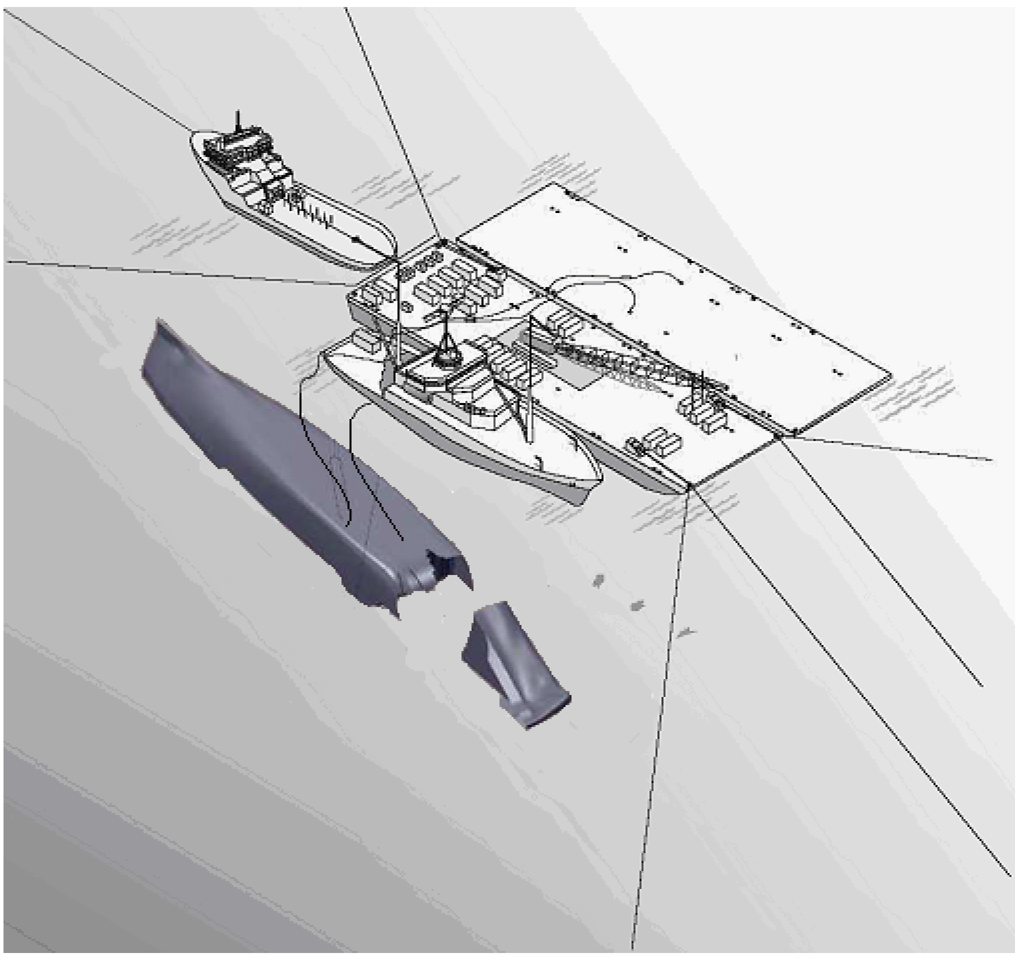
S0300-B6-RPT-010

0910-LP-102-8809

U.S. NAVY SALVAGE REPORT
USS *MISSISSINEWA*
OIL REMOVAL OPERATIONS



<u>DISTRIBUTION STATEMENT A:</u> THIS DOCUMENT HAS BEEN APPROVED FOR PUBLIC RELEASE; ITS DISTRIBUTION IS UNLIMITED.

PUBLISHED BY DIRECTION OF COMMANDER, NAVAL SEA SYSTEMS COMMAND.

MAY 2004

S0300-B6-RPT-010

0910-LP-102-8809

U.S. NAVY SALVAGE REPORT
USS *MISSISSINEWA*
OIL REMOVAL OPERATIONS

PUBLISHED BY DIRECTION OF COMMANDER, NAVAL SEA SYSTEMS COMMAND.

MAY 2004

Foreword

This report of *USS Mississinewa* (AO 59) oil removal operations documents the equipment, procedures, and teamwork used by Navy salvors to remove nearly 2 million gallons of oil from this submerged World War II Navy oiler sunk in 1944. The whole *Mississinewa* story is a fascinating one historically. This report provides glimpses of the early history, but focuses on more recent events following initial (August 2001) reports of oil releases from *Mississinewa* into the pristine waters of Ulithi Atoll, in the Federated States of Micronesia. I'd like to highlight below a few of the elements of the oil removal operation that I find particularly noteworthy.

This highly successful salvage operation was a true team effort involving Navy divers from *USS Salvor* (ARS 52), Mobile Diving and Salvage Unit One (MDSU-1), and Explosive Ordnance Disposal Mobile Unit Five (EODMU-5). *USS Salvor* was the diving support platform. In addition, I mobilized a Supervisor of Salvage (SUPSALV) team from the Naval Sea Systems Command (NAVSEA) and my Emergency Ship Salvage Material (ESSM) / Pollution Response contractor, GPC – A Joint Venture (GPC). In addition to the 14-man ESSM team, GPC mobilized four sub-contracted support vessels and crews via Seacor International based in Singapore. *Salvor's* commanding officer, LCDR John Carter was designated the Navy On-Scene Commander under a Commander Seventh Fleet chain of command. LCDR Carter did an outstanding job integrating these diverse forces into a highly effective and efficient team.

The operations site at Ulithi Atoll, with nary a small boat pier within 120 miles, presented unique logistics challenges. Personnel and equipment virtually from around the world converged on the tiny Ulithi Atoll, to be entirely self-sufficient on the five support vessels for the month-long operation. Careful operations planning, equipment redundancy, and salvor ingenuity were critical.

In addition to the usual operations planning, SUPSALV preparations included an Environmental Assessment (EA) required under the National Environmental Policy Act (NEPA). In all our years of salvage operations, this was only the second time I'm aware of that an EA has been required. We identified and accessed the services of an unusually well qualified environmental consultant, through our Salvage Engineering Services contractor (to avoid conflict of interest issues under the GPC contract). The "required" EA was very well done and proved to be an extremely valuable planning tool, not only for potential oil spill prevention and response, but also to ensure that the presence of our five response vessels and 156 personnel did not upset the ecological balance of Ulithi Atoll. After all, we were there to protect this delicate ecosystem.

Finally, I congratulate all members of the *Mississinewa* oil removal team for a job well done. I especially congratulate the Navy divers for their skill and professionalism, and GPC for outstanding operations planning, mobilization, and implementation, and for assembling and refining a new diver-friendly ESSM hot tapping and pumping system. This job represented an important step forward for the Navy in the field of submerged vessel offloading. Lest we rest too comfortably on our laurels however, I would point out that *Mississinewa* could not have offered more favorable operating conditions. Let's focus on lessons learned in section 6 of this report and look to improve our capability.

Captain Jim Wilkins, USN
Supervisor of Salvage and Diving
Director of Ocean Engineering

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTD)

TABLE OF CONTENTS (CONTD)

Section II: Underwater Survey Report I, USS *Mississinewa* (AO 59), Ulithi Atoll, 17 August – 17 September 2001

Section III: Underwater Survey Report II, USS *Mississinewa* (AO 59), Ulithi Atoll, 26 January – 18 February 2002

TABLE OF CONTENTS (CONTD)

LIST OF ILLUSTRATIONS

Section I: USS *Mississinewa* Oil Removal Operations

Section II: Underwater Survey Report I, USS *Mississinewa* (AO 59), Ulithi Atoll, 17 August – 17 September 2001

LIST OF ILLUSTRATIONS (CONTD)

Section II: Underwater Survey Report I, USS *Mississinewa* (AO 59), Ulithi Atoll, 17 August – 17 September 2001 (contd)

Section III: Underwater Survey Report II, USS *Mississinewa* (AO 59), Ulithi Atoll, 26 January – 18 February 2002

LIST OF ILLUSTRATIONS (CONTD)

Section III: Underwater Survey Report II, USS *Mississinewa* (AO 59), Ulithi Atoll, 26 January – 18 February 2002 (contd)

LIST OF TABLES

Section I: USS *Mississinewa* Oil Removal Operations

Section II: Underwater Survey Report I, USS *Mississinewa* (AO 59), Ulithi Atoll, 17 August – 17 September 2001

Section III: Underwater Survey Report II, USS *Mississinewa* (AO 59), Ulithi Atoll, 26 January – 18 February 2002

No Tables

SECTION I

U.S. NAVY SALVAGE REPORT
USS *MISSISSINEWA* (AO 59)
OIL REMOVAL OPERATIONS
ULITHI ATOLL

28 January – 1 March 2003

Prepared by:

U.S. NAVY
SUPERVISOR OF SALVAGE AND DIVING
NAVAL SEA SYSTEMS COMMAND

Naval Sea Systems Command
Code 00C, Supervisor of Salvage & Diving
1333 Isaac Hull Avenue SE, Stop 1072
Washington Navy Yard, DC 20376-1072

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER 1

1 INTRODUCTION AND BACKGROUND

1-1 Introduction

USS *Mississinewa* (AO 59) is a World War II U.S. Navy Fleet oiler that was sunk on 20 November 1944 at Ulithi Atoll, Yap State, Federated States of Micronesia (FSM) in the western Pacific Ocean. At its sinking, the 553-foot, 24,425-ton vessel had just taken aboard a full load of Navy Special Fuel Oil (NSFO), gasoline and diesel fuel. It was the victim of a Japanese Kaiten suicide torpedo, which carried a pilot and 1.5 tons of high explosive. The vessel rests upside down in 130 feet of water in position 09º58'8" N, 139º39'65" E. The 90-foot bow section is separated from the rest of the hull and lies 70 feet forward of it, as indicated in Figure 1-1.

In April 2001, sport divers located the wreck of *Mississinewa*. Four months later, in August 2001, a short time after a storm, oil was reported to be leaking from the wreck into the lagoon. The Naval Sea Systems Command (NAVSEA) Director of Ocean Engineering, Supervisor of Salvage and Diving (SUPSALV), tasked GPC, A Joint Venture (GPC), the Emergency Ship Salvage Material (ESSM) operations contractor, to survey the vessel to determine the location of the leak and to install a patch on the affected portion of the hull or piping. Temporary patches were installed and some trapped oil was recovered. A survey of the overall condition of the vessel was performed. The final report of this first operation is included as Section II of this report of subsequent oil removal operations.

In December 2001, a new oil leak was reported. SUPSALV tasked GPC to support a SUPSALV salvage engineer and the U.S. Navy's Mobile Diving & Salvage Unit One (MDSU-1) in securing the leak and further surveying the wreck. This response was executed with a large commercial diving support vessel subcontracted by GPC out of Singapore. The vessel provided suitable support for MDSU-1's surface-supplied air diving equipment and for appropriate ESSM leak control equipment and materials. This operation began on 26 January 2002 and ended on 18 February 2002. The final report of this second operation, which is included as Section III of this report, features a survey that included content sampling of selected tanks. In view of the likely chronic recurrence of the seeping oil, this Navy response team recommended offloading the oil in order to render a permanent solution.

This report describes the Navy's third *Mississinewa* operation, 28 January to 1 March 2003, by SUPSALV, U.S. Navy Fleet and SUPSALV contractor assets. The goal of this third operation was to remove the fuel and oil cargo from the wreck in order to ensure that the vessel would not continue to threaten the surrounding area with either continuing periodic chronic releases or a future catastrophic release of oil. The month-long operation in a remote area, integrating personnel and equipment mobilized from multiple locations thousands of miles away from their normal operating areas, resulted in the successful removal of all safely accessible oil from the vessel. It is estimated that more than 99% of the oil remaining at the start of the operation was successfully removed.

In conducting the operation, approximately 1.8 million gallons of NSFO and diesel fuel were pumped out of the vessel into a recovery barge. This oil was taken to Singapore and sold to defray part of the cost of the operation. In the process, 213 MK 21 air and scuba dives logged over 10,000 minutes of bottom time at 80- to 112-foot depths. A grid system developed by GPC enabled U.S. Navy divers to locate selected points on the ship's hull, mount flanges and valves, and drill strategically placed holes in cargo oil tanks. Divers then attached pumps, hoses and fittings to remove the oil. Tools developed or perfected by GPC at the SUPSALV ESSM base in Williamsburg, VA, performed essentially as planned, enabling a highly effective removal of oil that otherwise would have posed a continuing threat to an island economy and nearby pristine subsistence fishing grounds. Because of extensive pre-planning and training, the 2003 mission was completed 30 percent more quickly than initially projected.

