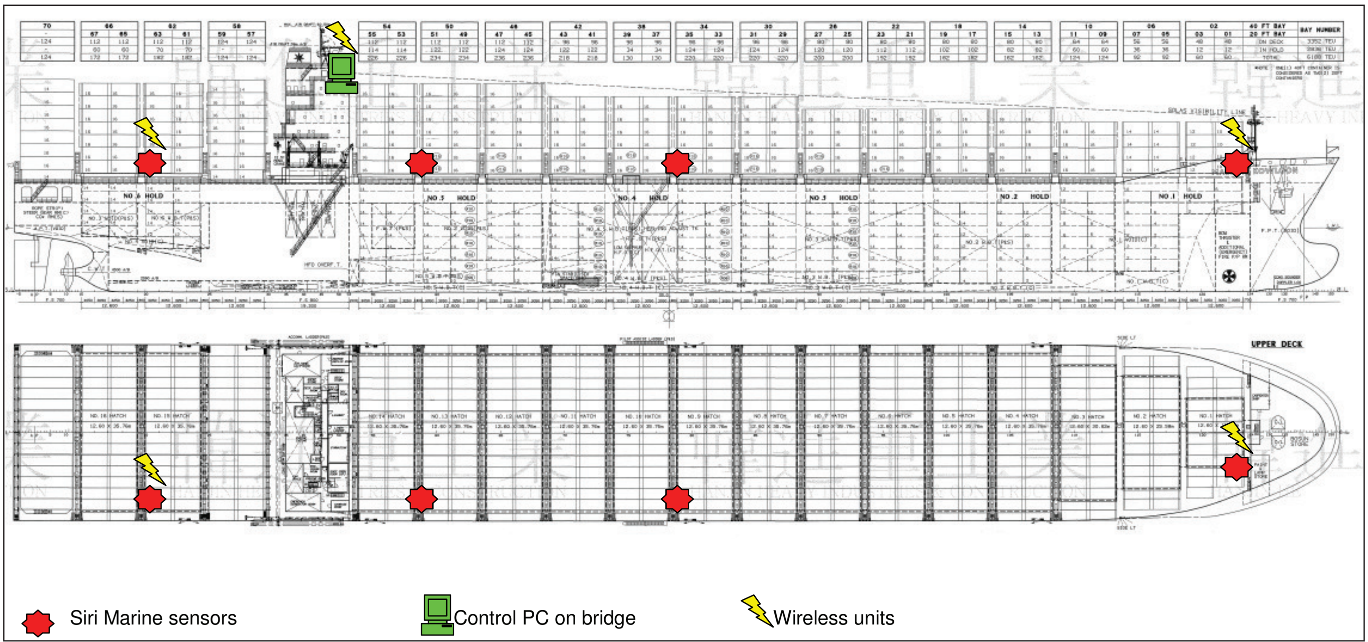


Figure 6: A typical motion sensor configuration that was used during the salvage operations on a 6200 TEU container vessel: two wireless sensor units and two hardwired sensors with a control PC on the bridge.

CASE STUDY 1 – *MSC NIKITA* (NEAR HOOK OF HOLLAND, SEPTEMBER 2009)

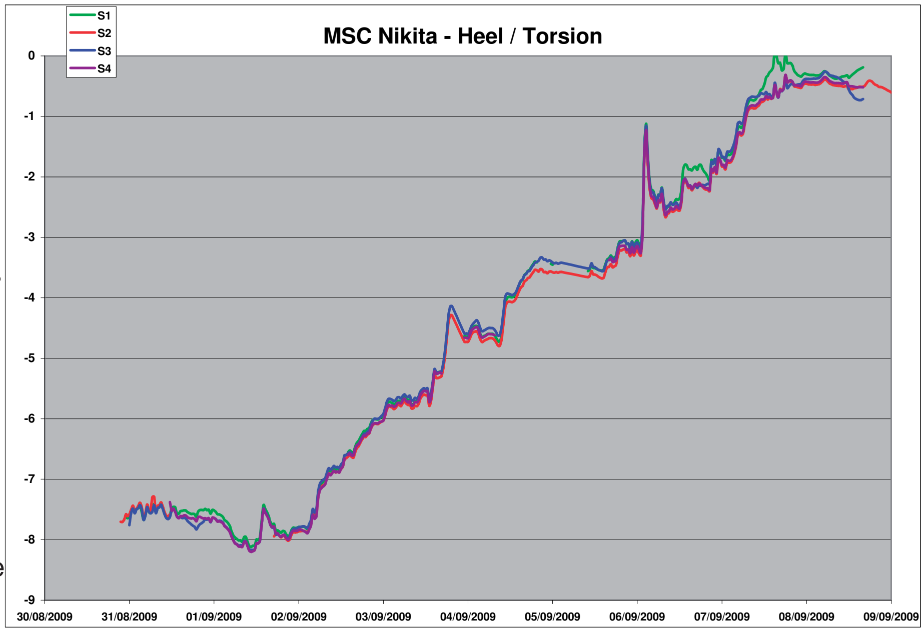
Figure 7: **MSC Nikita**.

