

APPENDIX

F. Salvage of HMS THETISF.1. Position of HMS THETIS

THETIS sank on the afternoon of 1 June 1939 in Liverpool Bay, England, 17 miles northeast of the Isle of Anglesey. The depth of water was 155 feet at mean low water. The average rise and fall of tide was 22 feet with a velocity of 4 knots at the surface. The period of slack water varied from 0 to 30 minutes. The bottom was of hard clay covered with a thin layer of sand. The cause of the sinking was the flooding of the two forward compartments through the lower starboard torpedo tube, the breech door having been opened while the muzzle door was open. The forward portion of the keel was about 2 feet clear of the bottom and the propeller shafts were well clear of the bottom. The maximum sinkage into the bottom was about 4-1/2 feet near the after end of the keel.

During the night of 1-2 June, the crew was able to raise the stern to the surface by blowing main ballast tanks and pumping out fuel and fresh water tanks. Four men escaped through the after escape hatch. An attempt to bring the escape hatch above the surface by towing the stern forward failed when the towing wire parted and the stern sank. Attempts to rescue the crew were discontinued on the afternoon of 3 June, and the operation thereafter was one of salvage only.

The position of THETIS was exposed from all quarters, and the worst sea conditions could be expected with prevailing winds southwest through west to northwest. Sea conditions were subject to very rapid change.

F.2. Salvage Plan

Two lift barges, each 100 feet long, and designed to lift by utilizing tidal action were used in the first attempt to lift THETIS and bring her in to shallow water in a more protected area. During the first attempt at making a lift, a swell suddenly came up after the slings had been secured at low water. Three of the six slings carried away before they could be released. It was then decided to lift with a larger improvised lift ship which would be less vulnerable to unfavorable sea conditions.

ZELO, a merchant ship, 308 feet long, with a beam of 43 feet and a deadweight capacity of 3,350 tons, was selected as the best suited for the purpose. The submerged weight of the submarine, if fully flooded, was approximated at 1000 tons. At the drafts expected during a lift, ZELO would experience 35 tons displacement per inch immersion, so that there would be little loss in lift due to sinkage.

ZELO was fitted out with eight wooden lifting beams supported by under-deck shores carried to the double bottom. Each lifting beam consisted of four pitch pine timbers of size ranging from 12 inches square to 16 inches square and extended over the side about 3 feet. The overside extension was built up to 42 inches diameter with green-heart. Each end of sling was to be secured to one end of a lifting beam by three round turns, then led to a fall on ZELO's deck.

F.3. First Salvage Attempt

Eight wire slings were placed under the submarine: two under the keel forward of the conning tower, two forward of the keel, two under the keel aft of the conning tower and two aft of the keel.

The forward slings were rigged by sweeping a messenger wire rope under the bow and using this messenger to haul the slings into place. At the stern, where the rudder and propellers prevented use of this method, a light manila messenger was passed by divers under the stern where it was clear of the bottom. This manila line was used to haul a wire rope reeving line into place which in turn was used to haul the sling under the bottom. The stern was lifted by means of the No. 1 and No. 2 slings in order to place the last two slings (No.'s 3 and 4) in the desired fore and aft position below the mud line.

When a lift was attempted on 21 July, No. 8 wire at the bow freed itself entirely, and No. 5 wire became slack and apparently slipped out of its desired position. Thus, No.'s 6 and 7 wires became overloaded and the No.'s 6 and 7 lifting beams failed.

ZELO was withdrawn and modified by fitting steel lifting beams with built-in bollards and cast-steel bolsters on the outboard ends. This work required five weeks. A completed bollard was tested to a pull of 180 tons.

ZELO was ballasted with 1000 tons of fresh water, the tanks being completely filled to avoid any free surface.

An inclining experiment performed after completion of this work showed that with the load of the submarine slung from the beams, there would be a positive, although small, metacentric height in the upright condition. This was considered acceptable since a small list would increase the metacentric height.

F.4. Lifting Phase

On 24 August, ZELO returned to the wreck. Slings were again rigged and at 6:30 A.M. on 28 August, the wire slings were secured and clamped tight (pinned down) at low water.

The submarine was lifted and moved inshore on that tide and on each of the five succeeding tides until she lay 2 miles from Moelfre Island in 78 feet of water. Here, the operation was halted to remove the No. 1 periscope so as to permit the submarine to be lifted to a lesser depth without interference between ZELO and the periscopes. The No. 2 periscope was found to be bent over and not to extend above the conning tower.

THETIS was then lifted and moved inshore three more times. On the evening of 3 September 1939, she lay in 37 feet of water (at low water), about 4/5 of a mile from Moelfre Island. At this point, ZELO slacked all the slings and allowed the tide to carry her clear of the submarine. The clearance between ZELO and the submarine was now about 3 feet at high water, and at low water the conning tower would be 6 feet below the surface.