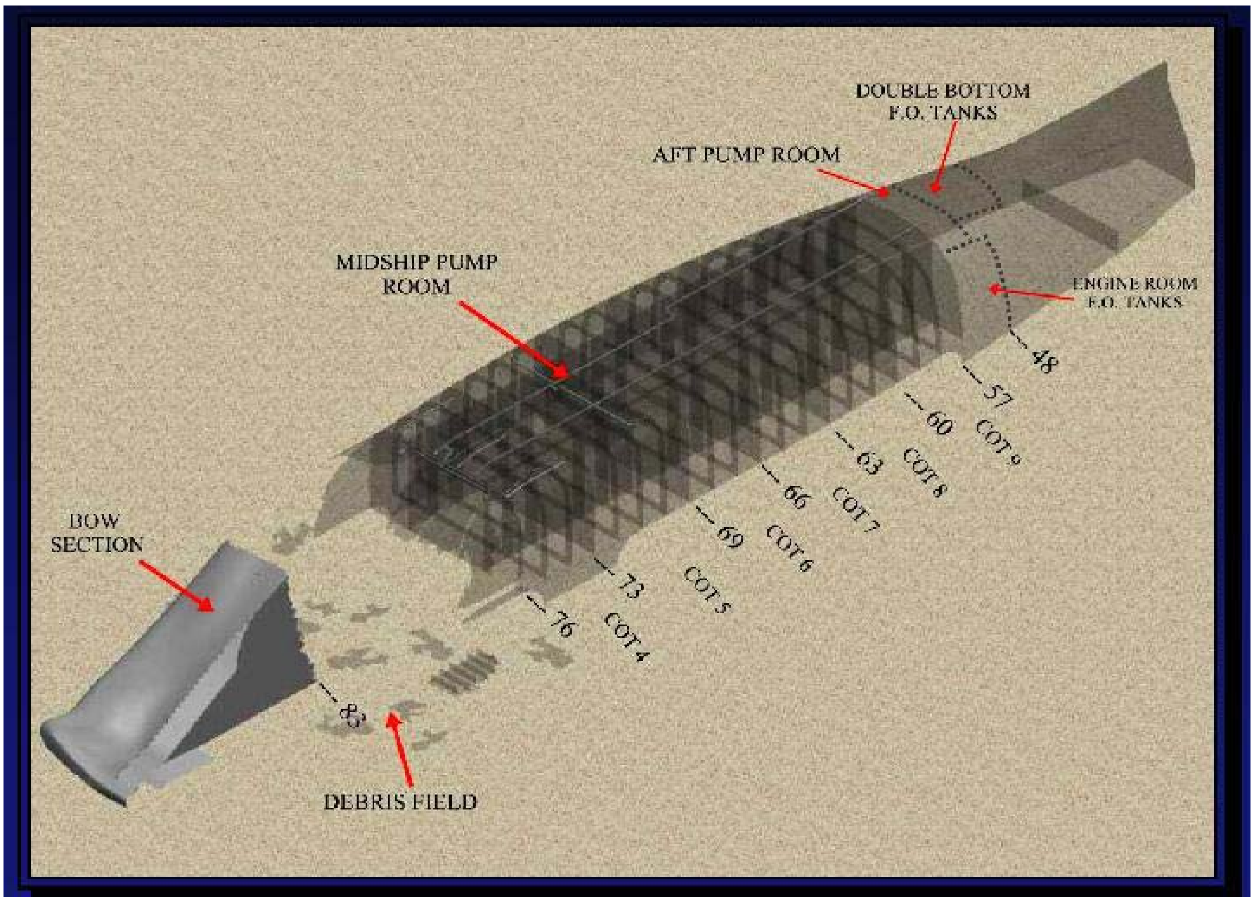


Figure 1-1. *Mississinewa*, Showing Tank Locations and Condition

1-2 Ulithi/Yap Area

The *Mississinewa* wreck is located at Ulithi Atoll, some 350 miles SW of Guam and 120 miles NE of the Island of Yap, in the Federated States of Micronesia. The atoll is composed of 49 islands, only four of which – Falalop, Mogmog, Asor and Fassarai – are inhabited. Total population is approximately 700. Of the atoll's 209-square mile lagoon, total landmass of the 49 islands is only 1.75 square miles. The only airstrip in the atoll is on Falalop. SUPSALV personnel, GPC personnel, and visitors had to be transported approximately eight miles from

Falalop to the *Mississinewa* operations site by small boat. Figures 1-2 and 1-3, respectively, depict the relative locations of Yap and Ulithi within the Federated States of Micronesia, and the *Mississinewa* wreck in Ulithi Lagoon.

Figure 1-2. Map of the Federated States of Micronesia, Showing the Locations of Yap and Ulithi

1-3 Overview of Previous *Mississinewa* Assessments and Repairs

(See also Sections II and III).

1-3.1 2001 Operations

After a particularly strong summer storm passed over the area, a steady stream of oil had been reported leaking from the wreck and impacting several nearby islands. On 17 August 2001, responding to direction from the Chief of Naval Operations (CNO-N45), SUPSALV tasked GPC to conduct a diving survey of *Mississinewa* in order to determine the source of the leak and to secure the leak if possible. In addition, GPC was to survey atoll beaches to determine beach-cleaning requirements. GPC responded with technical personnel and a subcontracted dive team.

Several reports describe the vessel's sinking and current condition. A team from the Government of Yap had investigated an oil spill from the wreck in early August. A team of U.S. Coast Guard and U.S. National Oceanic and Atmospheric Administration (NOAA) spill response specialists visited Ulithi just prior to the GPC team's arrival. Each of these groups generated a report of their findings.

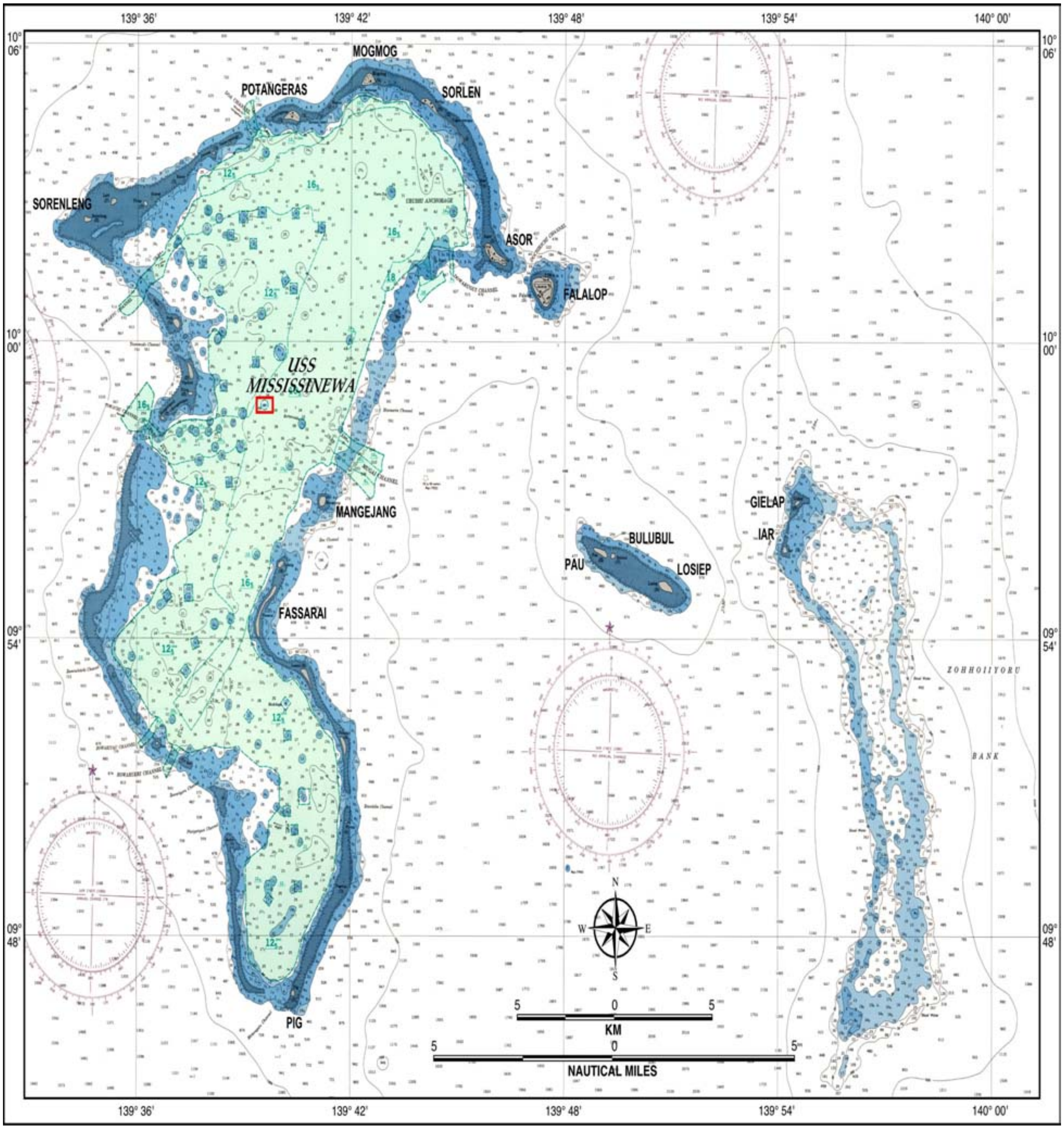


Figure 1-3. Nautical Chart of Ulithi Lagoon and Environs, Showing the Location of the Sunken *Mississinewa*

Navy Special Fuel Oil (NSFO) is relatively heavy oil that can be expected to rapidly form persistent tarballs. If the wreck generated an uncontrolled release, environmentally sensitive communities at greatest risk would be those that spend most of their time on the water surface or in the intertidal zone, such as marine birds, green and hawksbill sea turtles, and intertidal communities. Yap was concerned over the oil's impact on such species, as well as on local subsistence fishing.

The SUPSALV/GPC commercial diving team located the wreck in 130 feet of water and observed oil leaking from a crack in the hull plating. The initial source of the oil leak was a stripping line suction bell mouth found in the aft section of the hull in cargo oil tank #4, starboard wing (COT 4-S). This tank was near the location of the 1944 torpedo hit that sank the ship and separated the bow from the rest of the vessel. COT 4 became, in effect, the "bow" of the remaining hull. The oil leak rate was measured at approximately one quart per minute of what had been reported as NSFO. Several days later, a leak developed in the valve upstream of the plugged suction line and was sealed with concrete. Approximately 6,300 gallons of oil and water were removed from the damaged tank and stored in barrels for disposal in Guam.

A survey of the forward and aft portions of the wreck established the condition of the hull and extent of cargo tank damage. A beach survey was accomplished on four islands, showing little evidence of oil impact. Samples of the recovered oil, contaminated beach sand, and hull steel were obtained and returned to the SUPSALV ESSM Williamsburg base.

Original construction drawings of the USS *Ashtabula* class and other documents were very helpful in assessing the hull structure and oil loading condition of the wreck. In conjunction with the Captain's Report of Sinking, Program of Ship Salvage Engineering (POSSE) computer models were prepared to help estimate loading conditions at the time of the torpedo attack and probable remaining oils.

Theoretical analysis predicted that there could be as much as 3.3 million gallons of various oil products remaining onboard, and local government officials expressed a desire that the oil be removed. The vessel's hull structure aft of oil-tight bulkhead (OTB) 73 (aft of the damaged #4 tanks) was in good condition and there appeared to be sufficient shell plating thickness to contain oil in the tanks for many years to come. However, further deterioration of the exposed cargo piping system remained a concern.