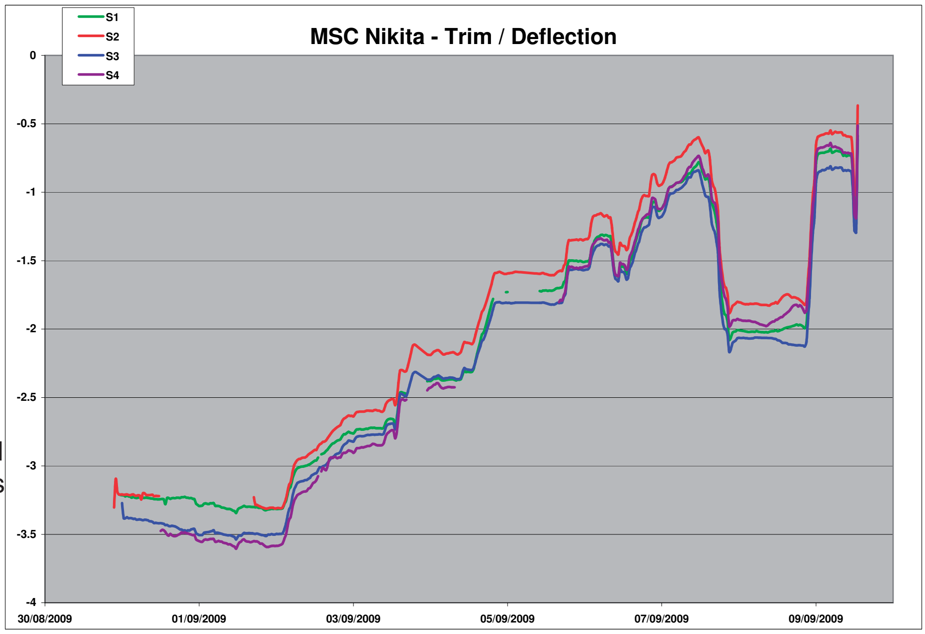
Figure 8: **MSC Nikita** *enters Rotterdam Harbour.*

The container vessel ***MSC Nikita*** collided with the ***Nirent Pride*** off the shore of the Hook of Holland in the middle of the night and sustained major damage in the aft ship. The engine room and aft cargo holds and spaces were flooded and the crew abandoned the vessel shortly after the collision. Salvors from Kotug and Svitzer Salvage arrived during the early morning to stabilise the vessel and prepare the salvage plan.

Siri Marine was mobilised on board during the afternoon of the same day and started the motion/condition monitoring. The vessel was unstable and further water ingress and risk of sinking was possible. Discharge of cargo from the aft ship was required to bring the vessel to a safe condition. An alternative was to beach the vessel. Offloading cargo at sea at very short notice was not possible and the weather forecast was unfavourable.

A salvage plan was prepared and the Rotterdam Port Authorities were asked to allow the vessel to enter port to offload the cargo and stabilise the vessel in sheltered waters. The motion/condition data from the vessel at sea showed that no major changes had occurred since the collision, information which became part of the decision-making process to allow the vessel to enter port.





Figures 9 & 10: The graphs above show the heel, trim and deflection / torsion during the offshore and offloading period.

The vessel entered port two days after the collision, was discharged at the Maasvlakte and towed to Verolme Drydocks for inspection and repair. Throughout the offshore period and during offloading the vessel's condition was carefully monitored with Siri equipment.

CASE STUDY 2 – *NEW FLAME* (GIBRALTAR, 2007–2008)

The bulk carrier ***New Flame*** collided with another vessel near Europa Point, Gibraltar, in August 2007.The collision resulted in major damage and water ingress in the forward section and the vessel started to sink. The foreship finally came aground on a shoal, although the aft part of the vessel was still afloat.

Figure 11: **New Flame***.*

The salvage operations consisted of:

- Removal of HFO and other hydrocarbons from the tanks;
- Attempt to refloat the vessel;
- Attempt to cut the vessel in half and refloat/salvage the aft part.

Unfortunately the refloating and cutting operations were not successful. The casualty deteriorated during foul weather conditions and finally the vessel sank completely, to be removed in parts as a 'wreck removal' project.

A motion/condition monitoring system was on board throughout the period and showed clearly the results of salvage actions and the effect of bad weather. Remote sensor systems (two motion sensors and a DGPS compass) were installed on the casualty and monitoring equipment was placed on a salvage tug. In addition a monitoring PC was placed onshore and during bad weather periods the vessel's motions and condition could be seen from the safety of the beach.