F.5. Slings

Slings were of 2-7/8 diameter 6-61 galvanized wire rope, having a nominal breaking strength of 240 tons. The 6-61 construction was selected because of the need for flexibility to permit securing to bitts of reasonable size. A piece of the wire was tested to a breaking load of 265 tons. This gave a safety factor in excess of four, assuming the load to be equalized among the slings. The only equalization of loads on the slings, other than that provided by the elongation of the wire under load, rested with judgment of the master salvor who eased back on those slings which appeared to be carrying more than the average load. Once equalization appeared to be satisfactory, the slings were painted where they passed over the side of ZELO. This assisted in taking up the slack for the succeeding lift. None of the slings were broken while ZELO was acting as the lift ship.

The weather was good during the period of 28 to 30 August, and although it deteriorated during the three lifts in early September, THETIS was no longer in such an exposed position and the lifting continued.

The weight being lifted could be determined from the draft marks of ZELO. It was noted that the weight decreased as the depth of THETIS decreased. This was attributed to the expansion of entrapped air within the submarine.

The large rise and fall of the tide and the tidal current caused the slings to foul each other and to move along the bottom of THETIS. This was a source of constant annoyance, and although it never caused a tide to be missed, it did require some of the lifts to be made without using one of the slings.

F.6. Towing

Before the first lift, a track was selected and surveyed which would have a gradually shelving bottom and would lead to a sheltered area near and southeast of Moelfre Island. Because of the tidal current, the slow speed of the tow, and poor visibility, it was not always possible to keep on the desired track. This caused some unexpected groundings but no serious difficulty. At the end of each lift, an attempt was made to ground THETIS with ZELO heading into the flood tide. This was not always successful, but when it did succeed, the holding of ZELO in place over THETIS while preparing for the next lift was greatly simplified.

Although ZELO's engines were ready for use, they were never needed. She was towed by two tugs and a third was available for use when needed and for planting new moorings at the end of the lift.

F.7. Final Lift to Surface

The final phase of the salvage plan called for bringing THETIS to the surface stern first by self-lift alone. She had been brought to a place which was well sheltered from the prevailing southwest and west winds with the expectation that the work of preparing the ship for dewatering would proceed expeditiously. However, there were persistent northerly and northeasterly winds accompanied by heavy swells and frequent rough seas during about two-thirds of the seven weeks actually required for this phase of the work.

The engine room hatch cover was replaced by a salvage hatch bolted to the top of the hatch trunk and containing a 6-inch spill pipe leading to the platform deck, a 2-inch flexible pipe leading to the bottom of the compartment near the forward bulkhead, and three connections. Other hatches were secured by strongbacks to prevent their being unseated by pressure inside the submarine.

For the two forward compartments, buoyancy was to be restored by blowing through a valve to be fitted in the torpedo loading hatch cover, the water escaping through the open torpedo tube. External main ballast tanks No.'s 2, 3, 4, 5, and 6 were to be blown down through their flood holes by air introduced into each tank, port and starboard, through valves to be fitted in the top of each tank. Main ballast tank No. 1 was to be blown by a hose secured in its flooding hole.

The doors in all bulkheads aft of frame 40 (the limit of the original flooding) were opened to permit the blowing air to reach all of the after compartments from the connection in the salvage hatch, and to permit water to flow to the spill pipes in the salvage hatch. While the divers were working in the control room, it was discovered that their air was escaping through the stuffing box of the periscope which had been bent over and later broken off during the lifting. The remainder of the periscope was removed and a wooden plug inserted in the hole. This plug did not stop the leak and it was replaced by an expandable wooden plug which was successful.

An attempt to dewater the ship on 11 October was unsuccessful when the port exhaust valve failed to hold the internal pressure. This was plugged and a further attempt made on 13 October, but this also failed because of leakage through the starboard exhaust valve. The salvage hatch was removed and a diver sent into the engine room. He found that both exhaust valve operating gears had not been turned to the fully closed position. They were fully closed and the salvage hatch replaced.

On 21 October, blowing was again started and continued throughout the day. On 22 October, blowing was resumed, and shortly after noon the bow came to the surface but sank again. Blowing continued and the bow again came to the surface and remained there. Since the salvage plan had called for the stern to be raised first, the spill holes were in the forward ends of the two parts of the ship. With the bow up first, not enough water could be removed from the stern and the bow was lowered to the bottom by venting some of the forward main ballast tanks.

When the stern still could not be raised, divers drilled a hole through the lower part of the pressure hull in the after crews' quarters to permit removal of the water trapped below the level of the door to the engine room.

Blowing was resumed on 23 October and a diver reported a good flow of water through this hole, but a large air leak was discovered through a 6-inch sea connection. This hole was plugged and at 2:00 P.M., the stern came to the surface. Blowing was shifted to the forward tanks and at 2:30 P.M. the bow also came up. THETIS was beached in a position where the open torpedo tube was above the surface at low water. The ship was now made tight, pumped out, floated clear of the beach at high water, and towed to Holyhead for drydocking. On 18 November, she was returned to the building yard at Birkenhead where she was repaired and commissioned as the HMS THUNDERBOLT.