1-3.2 2002 Operations

In December 2001, another *Mississinewa* oil leak was reported. At the request of the Yap government and as directed by CNO, SUPSALV tasked GPC to provide a more extensive response to determine the location of the new leak, install a patch on the affected portion of the hull or piping, and recover as much oil as possible. This tasking was executed with more equipment than the 2001 operation to support the SUPSALV Representative and divers from the U.S. Navy Mobile Diving & Salvage Unit One (MDSU-1) from Pearl Harbor, Hawaii, with assistance from Explosive Ordnance Disposal Mobile Unit Five (EODMU-5) from Guam. At SUPSALV's direction, GPC also provided a subcontracted support vessel and arranged for proper disposal of the recovered oil.

GPC mobilized tools and support equipment from ESSM Cheatham Annex, Williamsburg, VA, and the SUPSALV/GPC team arrived in Guam during the week of 22 to 25 January 2002. A commercial anchor handling tug, *Smit-Lloyd* 74, was mobilized from Singapore and arrived in

Apra Harbor, Guam on 31 January. The MDSU-1 team and equipment arrived early in the evening of 1 February at Anderson AFB, Guam.

Repair and oil recovery operations took place from 6 to 14 February and included the following significant events:

- Removal of a leaking 4-inch valve, plugging the pipe and capping with a blanking flange in #4 starboard wing tank.
- Plugging of a 12-inch pipe that was leaking in #3 starboard wing tank near the aft bulkhead.
- Patching of a hull crack approximately 24 inches long in the overhang at #3 starboard wing tank.
- Pumping of 3,400 gallons of NSFO and 7,400 gallons of associated contaminated water.
- Drilling, sampling and plugging of seven cargo oil tanks to verify contents.

Sampling the tanks enabled a refinement of the theoretical remaining oil content and the estimated maximum volume of remaining oil was reduced to 2.8 million gallons.

1-4 War Graves Considerations

All participants in both the 2001 and 2002 assessment missions and the 2003 oil removal project were acutely aware that the sunken vessel is the war grave for 63 of the ship's complement of 264 persons. The U.S. Government provided assurances to all concerned local and regional government officials, as well as to survivors' groups, that operations called for no activity in the vicinity of any ship's spaces that would have been manned. Therefore, no human remains would be disturbed. All cargo and bunker (ship's fuel) tanks were to be accessed directly through the skin of the ship or from within previously emptied tanks.

1-5 2003 Oil Removal Mission Tasking

In the fall of 2002, Yap Governor Vincent A. Figir contacted the American Embassy, FSM, to request the removal of remaining *Mississinewa* oil. The Embassy, in turn, initiated conference call discussions with other potentially involved federal agencies – the U.S. Coast Guard (USCG) District 14 (Honolulu) and USCG headquarters (Washington), the National Oceanic and Atmospheric Administration (NOAA), the Environmental Protection Agency (EPA), the Department of the Interior (DOI), and the U.S. Navy.

CNO tasked SUPSALV with planning and executing the offloading operation and tasked Commander Pacific Fleet (COMPACFLT) with providing a diving support platform and U.S. Navy divers to support the SUPSALV effort. Rescue and salvage ship USS *Salvor* (ARS 52) was tasked by COMPACFLT, via their chain of command, to serve as the diving support platform and provide diver support. Commanding Officer *Salvor* was designated the U.S. Navy On-Scene Commander (OSC) under a Commander Seventh Fleet (C7F) operational chain of command. MDSU-1 and EODMU-5 were tasked to provide divers to augment *Salvor*'s complement. SUPSALV tasked GPC with developing an operations plan, assembling the offloading systems using ESSM assets, providing appropriate commercial support vessels, and providing an operations team to support the on-scene SUPSALV Representative with technical direction and topside support.

1-6 Overview of 2003 Operations

Funding was in place to support a 40-day mission from approximately 1 February to 10 March 2003 to pump off as much as possible of the estimated maximum of 2.8 million gallons of oil from *Mississinewa* to minimize the future oil spill potential. *Salvor* served as the diving support platform.

Four other vessels, chartered in Singapore, also played major roles in this mission. Two identical 300' x 100' deck barges, *Fels* 20 and *Fels* 21, were towed from Singapore by anchor-handling tugs MV *Seacor Rover* and MV *Jaya Marlin*. *Fels* 20 was the primary work platform and was outfitted in Singapore to support all diving, offloading, and support systems that would not fit on *Salvor*'s limited aft deck area. *Fels* 20's outfitting included a 150-metric ton crane for repositioning equipment among the support vessels as required.

Three double-drum mooring winches on *Fels* 20 allowed precise positioning of the work barge in the six-point moor installed by *Seacor Rover* over *Mississinewa*'s position in Ulithi Lagoon. *Salvor* was moored alongside *Fels* 20 to starboard and *Fels* 21 was moored alongside to port. *Seacor Rover* was moored stern-to-stern with *Fels* 20. The Seacor Barge Master maneuvered the rafted vessels to position *Salvor*'s dive stations directly over target hot tap locations on *Mississinewa*.

Fels 21 provided temporary storage and transport for all oil removed from *Mississinewa*, with *Fels* 20 providing additional oil storage capacities as required. *Seacor Rover*, the larger of the two tugs, provided hotel services for all SUPSALV, GPC, and subcontractor personnel on scene. The smaller tug, *Jaya Marlin,* remained on station for logistic support and for the return barge transit to Singapore.

U.S. Navy Fleet, SUPSALV, and contractor personnel (totaling 156 from all sources on site) and equipment staged from as far away as 8,500 miles from the Western Pacific operations area, came together in a coordinated, self-contained operation, executing the mission in an extremely remote part of the world, while keeping cognizant organizations informed of daily progress. In all, 23 tanks and spaces were hot tapped or opened, and all safely accessible oil was removed. See Sections 3.1.1 and 4.4.2 for more hot tap detail.

1-7 Operational Factors

Sea state was the chief limiting operational factor. Relative motion in the seaway among the four moored surface support vessels and tug *Jaya Marlin* made relatively routine evolutions, such as transferring heavy equipment and personnel between platforms, much more difficult than would have been the case in calmer waters. Although wave height ranged from four to eight feet during the mission, conditions on the bottom, where dives ranged from 80 to 112 feet, were nearly ideal, with diver visibility in the 70-foot range.

1-8 Mission Purpose

The purpose of the oil offloading operation was to remove an estimated maximum of 2.8 million gallons of cargo and fuel oil remaining submerged in *Mississinewa*, to the extent feasible, in order to prevent a potential catastrophic release and to minimize future smaller but troublesome releases into the pristine Ulithi Atoll waters. It was estimated that up to 14,000 gallons of oil (about 0.5% of the 2.8 million gallons) might remain after offloading operations due to oil clingage on tank walls, oil trapped by internal tank structure, and inaccessible oil contained in piping. Additional background concerning *Mississinewa*'s sinking, current condition of the wreck, and surrounding environmental conditions are addressed in greater detail in the U.S. Navy Environmental Assessment (EA) of May 2002.

Project goals were to:

1. Conduct POL removal operations while respecting *Mississinewa* as a war grave.
2. Offload all oil from tanks and other spaces safely accessible by divers.
3. Secure the wreck to minimize future leakage.
4. Minimize oil spills and environmental impacts during the operation.
5. Properly dispose of the recovered oil and all wastes generated during the operation.

CHAPTER 2

2 COMMAND AND ORGANIZATION

2-1 Organizations Involved

Although numerous agencies of the U.S. and FSM governments were involved to varying degrees (see Section 1.6), the critical operational organization was the U.S. Navy. See Figure 2-1 for the U.S. Navy's operational chain of command during the *Mississinewa* project. COMNAVMARIANAS PAO refers to Commander, U.S. Naval Forces Marianas, Public Affairs Office.

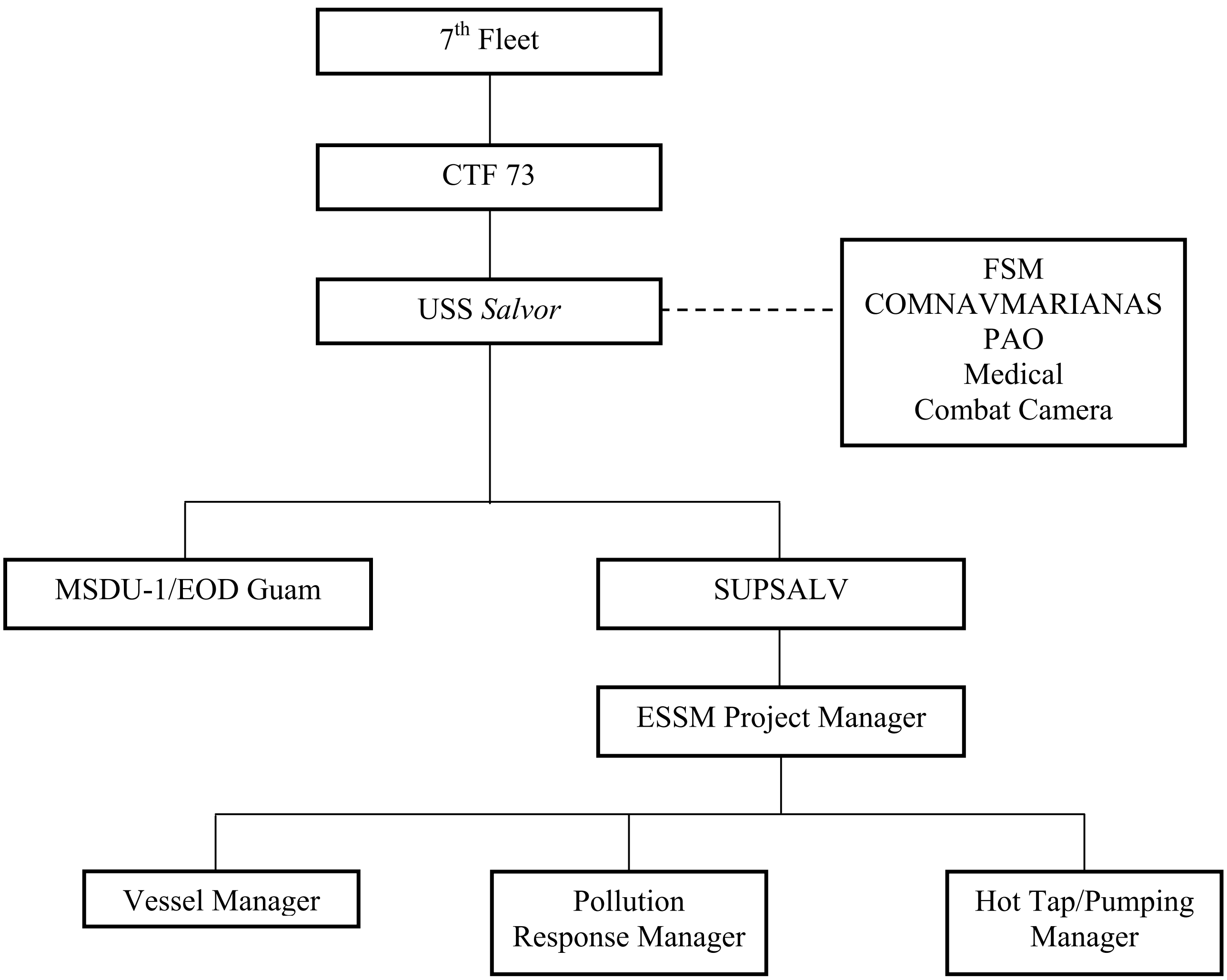


Figure 2-1. *Mississinewa* Operational Organization Chart

U.S. Navy On-Scene Commander (OSC). Commanding Officer, *Salvor*, LCDR John A. Carter, USN, was designated OSC, reporting up the COM7THFLT chain of command and directing all *Mississinewa* offloading operations. Navy diving operations were coordinated for the OSC by Master Diver MMCM (DSW/SW/MDV) Jim Nichols, *Salvor*; CWO2 Bob Cassels and Master Diver HTC (DSW/SW/MDV) Mike Moser, MDSU-1, Pearl Harbor; and Master Diver HTCS (DSW/SW/MDV) Bob Barker, EODMU-5, Guam.

SUPSALV Representative. The SUPSALV Representative, Bill Walker, designated the On-Scene Salvage Supervisor in the C7F organization, coordinated overall technical and financial aspects of the project and all NAVSEA contractor activities for the OSC (see Figure 2-2).

GPC Project Manager. The Contractor Project Manager, Ron Worthington, managed all contractor operations, including sub-contracted support vessels, and reported to the SUPSALV Representative. Ron performed the bulk of the detailed oil removal planning prior to the operation and technical direction during the operation.

