PRESTIGE OIL RECOVERY FROM THE SUNKEN PART OF THE WRECK

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Introduction

This lecture deals with the equipment developed and the experience gained during the performance of operations carried out over a number of months during both the summer of 2003 and 2004 in water depths of nearly 4,000 meters, for the recovery of the fuel contained in the tanks of the Prestige tanker. Repsol YPF was appointed by the Spanish government to recover the fuel remaining in the wreck and subsequently selected Sonsub as the main contractor.

The sinking

In November 2002 the single-hull tanker Prestige sank at a distance of about 240 km (130 nautical miles) from the North West coast of Spain off Galicia, splitting in two halves 1.9 nautical miles apart. The bow came to rest in 3,830 metres water depth, while the stern came to rest in 3,565 metres water depth.

The 1st distress signal was sent on the 13th November 2002, while the ship sank in two parts on 19th November 2002

Initial activities

Prior to the actual project for the recovery operations, a number of activities were performed. These included:

- During the month of December 2002 the Nautile mini submersible was engaged to perform preliminary survey and leak plugging of the wreck
- The Spanish Government appointed a Scientific Advisory Committee to advise as to the most suitable solutions to be adopted
- A large number of proposals, including one by Sonsub, were analysed by the Scientific Advisory Committee
- In 14th February 2003 the Spanish Government entrusted Repsol YPF with the study of the technical viability, and following this with the management of the development of the necessary technology and the recovery operations.
- 3 'Doability studies' were assigned, two to Sonsub and one to Seal Engineering to develop the concepts considered the most interesting. These were to be completed in three months.

Technical challenges

The main technical challenges that were faced were:

- The 3,830 metres water depth. This was well beyond the state of the art for workclass ROVs, as well as all the required equipment. Previous wrecks that had required similar recovery (e.g. Erika) were in diver depths
- Viscosity of 5 million cSt. This created a major challenge for the transfer of the oil both from the wreck to the surface, and for the transfer to shore
- The very tight schedule. During the 2003 operations, it was a requirement to design, construct and test the innovative solutions and equipment developed within September 2003. The contract for this was placed in May 2003

Selection of Sonsub

Repsol YPF was appointed by the Spanish government and selected Sonsub as the main contractor, firstly for the doability studies, then for the innovative equipment development, then for the 2003 survey and verification operations, and finally for the 2004 full recovery. These contracts had the following schedule, which again illustrates the rapidity with which the activities had to be performed:

- March 2003, Sonsub selected to perform the doability studies on:
  - Shuttle recovery system
  - Coffin to confine the wreck
- April 2003, Sonsub selected to develop and construct:
  - Tapping tools
  - Extraction valves
  - Water injection system

- May 2003, Sonsub selected to perform:
  - Survey of the wreck
  - Plugging of leaks
  - Verification testing of shuttle concept
- February 2004, Sonsub selected for complete recovery of a target 11,100 tonnes of oil

Equipment developed

The following main new items of equipment had to be developed, tested and employed for the recovery operations:

- Heavy work class ROVs for 4000 m water depth
- Measurement systems to define residual oil
- Beam sensors for positioning
- Tapping tools for 700 mm openings in tanks
- Anchored valve systems over openings
- Shuttles of 350 m^3 volume
- Transferral of oil from shuttles with 'core flow' technology

The ROV for up to 4000 metres

Prior to this project, the INNOVATOR™ had a proven track record of performance and reliability operating on Deep-water Projects up to 3,000 m. The Prestige Project presented a ground breaking challenge which involved a modification program to upgrade all aspects of the Innovator ROV system to operate continuously in 4,000m of water.

This was achieved using the existing 3000 m umbilical to the Tether Management System, and the 1200 m tether already developed for touch down monitoring of pipelines. The configuration was changed in that the tether was deployed vertically rather than horizontally.

Due to the inherent capabilities that the INNOVATOR™ already had as well as its track record, the actual items of equipment that had to be modified to achieve the 4000 m water depth target were limited to the following principal systems:

- Buoyancy
- Manipulators
- Cameras and lights

The testing of the ROVs was carried out as the first activity of the 2003 campaign, and was essetial to the feasibility of performing any of the operations on the wreck.

Plugging of leaks

Following the successful tests on the INNOVATOR ROVs, operations commenced on the survey of the wreck, following which the plugging of the leaks still present from the various tanks was carried out, using a number of different methods and tools.

Remaining fuel on the wreck

The oil measurement analyses performed during the 2003 campaign indicated that the remaining fuel oil could be estimated at:

- 13 000 Tm in the bow, located in port and starbord tanks, while the central tanks were effectively empty, and
- 700 Tm in the stern

Polar Prince and FPSO ODIN on site

The Polar Prince, a multi purpose DP2 class vessel operated by Sonsub, was adopted for both the 2003 and the 2004 operations. This vessel was able to deploy up to 3 INNOVATOR ROVs to full depth simultaneously, as well as all the necessary tapping tools, extraction valves and water injection systems.

The MST/FSO *Odin* was the designated oil recovery vessel. She is a Multi-purpose Shuttle Tanker vessel with DP 3 dynamic positioning capabilities used as a Floating Storage and Offloading unit. She stocked the Prestige oil cargo once recovered to the surface and discharged from the shuttle tanks.

ROV performs beam sensor operations

A deck structural ultra sonic beam detection and plate thickness system was used to map the location where the extraction valves were to be installed.