SUMMARY, CONCLUSION AND DISCUSSION

Motion and environmental monitoring equipment has been used on numerous projects over the last few years. The equipment has changed from scientific research instrumentation, which was employed occasionally in special circumstances, to the present durable, easy-to-use systems that are specifically designed for the maritime environment.

The systems were used to:

- Assist the salvage master on board in his decision-making process;
- Verify the calculations of computer models;
- Record any changes in a casualty, both short-term and over longer periods;
- Provide early warning when the structural integrity of the casualty deteriorates and gives time for corrective action;
- Provide input to (intermittent) condition reports;
- Provide documented records regarding the progress of a salvage operation and the condition

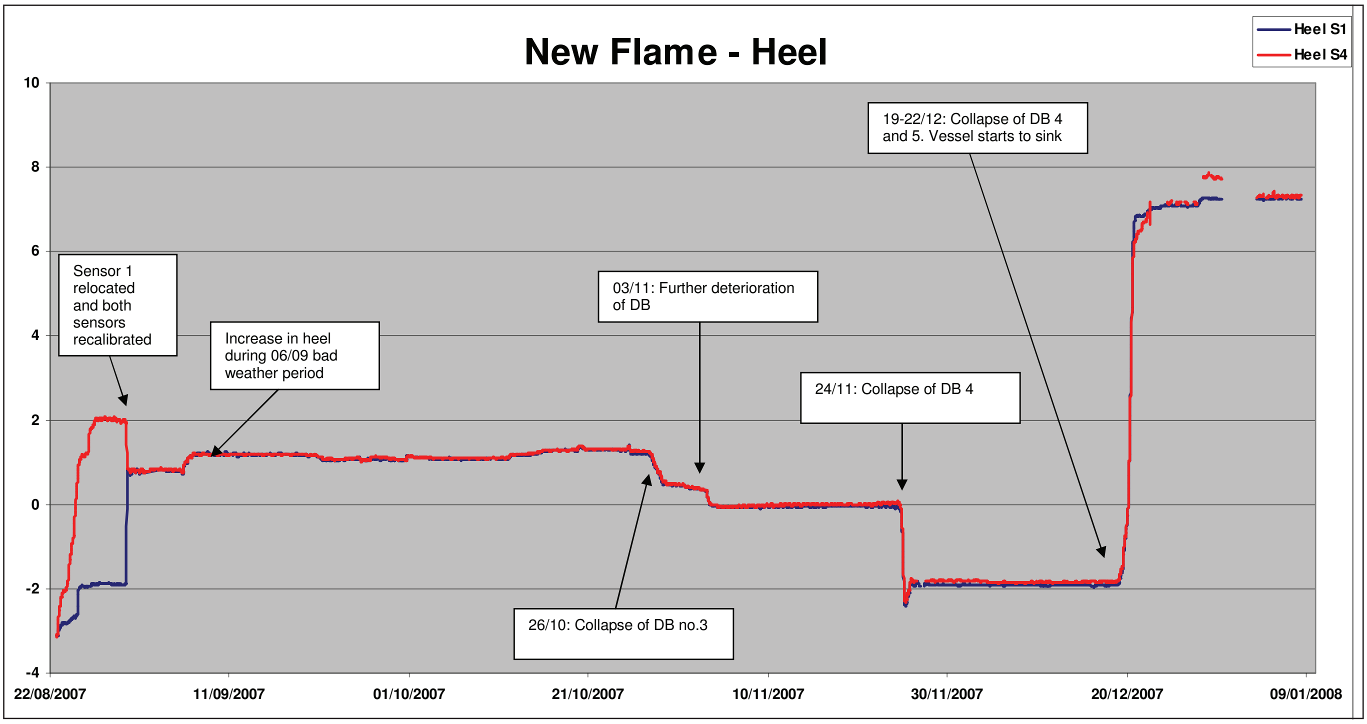


Figure 12: This demonstrates the changes in heel over a period of five months and the results of bad weather.

of a casualty during the operations and upon re-delivery to its owners;

- Provide a clear picture to external parties, (local) authorities etc that everything is being done to keep the casualty under control.

It is true to say that, on a few occasions, the work was completed and the input from the monitoring system was minimal. This however only confirms that no unexpected situations arose and the systems were still on-site in case the situation deteriorated. (Occasionally a specialised pump or other equipment can also be mobilised to the site.)

The use of such systems is still seen by some people as fashionable. It is, however, the opinion of the author that it is 2010 and that available and state-of-the-art equipment and services should be used to provide all the information possible to a salvage team so it can complete the job safely. Moreover, the records can be used for post-processing of a salvage operation and for future learning.