Hot Tap/Pumping Supervisor. GPC Hot Tap Supervisors Paul Schadow, Craig Moffatt, and Kevin Smith were responsible for conducting all hot tapping, pumping and barge loading operations and determined which pumping systems would be used.

Barge/Support Vessel Supervisor. Rick Groen, *Seacor Rover*, was responsible for all matters relating to the four vessels contracted for the operation, including installation of the six-point moor. He reported to the GPC Project Manager.

Pollution Response Supervisor. The Contractor Pollution Response Supervisor, Jonathan Boos, International Response Corporation (IRC), was responsible for all aspects of pollution prevention and spill response, and answered to the GPC Project Manager.

2-2 NAVSEA 00C On-Site Organization

Figure 2-2 shows the SUPSALV on-site organizational relationships with its ESSM contractor, GPC.

2-3 Formal Agreements

A significant factor influencing the United States' posture and reaction to the *Mississinewa* situation was the existence of the Compact of Free Association. This treaty – among the U.S., the Federated States of Micronesia, and the Marshall Islands – memorializes and preserves a special relationship between the U.S. and these former trust territory island states, particularly where military matters/assets are concerned. All U.S. Navy decisions were made and all operations undertaken against the backdrop of, and in keeping with, the Compact of Free Association.

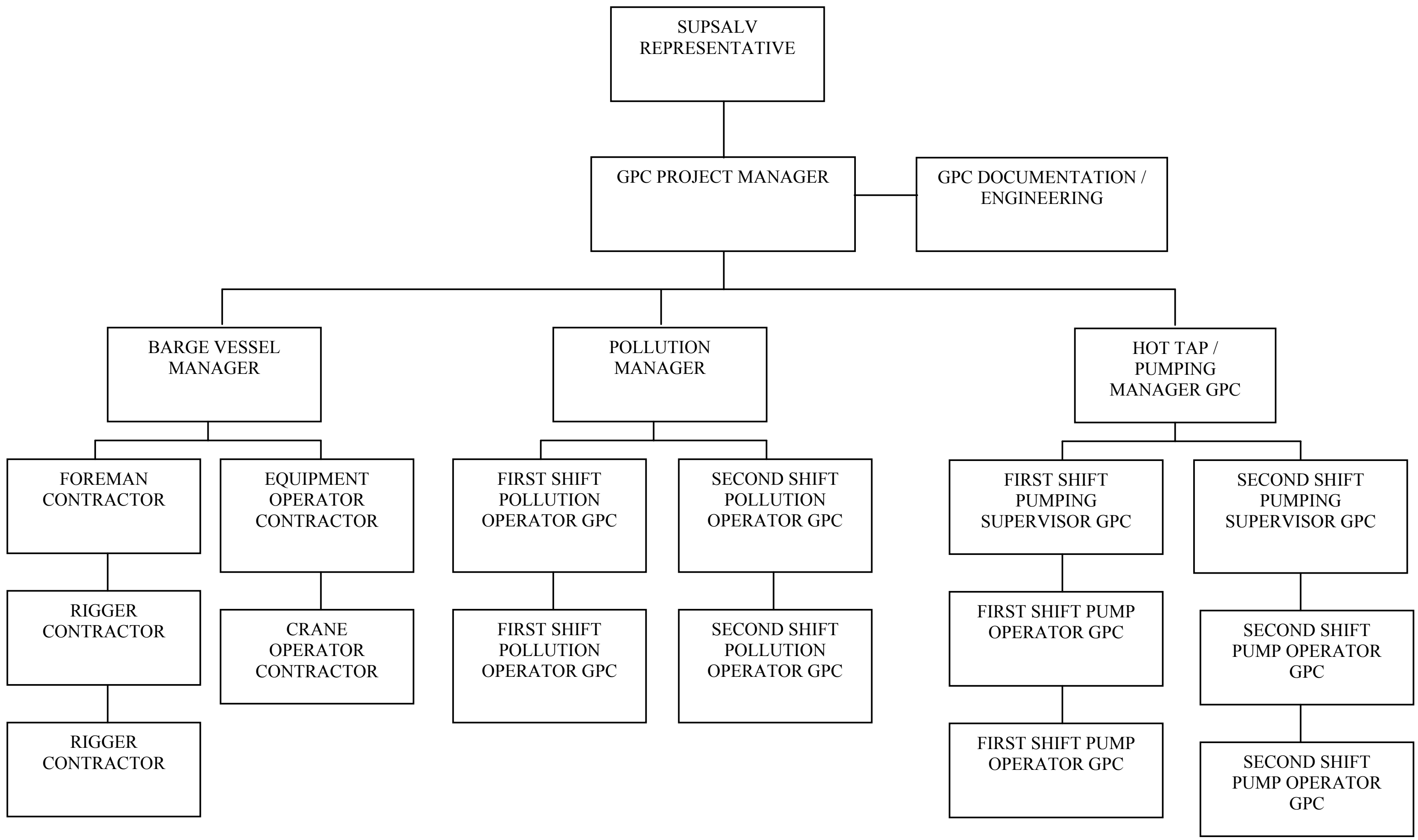


Figure 2-2. NAVSEA 00C/ESSM Project Organization Chart

2-4 Personnel

Although *Salvor*'s complement is 110 (8 officers, 102 enlisted), for the *Mississinewa* mission, only 92 of the ship's company were aboard, 18 fewer than at full manning.

During the peak operations period, the following was the personnel breakdown from all sources:

Salvor	92
SUPSALV Representative	1
MDSU-1	13
EODMU-5 Guam	2
Yap Representative	1
GPC	15
Seacor Rover/Fels 20	20
Jaya Marlin	12
TOTAL	156

CHAPTER 3

3 PLANNING AND MANAGEMENT

3-1 Planning

3-1.1 Concept of Operations

The *Mississinewa* offloading concept of operations involved the use of divers to hot tap into oil cargo and fuel tanks on the vessel's inverted hull and to rig submersible pumps and hoses for pumping oil to a barge on the surface. The five vessels supporting the operation, as previously described, were employed as follows:

- Upon arrival in Ulithi Lagoon, *Seacor Rover*, specially configured for anchor handling, deployed a six-point moor centered on *Mississinewa*'s position. The primary work barge, *Fels* 20, was placed in the moor directly over *Mississinewa*. Three double-drum mooring winches on *Fels* 20 allowed precise positioning of the work barge in the moor.

- *Salvor* was moored alongside *Fels* 20 to starboard.

- *Fels* 21 was moored alongside *Fels* 20 to port.

- *Seacor Rover,* the larger tug, was moored stern-to-stern with *Fels* 20.

- *Jaya Marlin*, the smaller tug, remained on station for logistic support and for the return barge transit to Singapore.

The Seacor Barge Master maneuvered the rafted vessels in the moor to position *Salvor*'s dive stations directly over target hot tap locations on *Mississinewa*. *Fels* 21 provided temporary storage and transport for all oil removed from *Mississinewa*, with *Fels* 20 providing additional oil storage capacities as required. *Seacor Rover* provided hotel services for all SUPSALV, GPC, and subcontractor personnel on scene.

U.S. Navy hard-hat divers, with breathing air hoses from the surface, descended from *Salvor* to the pre-determined points on *Mississinewa*'s hull in order to attach hot tap equipment to the high point of each tank, position and rig pumps, hoses, manifolds, and related hardware, and monitor the systems as required during pumping. In two cases, divers were required to cut diver access ports through *Mississinewa*'s shell plating in order to enter and hot tap or investigate internal or otherwise inaccessible tanks. The access ports were then secured by welding steel plates over the openings.

A hot tap is a device that employs a flange with a 4-inch pipe nipple and valve bolted or welded to the shell plating of the hull over a tank. With the valve opened, the hot tap machine, with a cutter device (similar to a hole saw), is secured to the valve and the cutter is advanced through the valve and against the hull. Using a hydraulic hand drill, the cutter is rotated to cut a hole (in *Mississinewa* operations, a 3 1/2-inch hole) through the hull. The cutter is then retracted, the valve is closed, and the hot tap machine is removed and replaced by a hose connected to a submersible pump. With a 4-inch hose to the recovery barge attached to the discharge end of the pump, the valve is opened and the tank is ready to be emptied.

Divers positioned lightweight, high-capacity submersible pumps on the hull to service several hot tap locations, and connected hoses from the hot taps to the pump and from the pump through a manifold on the bilge keel to the dive platform. Although not in the plan, in the on-site configuration an inline booster pump was positioned on *Salvor* to boost pressure and flow across the working barge and into the receiving barge. A second pumping system, the donut pump, floated on the surface alongside *Fels* 20 and was connected directly to the hot tap valve through a sufficient length of 4-inch hose. While the donut pump's flow was less than one-half of the primary pumping system (160 gpm vs. 380 gpm), it served effectively for smaller tanks and stripping operations. Diving operations were controlled from *Salvor*'s deck and pumping operations from *Fels* 20.

In some cases during *Mississinewa* hot tapping (for example, when tank vents were no longer open), a second hole was cut low in the tank to allow the ingress of water to replace the removed oil. Each tank that was confirmed to contain oil was pumped off in this manner. After a series of pumping and settling cycles, when all removable oil had been pumped, the valve was removed from the flange and the hole first was secured with a small, and later a large, dome-shaped cap with a tamper-proof nut in a manner that would prevent future access by sport divers.

Planning for gaining access to the ship's internal fuel tanks called for using Broco rods to cut through the outer shell plating and open a hole large enough for a diver to enter. The diver would then proceed to the inner tank wall and drill to see if oil was present. If oil was found, the hot tap flange and valve would be attached to the tank and the tank would be pumped.

Salvor and MDSU-1 divers and diving equipment were mobilized from Pearl Harbor with a diver/equipment augment from EODMU-5, Guam. All specialized hot tap and pumping equipment and the majority of the GPC operators were mobilized from the SUPSALV ESSM base in Williamsburg, VA. The two subcontracted support vessels and two deck barges were hired and mobilized by GPC from Singapore. After cost comparison, GPC determined that the use of two barges with accompanying tugs was a more practical and cost-effective alternative to its original plan to charter a single "tanker or tank barge with tug" described in the U.S. Navy Environmental Assessment (EA). All recovered oil was sold in Singapore to defray the cost of barge tank cleaning and other operational costs.

Extensive planning focused on personnel safety, as well as oil spill prevention, to minimize the environmental impact of the offloading operations on the pristine waters and ecosystems of Ulithi Atoll. U.S. Navy spill response equipment and personnel remained in a ready mode throughout the operation in the unlikely event of a significant oil release. GPC anticipated minor releases of oil, causing surface sheening throughout the operation, and the EA noted that less than 1 percent of the estimated maximum of 2.8 million gallons of oil would likely remain in the tanks following offloading due to oil clinging to tank walls, in piping and other spaces not safely accessible by divers.

3-1.2 Diver Training

GPC conducted hot tap training for the Navy divers in Hawaii for 10 days in early December 2002. Instruction and hands-on training of divers who would later perform the actual tasks on the wreck helped both divers and topside personnel in executing the mission. Among other things, divers became familiar with the grid reference wire system by seeing it laid out in a parking lot. The grid, once overlaid on the vessel's hull, would be a "navigational aid" in identifying the spots to drill hot tap holes.

Divers used mock-up 1-inch thick hull plates to practice hot tapping procedures. Twenty MDSU-1 and *Salvor* divers were trained in two separate locations (welding practice off *Salvor* and hot taps, using both drill press and hand-held drill, off a nearby pier). Additional training operations were conducted aboard *Salvor* offshore in 120 feet of water on a mock hull plate where a flange was attached and the hot tap hole completed.

3-1.3 Environmental Issues Considered

The Navy conducted a comprehensive environmental assessment nearly a year prior to deploying for the *Mississinewa* project. The potential impact of the proposed operation, including an incidental release of oil during the process of cargo removal, was scrutinized from the perspective of the potential environmental consequences to the following resource categories:

- Water
- Biological
- Land
- Cultural/historical maritime
- Socioeconomic
- Waste management
- Human health and safety

At the request of SUPSALV, the National Oceanic and Atmospheric Administration (NOAA) performed an intensive analysis of potential spill trajectories based on historical wind data. NOAA concluded that during the NE trade wind period (generally from October through May), any oil releases would quickly move outside the lagoon to the SSW, posing only short-term risks of exposure. By contrast, during the SW trade wind period (generally from June through September), oil slicks would persist within the lagoon and pose some risks to sensitive resources. It was clear that oil removal operations during the NE trade wind season would pose a lower risk of environmental impact due to inadvertent oil releases.