Marking of hot tapping locations

The locations for the installation of the tapping tool were then marked.

Positioning of tapping tool

Hop-tapping and extraction valves installations were performed on each of the four cargo tanks within the wreck bow section.

Tapping tool

The tool, which carries the extraction valve, is provided with an anchor bolt unit (6-off per system) to lock the valve to the deck before starting the trepanning operations. The centre of the tool carries the trepan tool for cutting 700mm holes. The system is operated by ROV through a dedicated IHPU

Extraction valve

The design of the extraction valves were particularly focused on safe recovery operations and each valve included failsafe shut-down systems as necessary to ensure that oil spills were avoided during the extraction process. Each valve includes a double gate system on top and bottom. The bottom gate is operated by ROV torque tool while the top one is either operated by ROV or can close automatically through a “fuse-bolt” system broken by the force exerted when the shuttle tank is completely filled with oil.

Water injection system

During the flow of oil from the cargo tanks to the shuttle tanks, it was necessary to ensure the free entry of water into the lower part of the tanks to replace the escaping oil. For this purpose, a dedicated water injection system was developed composing of water injection casings being installed via the Prestige deck hatches.

Shuttle during construction

Each shuttle tank is composed as follows:

- A main aluminium body with a diameter of approx 5.3m and an overall length of approx 23m, suitable to take up to a maximum of 350 m3 of oil;
- A bottom interface provided with an ROV operable door to allow flowing of the oil from the oil extraction valve into the shuttle tank;
- A top interface with two ROV operated gate valves system and a mechanical interface to the riser termination unit;
- A pull down winch located on the top section of the shuttle tank to allow connection and controlled final approach/release from the oil extraction valve;
- Suitable buoyancy installed externally to the shuttle tank to have it buoyant and allow controlled transportation through the water column by using the dedicated shuttle handling equipment.

Shuttle towing

Following completion of extraction valves’ installation, the shuttle tanks were towed offshore and prepared for installation.

Shuttle deployment

The shuttle tanks were designed to be continuously buoyant with the descent and recovery operation regulated and controlled by means of ballast chains. They are deployed to the Prestige wreck in approximately 4 hours time, connected to the extraction valve assembly with a secondary connection to a safety anchor dead weight.

Shuttle winch system

Once deployed and connected to the pre-installed extraction valves, final positioning of the shuttle to enable safe oil extraction is achieved via the operation of an ROV operated mechanical winch which is an integral part of the shuttle.

Oil filling

The shuttle lower door assembly can then be opened again via ROV intervention in preparation for the gravity entry of oil from the extraction valve.

Oil flow through valve and Shuttle being filled

During the extraction process the flow oil is controlled by ROV operation of the double gate extraction valve, with again failsafe systems to ensure overfilling is avoided.

Shuttle recovery

When the shuttle was approximately 60m WD, a riser assembly is lowered from the Odin and connected to the shuttle.

Shuttle top interface to riser

The top interface connects to the riser termination unit and has two ROV operated gate valves to permit the oil to be pumped into the riser

Riser termination unit

The riser/pump assembly system is made up of a number of different components. These are:

- An handling winch;
- A 6" flexible hose (riser);
- A riser termination unit provided with a pump and a mechanical interface allowing to dock and lock onto the shuttle tank top interface:
- A service hydraulic bundle to allow operation of the riser termination unit from the surface.

Oil transfer to FPSO via Core Flow

One problem faced during the engineering phase was the fuel discharging operation. This was a point of great concern because, given the very high oil viscosity, it initially seemed very difficult to pump the fuel out of the shuttle for a route of about 60m length from the shuttle riser connection to the Odin tank. The adopted innovative "Core Flow" solution proved highly successfully and a significant contribution to the overall success of the project. In effect water is pumped into the riser during the discharging in such a fashion as to form an outer sheath around the oil, giving birth to a so called *core flow* where the oil flows inside the water film. This latter functions as a "lubricant", i.e. it reduces the friction losses between the highly viscous oil and the riser walls. With this method, by using a "standard" pump mounted at the bottom end of the riser it is possible to pump the oil up to the Odin tank.

Bacteria injection

The final phase of the project consisted of bioremediation nutrients injection. The rate at which micro organisms naturally present in the water and in the oil actively consume fuel-derived toxic compounds can be greatly increased by the addition of nutrients. This solution has been adopted for all tanks on the Prestige where some oil still remains after the operations.

Prestige key dates

The following dates summarise the project development:

- March to May 2003 Concept developed
- May to July 2003 equipment for operations in 3830 m designed, constructed and tested
- October 2003, first cargo of 100 tonnes recovered with shuttle concept
- December 2003 to April 2004, procedures and equipment for industrial recovery completed
- June to October 2004 complete remaining cargo of 13,400 tonnes of oil recovered

Sonsub Capabilities

Sonsub has established itself as having:

- Unique deepwater intervention capability up to 4000 m water depth
- Marine spread resources, operating 8 vessels
- State of the art ROVs, with a total of 58 vehicles operated
- Underwater operations experience
- Innovative, project specific, equipment development
- Experience from the Prestige project
- Access to a worldwide group with such as Saipem that can support all its activities

Conclusion

The recovery of the fuel from the Prestige wreck, although considered by salvage experts as impossible at such a depth, was completed:

- within schedule
- within budget
- without any environmental pollution
- within any incidents or accidents