Since NSFO is a blend of light and heavy oil, it was understood that the light fractions would evaporate within hours and residue would form persistent tarballs. Because of low solubility, the oil would pose little risk to aquatic resources in the water column, but there would be potential impacts at the water's surface and in the intertidal habitats (along the shoreline). Marine birds and sea turtles were the primary concerns in these habitats.

The assessment concluded the following:

- The *Mississinewa* Operational Plan was designed to minimize environmental impacts in general and oil spill risks in particular.
- Potential oil spill volumes were small.
- On-site containment and recovery should be effective.
- Dispersants would be used to protect sensitive resources (birds and sea turtles) only if these resources were threatened by significant spills that escaped containment.

3-1.4 Sanitary Wastewater

Seacor Rover and *Jaya Marlin* were self-contained with respect to storing and processing sanitary wastewater. *Salvor*, however, can store only 8 to 12 hours' accumulation of sanitary wastewater before needing to pump. She has no wastewater processing capability. *Salvor* and the portable berthing vans installed on *Fels* 20 were plumbed to route their waste into an on-board, dedicated waste cargo tank on *Fels* 20. From that tank, the waste was slowly pumped to a pair of portable Marine Sanitation Devices (MSDs) installed on *Fels* 20 for processing the waste and discharging purified water. This procedure eliminated the discharge of sanitary wastewater into the Ulithi Atoll for the duration of the operation.

3-1.5 Solid Waste

GPC leased two standard 8' x 8' x 20' open-top containers for solid waste storage, and provided a small trash compactor and small barrel burner. Solid waste was separated into burnable trash and wet, non-burnable, compactable waste. Solid waste containers were located on *Fels* 20. Crew members from both *Salvor* and *Seacor Rover* hand-carried solid waste bags daily from their respective vessels to the containers on the work barge, where they segregated burnable trash from solid waste. Once a week, *Jaya Marlin* collected the burnable trash, traveled a safe distance offshore, and burned it on the afterdeck in barrels.

After compactable trash was compacted, it was placed in large (36 square feet), 1-ton-capacity storage bags constructed of high-strength poly material. This poly-bagged trash was ultimately disposed of at proper facilities in Singapore.

3-2 Management

3-2.1 Daily Routines

Daily routines aboard the "floating village" normally involved the following:

- 0700 briefings of various crews by respective supervisors and 1900 meetings, chaired by the OSC, CO *Salvor*, to recap each day's activities and establish objectives for the next day.
- Divers in the water by 0800, consisting of two three-man teams relieving each other for meals and securing diving operations by approximately 1800, unless unexpected underwater developments dictated later dives. (It became clear after two days that the

original plan of 24/7 diving would not be required, enabling 11- or 12-hour days for divers instead.)

- Pumping 24 hours a day when required.

3-2.2 Communications Plan

The following was the Communications Plan in place for the duration of the *Mississinewa* project.

- **Liaison with FSM/Yap/Ulithi government:**

  Commander U.S. Naval Forces Marianas (COMNAVMAR) was responsible for U.S. Navy coordination with Yap, FSM, via the U.S. Embassy at Kolonia. CDR Dodge, COMNAVMAR, was the point of contact for *Mississinewa* forces with the Yap, FSM government. In addition, informal liaison was facilitated by an on-scene Yap representative, on *Seacor Rover*, as assigned by Yap Governor Robert Ruecho, Governor Figir's successor.

- **Situation Reports (SITREPs):**

  The OSC was responsible for distribution of a daily situation report by U.S. Navy message via the chain of command. The SUPSALV on-scene representative reported on the planned and completed actions of NAVSEA contractors and provided an overall status of operations through the OSC's daily SITREP.

- **Reporting Significant Spills:**

  Extremely small volumes of oil released from *Mississinewa* during the offloading operation generated a visible sheen on the surface of the water very close to the diving support platform. *Salvor* had anticipated a light sheen throughout the offloading operation, but the sheen was actually a periodic, infrequent event. GPC pollution operators were responsible for visual surveillance of the operating area and of surrounding waters and islands as directed by the GPC Pollution Manager. The Pollution Manager reported such unusual releases up the chain of command.

  Salvor's daily SITREPs reported estimated volumes of minor operational spills when they occurred. Significant spills, beyond a sheen (as determined by OSC, in consultation with the on-scene SUPSALV and Yap/FSM representatives), had they occurred, would have been reported by U.S. Navy message in accordance with OPNAVINST 5090.1B. *Salvor* was responsible also for assisting the Yap/FSM representative in communicating spill reports up his chain of command as required.

- **Communications:**

  Salvor's communications suite allowed global access via HF and satellite systems as well as e-mail.

  Mini M: ESSM provided shipboard and land-based Mini M satellite communications systems.

E-mail: *Seacor Rover* made its Global E-mail System available to selected users.

Radio: All operational elements provided VHF communications via base stations, hand-held radios, or small-boat-mounted radios.

- Primary working frequency: Channel 81
- Secondary working frequency: Channel 83
- Contact list and call signs for key personnel

- **Public/Media Affairs:**

  These activities, including VIP site visits, press enquiries and releases, and related issues were coordinated between the OSC, *Salvor,* and the designated COMNAVMARIANAS public affairs officer (PAO).

  SUPSALV arranged for limited still photo and video documentation by U.S. Navy Combat Camera. COMNAVMARIANAS PAO coordinated the release of this documentation.

CHAPTER 4

4 DIVING AND OIL RECOVERY OPERATIONS

4-1 Support Vessels

As previously described, five primary support platforms were on station during the *Mississinewa* project – *Salvor*, chartered Singapore-based anchor-handling tugs *Seacor Rover* and *Jaya Marlin*, and deck barges *Fels* 20 and *Fels* 21.

4-1.1 *Salvor*

Features: The mission of the ARS *Safeguard* class rescue/salvage vessel is fourfold: to re-float stranded vessels, provide heavy lift capability from ocean depths, tow disabled vessels, and conduct manned diving operations. For rescue missions, the ships are equipped with fire monitors forward and amidships, which can deliver either firefighting foam or seawater. Their salvage holds are outfitted with portable equipment to provide assistance to other vessels in dewatering, patching, supplying electrical power, and other essential services required to return a disabled ship to an operating condition.

Background: The U.S. Navy has responsibility for salvaging U.S. Government-owned ships and, when in the best interests of the United States, privately owned vessels. Steel-hulled construction, combined with speed and endurance, suits ARS ships for rescue/salvage operations of both U.S. Navy and commercial shipping.

General Characteristics:

Primary function:	Firefighting, combat salvage, rescue towing, diving
Builder:	Peterson Builders
Date deployed:	August 16, 1985
Power plant:	Four Caterpillar 399 Diesels, two shafts, 4200 horsepower
Length:	255 feet
Beam:	51 feet
Draft:	16 feet, 9 inches
Displacement:	3,282 tons full load
Speed:	14 knots
Endurance:	8,000 miles at 8 knots
Salvage capability:	7.5-ton capacity boom forward; 40-ton capacity boom aft
Heavy lift:	Capable of a hauling force of 150 tons
Diving depth:	190 feet, using air
Ships in class:	USS *Safeguard* (ARS 50), Sasebo, Japan USS *Grasp* (ARS 51), Little Creek, VA USS *Salvor* (ARS 52), Pearl Harbor, HI USS *Grapple* (ARS 53), Little Creek, VA
Crew:	6 officers, 94 enlisted (design complement)
Armament:	Two .50-caliber machine guns; two Mk-38 25mm guns

4-1.2 *Seacor Rover*

Primary function:	Offshore Anchor Handling Supply
Flag:	Nassau, Bahamas
Builder:	Jaya Shipbuilding and Engineering PTE Ltd, Singapore
Year built:	2002
Power plant:	2 Wartsila 6L26A Diesels, 5506 Brake Horsepower (BHP)
Length:	200.1 feet
Beam:	49 feet
Draft:	19 feet
Gross tonnage:	1598 tons
Speed:	13.5 knots maximum
Salvage capability:	5.9-metric ton capacity boom aft
Anchor handling:	Capable of 150 tons hauling force

4-1.3 *Jaya Marlin*

Primary function:	Offshore Supply Tug
Flag:	Singapore
Builder:	Jaya Shipbuilding and Engineering PTE Ltd, Singapore
Year built:	2001
Power plant:	2 Yanmar Diesels, 5000 BHP
Length:	112 feet
Beam:	26 feet
Draft:	14.8 feet
Gross tonnage:	496 tons
Speed:	13.5 knots maximum

Figure 4-1 and Figure 4-2, respectively, show *Salvor* underway and *Jaya Marlin* alongside *Seacor Rover*.

4-1.4 Barges *Fels* 20 and *Fels* 21

These standard 300’ x 100’ deck barges feature open-deck space and below-deck tanks, which suited them well for service on the *Mississinewa* project. *Fels* 20, with one 150-metric ton crane and various berthing and equipment vans welded to the deck in Singapore, served as the main working barge, while *Fels* 21 was the oil receiving/storage barge. See Section 5-3.2 for further information on the barges.

Figure 4-1. USS *Salvor* (ARS 52)

Figure 4-2. *Jaya Marlin* alongside *Seacor Rover*

4-2 Mooring System

GPC designed a six-point mooring system based on historical wind data provided by NOAA. Figure 4-3 shows a notional vessel-mooring configuration with prevailing northeast winds in the operations area.

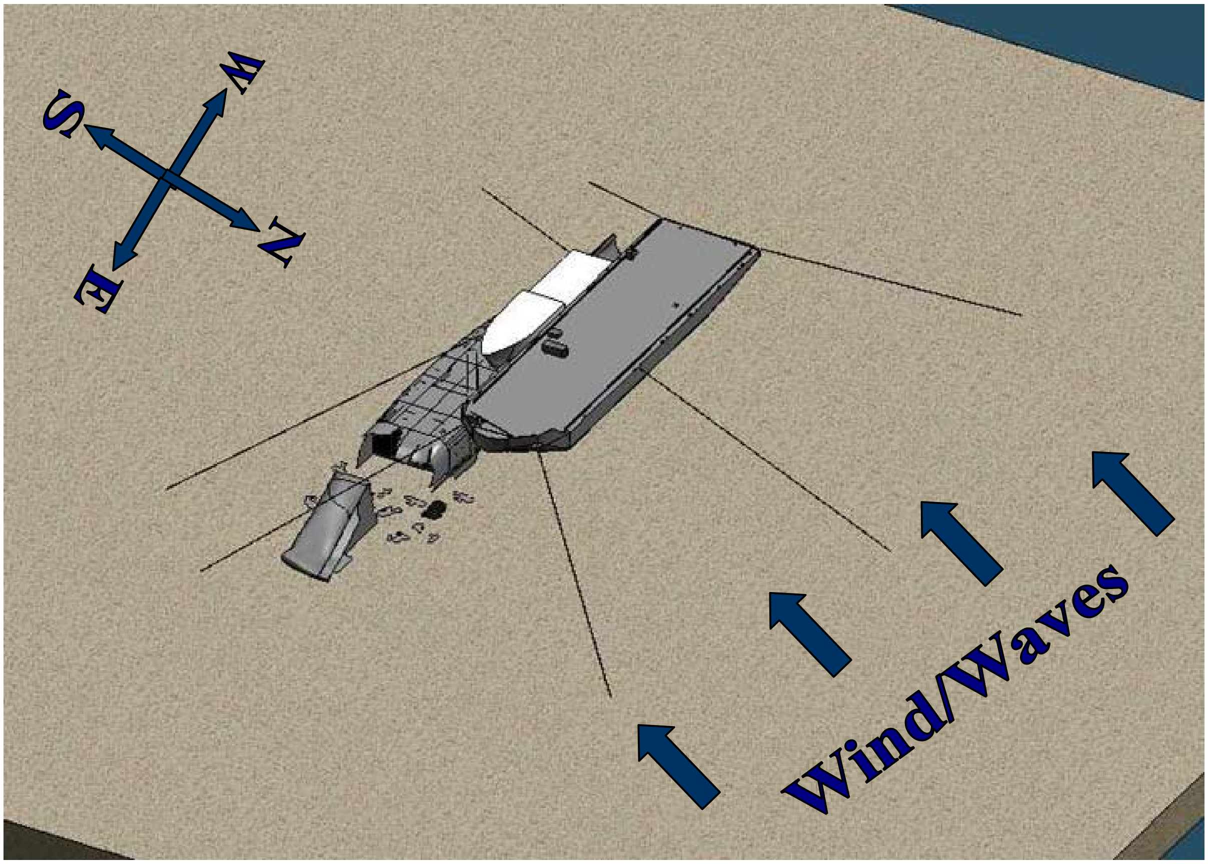


Figure 4-3. Notional Vessel Mooring Plan for NE Winds

GPC's notional plan was modified on site, in concert with *Seacor Rover*'s Barge Master, to accommodate weather conditions and loads. The sequence and placement of the legs were determined by the desire to never pass an anchor wire directly over the wreck of *Mississinewa*, and to provide greater holding power with respect to the forces exerted by the prevailing winds and seas. The first four anchors were deployed on 1 February and the last two on 2 February. The Barge Master on board *Seacor Rover* directed the deployment and subsequent fine-tuning of the mooring legs using a combination of GPS coordinates and the image of *Mississinewa* superimposed on a Personal Digital Assistant. The bow and the stern of *Mississinewa* had been buoyed by the advance party and served as additional reference points for anchoring. Once the anchors were set, the barge was positioned over the wreck using the three double-drum anchor winches that had been welded to *Fels* 20's deck in Singapore during mobilization in January.

The plan called for *Fels* 20 (the work barge) to be in a six-point moor, so *Fels* 21 (the oil recovery barge), *Salvor*, and *Seacor Rover* could tie up to her port side, starboard side, and stern, respectively, as shown in Figure 4-4.

Figure 4-4. *Fels* 20 Barge In a Six-Point Moor With *Fels* 21 Barge to Port, *Salvor* to Starboard, and *Seacor Rover* to Stern

Figure 4-5 shows the actual deployed positions of the six anchors with respect to *Mississinewa'*s hull on a nautical chart of the Ulithi area.

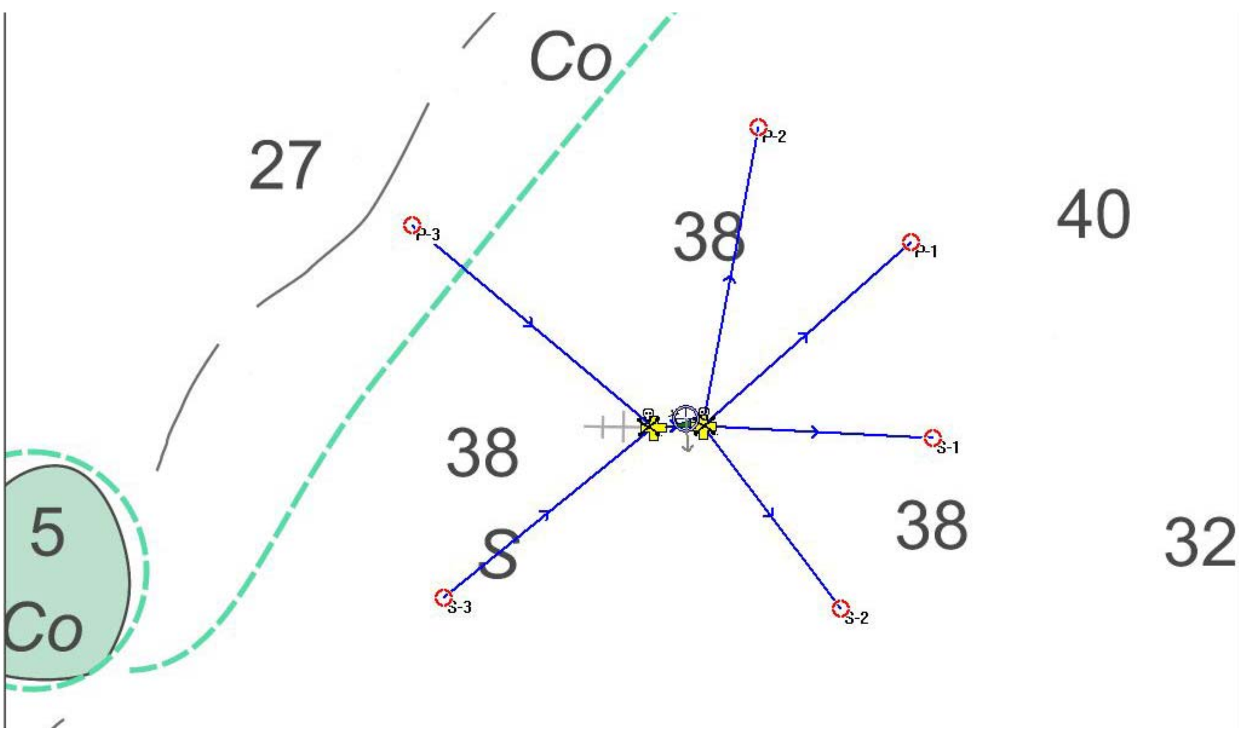


Figure 4-5. Six-Point Moor Anchor Deployment over *Mississinewa*

A typical anchor configuration included wire rope leading from the mooring winch aboard *Fels* 20, two shots of 3-inch chain, and a 5-ton Flipper Delta anchor. See Section 8-5 for the mooring arrangement. The anchors were deployed over two days in the sequence shown below, referenced to port (P) and starboard (S) side of *Fels* 20:

S-3 (aft)
S-1 (forward)
S-2 (beam)
P-1 (forward)
P-2 (beam)
P-3 (aft)

Figure 4-6 shows the topside configuration of all of the support vessels in the moor over *Mississinewa*. Two 10' x 50' inflatable fenders per side were positioned on both port and starboard sides of *Fels* 20 to enable *Salvor* and *Fels* 21 to moor alongside of her. Figure 4-7 shows one of the fenders being lowered into place.

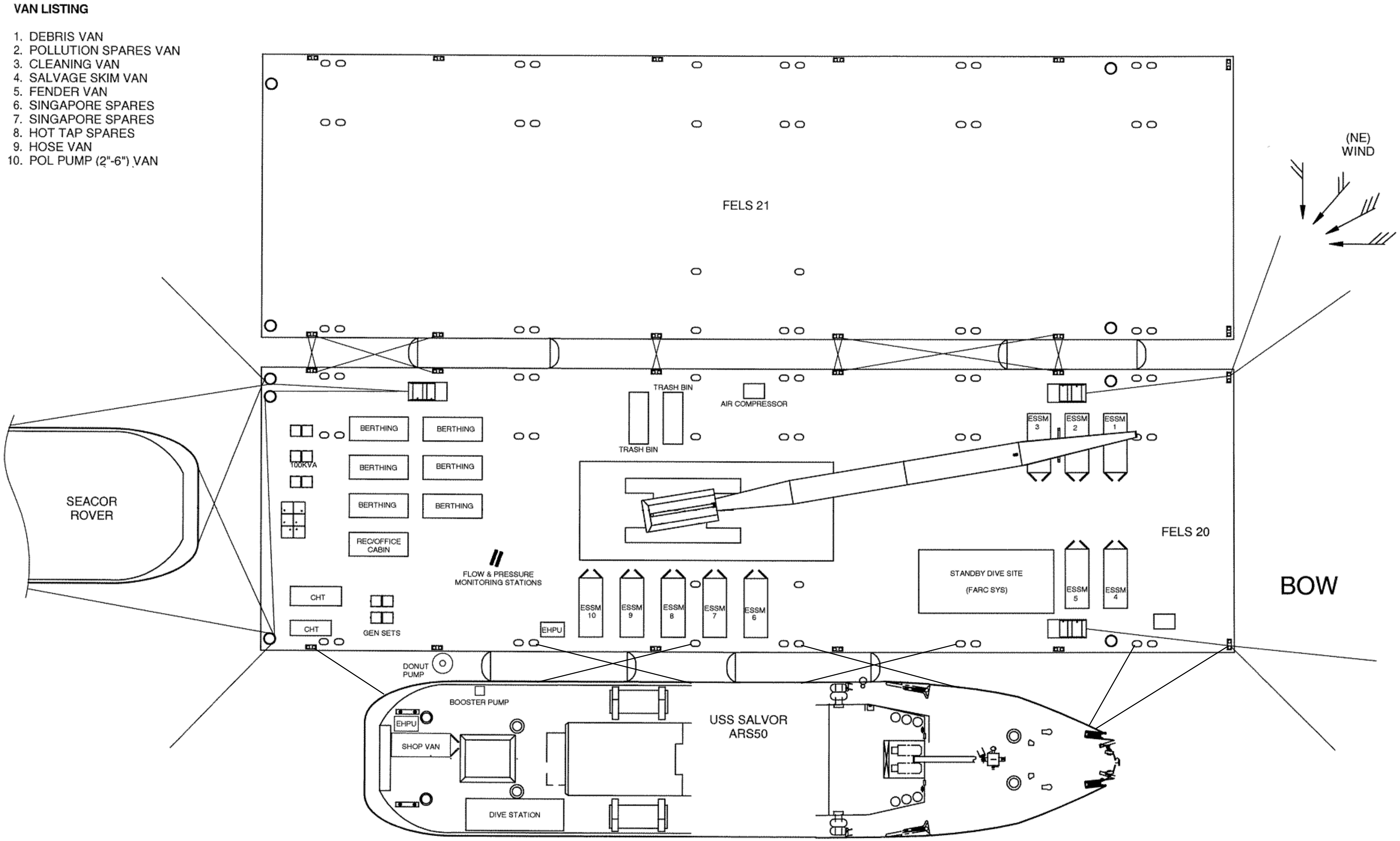


Figure 4-6. Relative Locations of *Salvor*, *Fels* 20*, Fels* 21, and *Seacor Rover* over the *Mississinewa* Site

Figure 4-7 shows a deck view of a fender being lifted into position on *Fels* 20, the primary support barge.

Figure 4-7. One of Four 10' x 50' Fenders Placed Alongside *Fels* 20

4-3 Diving Operations

4-3.1 *Salvor* Dive System

Salvor's Diver Life Support System (DLSS) is capable of supporting two working divers and one standby diver to 190 feet of seawater (fsw) on air. The system supports standard air diving and surface decompression diving, as well as a recompression chamber.

The DLSS equipment consists of a primary medium-pressure system that uses two air compressors, a secondary high-pressure air system that uses one air compressor, an oxygen system, a double-lock recompression chamber, an electrical system, and a diver's handling system.

4-3.1.1 Primary Compressed Air System

The medium-pressure air system is the primary DLSS supply and delivers 300 psig of air to the Surface-Supplied Diver Consoles (SSDCs) and recompression chamber. Two electric motor-driven, two-stage, RIX model 2JS2B-300B air compressors supply the system. The two compressors are designed to operate in a fully automatic mode in a lead-lag arrangement.

4-3.1.2 Secondary Compressed Air System

The DLSS high-pressure air system is the secondary air system and delivers 3,000 psig of air to the SSDCs, recompression chamber, and scuba charging station. One electric motor-driven, four-stage, RIX model 2JS4B-150A air compressor supplies the system. The compressor can be operated in manual or automatic mode. The automatic mode is controlled using a pressure switch.

4-3.1.3 Oxygen System

The DLSS oxygen system serves the Built-in Breathing System (BIBS) located inside the recompression chamber. The system consists of two banks of two cylinders each. They are removable, replaceable Linde K-type cylinders containing 1,800 to 2,265 psig, depending on the cylinders' manufacturer.

4-3.2 *Mississinewa* Dive Plan

GPC developed the *Mississinewa* Project timeline based upon estimated time for accomplishing each hot tap. *Salvor* Master Diver Jim Nichols incorporated that input into *Salvor*'s own dive plan, to ensure that the appropriate diver skills were available on the bottom to accomplish the tasking for a given dive. In general, decompression times were about 30 to 45 minutes, following 60 to 90 minutes of working at the depth of approximately 90 feet. Even though the sea bottom depth was 130 feet, the normal working surface for the divers on the upside-down vessel was approximately 90 feet. This saved about 40 feet of diving depth and, consequently, reduced descent, ascent, and decompression times. Over 90 percent of the dives used surface-supplied air and the remainder used scuba tanks. MK 21 surface-supplied air dives were working dives, while scuba dives accomplished photo documentation (using hand-held digital cameras), minor maintenance and bottom closeout.

Originally, the dive plan called for around-the-clock diving. Within two days on-site, however, it became clear that the hot tap installation could best be accomplished during daylight hours; therefore, most dives took place between 0700 and 1800. Sufficient divers were available that meal breaks did not interrupt work on the bottom. A dive team included two divers in the water and one standing by on *Salvor*'s deck. One team of two on-call divers was dedicated to the possible need for overnight repairs, such as a hose or valve carrying away during pumping operations, but they were never required.

During the first day of diving, divers laid out the grid reference system, consisting of a series of athwartships wires of variable lengths that were strung out from a single, longitudinal wire on the vessel's centerline keel. All segments of the gridline were 1/4-inch wire rope. From *Ashtabula* class plans, engineers on the surface knew the locations of the hull's structural components, such as frames, bulkheads, and longitudinal members. The grid, when used in conjunction with visual checks of *Mississinewa*'s riveted hull plates in combination with coaching from the GPC topside crew headed by Paul Schadow, enabled divers to precisely "navigate" their way around the hull – essential when attaching the flange and executing the hot tap, in order to avoid the ship's internal structural members. Sounding the targeted area with a hammer provided additional confirmation before placing the hot tap, thus avoiding drilling into major structural members.

Mississinewa's hull was in remarkably good shape, considering that it had been on the seafloor for 59 years. It was encrusted with a 1½-inch thickness of marine growth, which divers broke away with chipping hammers and cleaned with grinders to expose an area of approximately 9 square feet to make way for each hot tap. One team of divers cleared the work area for the hot tap, often clearing two or three such areas before the end of their dive. The next dive team would mount two or more flanges for the hot tap equipment. A third team would accomplish the hot tap, attach the pump hose, and signal readiness to commence pumping. Pumping operations were always started with divers on station to observe the initial pumping for any signs of leaks or other problems. Once system integrity was confirmed, divers could undertake additional tasks or return to the surface. Figure 4-8 shows a view of two divers with a hot tap machine on *Mississinewa*'s hull.

Dive system redundancy was provided by both Explosive Ordnance Disposal Mobile Unit Five (EODMU-5), which brought a backup Fly-Away Recompression Chamber (FARC) from Guam, and Mobile Diving and Salvage Unit One (MDSU-1), which brought a second divers' air system from Pearl Harbor aboard *Salvor*, both for emergencies. In addition, USN CONOPS intended that the 13 MDSU-1 divers and two EODMU-5 divers could have continued autonomously had *Salvor* been pulled off the line for other commitments. MDSU-1 and EODMU-5 were prepared to use the spare air system and chamber to continue without *Salvor* if necessary.

Figure 4-8. Two Divers Working the Hot Tap Machine on *Mississinewa*'s Hull

No diver injuries or equipment casualties occurred and operations went nearly exactly as planned. However, *Salvor* did sustain a casualty to the union nut on its HP diving air system. The solution was to bring on line the MDSU Fly-Away Dive System (FADS) III with a high-pressure air compressor, diver control console, volume tank, and all umbilicals. The union nut was removed, flown to Guam, repaired on USS *Frank Cable*, and returned to Ulithi on Pacific Missionary Air.

Miscellaneous Statistics:

- EODMU-5 mobilized from Guam with a complete double-lock recompression chamber system, including generators, air-conditioning, and life support system. They were very self-supporting.

- The three Master Divers – one each from *Salvor*, EODMU-5 and MDSU-1 – stood duty in rotation. Master Diver Nichols aboard *Salvor* was the senior Master Diver on station and was in overall charge of diving operations.

- Dive planning tended to depend on the needs of a specific job.

- The three open tanks – numbers 4 starboard, center, and port – were visually inspected and confirmed to be empty. Tank number 5 starboard, along with numbers 6 starboard and port, had been confirmed to be free of oil in the 2002 survey. All four bow tanks, one through hot tapping and three by Broco rod cutting, were confirmed to contain no oil. The remainder of the tanks with oil on *Mississinewa* were hot tapped, pumped, and closed.

- The capacity of the five centerline tanks was 300,000 gallons each.

- The capacity of the seven P/S wing tanks was 150,000 gallons each.

- The SUPSALV ESSM hot tap for this job weighed 43 pounds (i.e., diver-portable) with manual, diver-controlled (vs. hydraulically controlled) feed. The weight was 10 percent of the USN standard 400- to 600-pound hot tap system, which requires a crane, floats, etc.

- New decompression tables were tested during the operation. The air decompression tables currently used by the U.S. Navy were developed in the 1950s. Since that time, both experimental and operational dives have indicated areas of the tables that need improvement. A major effort to develop safer and more integrated tables was begun at the Navy Experimental Diving Unit (NEDU) in 1997. The *Mississinewa* operation afforded the opportunity to beta-test these new tables. Results were successful; no decompression sickness was observed in over 200 man-dives. Some of these dives were extremely aggressive, having bottom times in excess of 100 minutes.

4-3.3 Oil Volume Estimate

The Operations Plan for the *Mississinewa* offloading estimated that up to 2.8 million gallons of oil remained onboard *Mississinewa*, as shown in Table 4-1.

Table 4-1. Estimate of Oil Remaining on *Mississinewa*

***Mississinewa* POL**		
Product	**Tanks**	**Gallons**
NSFO	COT	2,062,116
Diesel	COT	378,000
AvGas	COT	None
Fuel Oil	FOT	332,976
Lube	LOT	2,604
Total		**2,775,696**

In Table 4-1, total gallons were rounded in accordance with the U.S. Navy EA. The abbreviations COT, FOT, and LOT refer, respectively, to Cargo Oil Tank, Fuel Oil Tank, and Lube Oil Tank.

The remaining oil volume was believed to be distributed among the tanks in the vessel's after and mid sections. Four tanks in the bow were also thought to contain some oil. Estimated oils present by type included 2,062,116 gallons of NSFO, 378,000 gallons of diesel oil, 332,976 gallons of ship's fuel oil (most likely NSFO), and 2,604 gallons of lube oil. All aviation gasoline on board just prior to the sinking in 1944 had been in a single centerline tank forward that was destroyed in the explosion. The AvGas was undoubtedly consumed in and contributed to the explosion.

4-4 Tap Location, Hot Tap, and Pump Sequence

4-4.1 Location and Marking of Hot Tap

The locations for the planned taps on the main cargo tanks are laid out in Table 4-2. These points were identified as the highest tank point as the vessel now lies and the closest flat-plate location based on the shell-plate expansion drawings. These dimensions are also shown on the sketch in Figure 4-9. A wire grid was fabricated to assist divers in locating these positions. The following details describe the grid:

a. A prefabricated grid complex of red covered, flexible, lifeline wire, laid on the hull surface.

b. Hull attachments were used down the centerline as markers and attachment points for the grid system. C-clamps were used on the bilge keel to fasten the grid system at the tank bulkheads.

c. The prefabricated grid system was fitted with snap hooks at the prescribed reference points for the offsets to the tank hot tap locations. Hot tap locations were marked with magnets, positioned using the offset wires. Other significant structures such as frames and longitudinals were marked as necessary. Using the same locating technique, additional hot taps were placed in the following locations that are not shown in Table 4-2:

   - Pump room
   - Two inner bottom tanks
   - Port and starboard ship's fuel tanks
   - After starboard bow tank

Table 4-2. *Mississinewa* Hot Tap Hole Locations

The designation of primary tap or water inlet is based on the starboard side of the wreck being slightly higher than the port side. CK stands for center keel.

Tank	Wing Stbd. Primary Tap (TAP A)	Wing Stbd. Water Inlet (TAP B)	Center Tank Primary Tap (TAP C)	Center Tank Water Inlet (TAP D)	Wing Port Primary Tap (TAP E)	Wing Port Water Inlet (TAP F)
Cargo FO #5 Longitudinal	76.7 ft. aft of Frame 76 along CK	76.7 ft. aft of Frame 76 along CK	65 ft. aft of Frame 76 along CK	65 ft. aft of Frame 76 along CK		
Transverse	27.5 ft. to stbd. side of CK	20 ft. to stbd. side of CK	17.6 ft. to stbd. side of CK	17.6 ft. to port side of CK		
Diesel #6 Longitudinal			111.7 ft. aft of Frame 76 along CK	111.7 ft. aft of Frame 76 along CK		
Transverse			17.6 ft. to stbd. side of CK	17.6 ft. to port side of CK		
Cargo FO #7 Longitudinal	146.5 ft. aft of Frame 76 along CK	146.5 ft. aft of Frame 76 along CK	146.5 ft. aft of Frame 76 along CK	146.5 ft. aft of Frame 76 along CK	146.5 ft. aft of Frame 76 along CK	146.5 ft. aft of Frame 76 along CK
Transverse	27.5 ft. to stbd. side of CK	20 ft. to stbd. side of CK	17.7 ft. to stbd. side of CK	17.7 ft. to port side of CK	20 ft. to port side of CK	27.5 ft. to port side of CK
Cargo FO #8 Longitudinal	181.5 ft. aft of Frame 76	181.5 ft. aft of Frame 76	181.5 ft. aft of Frame 76	181.5 ft. aft of Frame 76	181.5 ft. aft of Frame 76	181.5 ft. aft of Frame 76
Transverse	25.5 ft. to stbd. side of CK	19.5 ft. to stbd. side of CK	17 ft. to stbd. side of CK	17 ft. to port side of CK	19.5 ft. to port side of CK	15.5 ft. to port side of CK
Cargo FO #9 Longitudinal	216.7 ft. aft of Frame 76	216.7 ft. aft of Frame 76	216.7 ft. aft of Frame 76	216.7 ft. aft of Frame 76	216.7 ft. aft of Frame 76	216.7 ft. aft of Frame 76
Transverse	23.5 ft. to stbd. side of CK	21.75 ft. to stbd. side of CK	17 ft. to stbd. side of CK	17 ft. to port side of CK	21.75 ft. to port side of CK	23.5 ft. to port side of CK

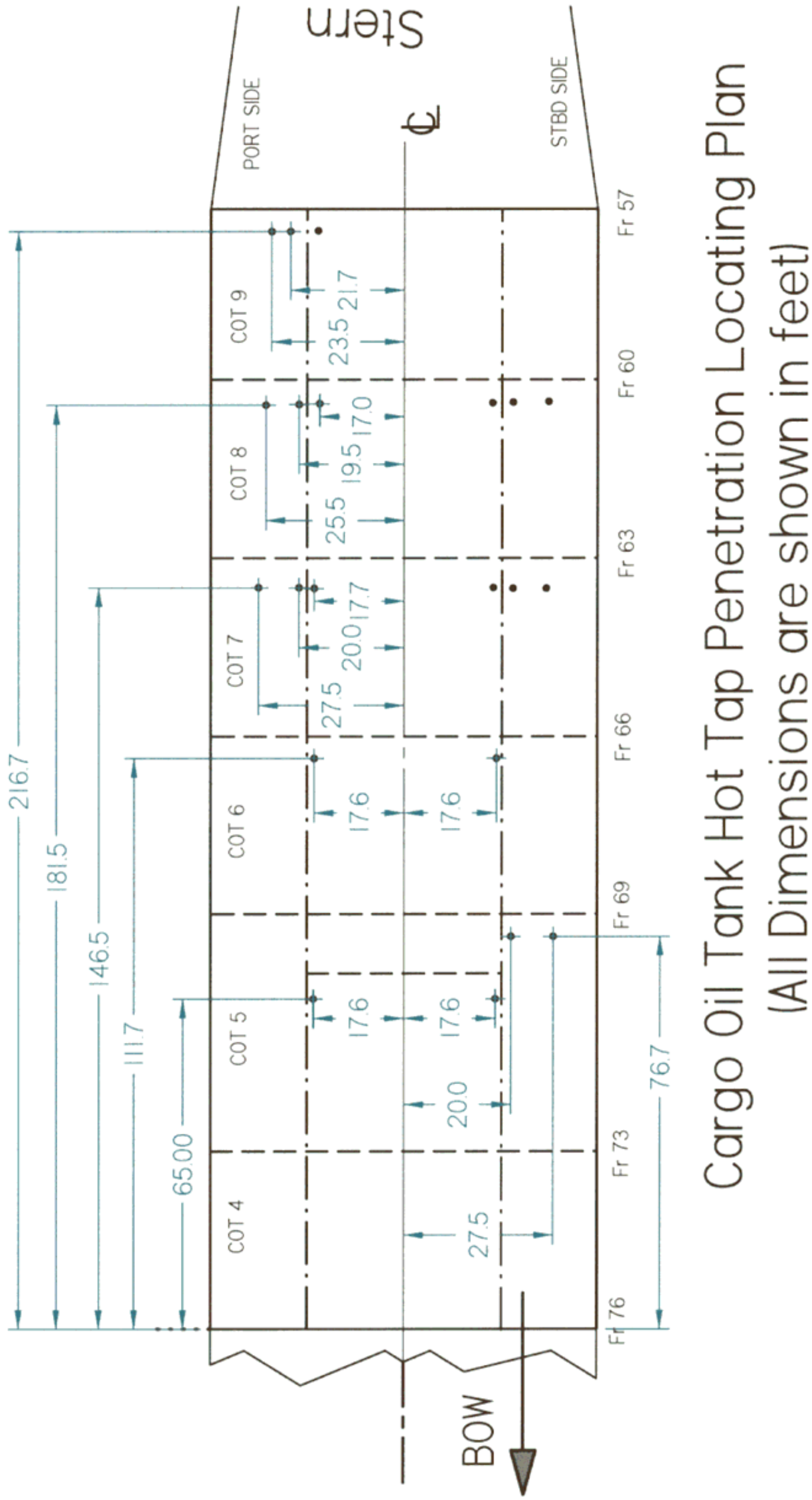


Figure 4-9. Cargo Tank Locations

4-4.2 Hot Tap Technique

The hot tap technique is a controlled entry through a valve that uses a hot tap machine to drill a hole into the hull of a submerged vessel so that the vessel's contents can be pumped to the surface. The following process was used to accomplish the hot taps in the hull of *Mississinewa*:

1. **Hull Cleaning.** A 3' x 3' area at the designated hot tap hull location was thoroughly cleaned. A brick hammer and a scraper were used to remove growth from the hull. Then the surface was cleaned with a hydraulic grinder/wire wheel.

2. **Flange Attachment.** Each hot tap flange was placed on the hull and held temporarily with three 1,000-pound force magnets. Figure 4-10 provides an example, using a steel plate to represent the *Mississinewa*'s hull.

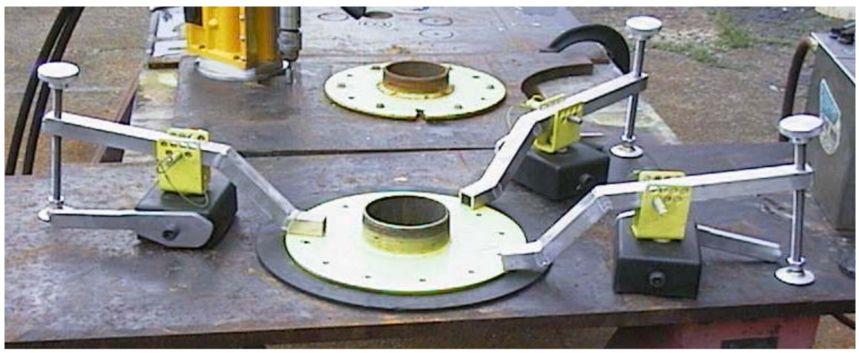


Figure 4-10. Hot Tap Flange Held in Place with Magnets

The *Mississinewa* project used the blind hole/self-tapping bolt method to attach each flange. Since the selected hot tap locations were predominantly in 81/100-inch thick or greater hull sections, a 9/32-inch hole was drilled to a depth of 3/4 inch using a stop on the drill bit to control the hole's depth. A 5/16-inch self-tapping bolt was screwed into the hole using a ratchet wrench, and torqued to 18 foot-pounds. Between 8 and 12 bolts were used to secure each flange.

Figure 4-11. "Bubba Bar" and Drill in Position over Flange

A hydraulic drill and a "Bubba Bar" were used to drill the blind holes (i.e., holes that did not go all the way through the 7/8-inch steel hull plate) for the self-tapping bolts. The "Bubba Bar," shown with the drill in Figure 4-11, is a 5-foot long, 2-inch diameter aluminum pipe assembly that attaches to the hull on one end using a magnet with 1,100 pounds of force. The drill is mounted near the mid-point on a fitting that can slide forward or backward so the drill can align with the hole that is to be bored. When the diver pushes on the free end of the pipe, the leverage enables him to easily drill into the steel hull plate, despite the diver being relatively light in the water due to buoyant forces. One setting of the magnet and "Bubba Bar" enabled the divers to drill all 8 to12 holes in the flange. The bolts were then torqued and the flange readied for attaching the valve. The time needed to attach each flange was 10 to 15 minutes.

3. **Hot Tap.** The screw-on 4-inch full port valve assembly was threaded onto the flange and tightened, as shown in Figure 4-12. The hot tap machine, shown in Figure 4-14, was attached to the valve using a camlock fitting. A 3/4-inch hose located on the side of the hot tap machine provided a vent to the surface manifold system. The hot tap pilot/cutter was fed to the hull surface through the open valve, the diver-held drill was fitted to the end of the cutter shaft, and the pilot hole was drilled. Air that vented from the tank as the pilot broke through the hull plate was relieved through the air hose to the surface manifold. While venting the tank, hot tap drilling continued with the 3 1/2-inch cutter. The time needed to complete each hot tap was 10 to 15 minutes.

Figure 4-12. Valve Threaded onto Flange

Figure 4-13. Two Divers Drilling into *Mississinewa*'s Hull with a Hot Tap Machine

Figure 4-14. Hot Tap Machine

4. **Hot Tap Machine Extraction.** The hot tap cutter head was then extracted, the valve was closed, and the hot tap machine was removed. Twice, the coupon from the hot tap remained attached to an internal structural piece of the hull. In these two cases, a "Bung Buster" was used to clear the obstruction. Once the entry way was clear, the valve assembly was ready to accept the hose from the pumping system.

4-5 Pumping Operations

4-5.1 Pumping Equipment

- Hydratech 4-inch centrifugal/screw pumps
- Hose, risers, UW manifolds, and valves
- Hydraulic hoses and control systems
- Product control and monitoring equipment
- Peristaltic pumps and equipment

4-5.2 Pump and Hose Installation

Several pumping options were available to remove the oil from *Mississinewa*. The primary pumping system utilized the 4-inch Hydratech hydraulic pump due to its relative high-volume capacity and light weight. This pump weighs less than 50 pounds and is handled easily by the divers without special lifting equipment. In addition, the peristaltic pump was used in situations where a vacuum was needed to extract air/gas and small quantities of oil.

System 1: A 20-foot, 4-inch hose section from an elbow on the hot tap valve fed the pump, located in a stand on the hull of *Mississinewa*. The 4-inch discharge hose from the pump led to a manifold on the bilge keel and from there up to *Salvor*'s deck. Aboard *Salvor,* a second 4-inch booster pump, rigged in series, pushed the oil through the monitoring manifold on *Fels* 20 and to the receiving barge, *Fels* 21, alongside.

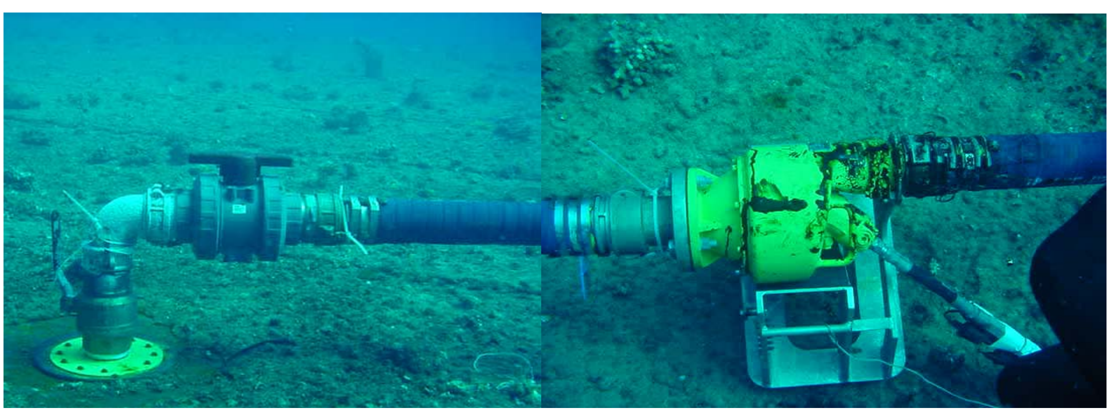


Figure 4-16. Oil Flows from the Hot Tap to the Pump and Up to the Surface

System 2: A 4-inch (suction) hose ran directly from the hot tap valve to the donut pump floating on the surface adjacent to *Fels* 20. From the donut pump, a discharge hose went onto *Fels* 20, transferring oil through the monitoring manifold and into the tanks on *Fels* 21.

System 3: A 2-inch hose ran directly from the hot tap valve to the peristaltic pump located on *Fels* 20's deck, through the monitoring manifold and into *Fels* 21.

In all options, the rise and fall of the vessel from waves and swells was absorbed in hose catenaries, either between the manifold on *Mississinewa*'s bilge keel and the support vessel or in the long hose section between the support vessel and the hot tap valve. In those systems that went directly from the hot tap to the surface, a restraining line secured to the hose some 20 feet above and fastened to the bilge keel prevented a direct strain on the valve assembly. No sea motion was experienced between the hot tap flange and the manifold on the bilge keel.

4-5.3 Water Inlet to Replace Pumped Oil

In those tanks that were not open to the sea through vents or hull fractures, a hole was bored below the oil level in the tank using a boring machine mounted to a 4,000-pound magnet. This hole was bored to allow water to quickly replace the oil that was being pumped from the tank, increasing pump flow rate and/or preventing the tank from collapsing. Figure 4-17 shows the hydraulic boring machine and cutter.

Figure 4-17. Boring Machine

4-5.4 Pumping Cycles

The pumping cycle for all tanks included hot tapping, pumping until significant water was discharged with the oil, settling several hours, or in some cases days, then repeated cycles of slow pumping (stripping), and settling until a beaker of discharged water revealed no (or barely detectable) visible sheen, as validated by the SUPSALV Representative, Bill Walker. For some tanks, up to 14 pumping and settling cycles were completed before closing out, as indicated in table 4-3, the *Mississinewa* Tank Pumping Log.

Table 4-3. Tank Pumping Log

Tank	Initial Pumping (date, time, gallons)	Stripping -> (date, time, gallons)									Total Gallons
5-S	2/6 1830 81,000	2/6 1945 1,250	2/7 3,514	2/10 1300 1,500	2/11 1340* 900	2/11 1545	**Cap**				**88,164**
	2/7 1710 101,995	2/7 1830 1,005	2/8 0800 3,000	2/8 0900 2,000	2/10 1547* 9,000	2/11 ~1300* 2,500	2/12 1100* 3,000	2/12 ~1400** 800	2/13 0815 2,250	Subtotal 125,550	
		2/13 1155 1,142	2/13 1515 2,000	2/18 1708 6,549	2/19 0758 6,125	2/19 0915	**Cap**			Subtotal 15,816	**141,366**
	2/9 0138 * 271,000	2/9 0800 2,000	2/11 ~0900 1,000	2/11 1129 1,000	2/11 1545	**Cap**					**275,000**
7-C	2/10 0330 354,000	2/10 0800 2,000	2/13 1705 1,000	2/14 0730 1,200	2/14 1249 800	2/15 0721 1100	2/15 0817	**Cap**			**360,100**
8-C	2/10 2030 184,760	2/14 1658 3,200	2/15 0728 1,500	2/15 0921 1,300	2/16 1056 1890	2/16 1148 849	2/16 1257 180	2/16 1315	**Cap**		**193,679**
7-S	2/11 0800 184,000	2/15 0829 1,200 C - 1276	2/15 ~0845 1,100	2/16 0920 2,365	2/16 0935	**Cap**					**188,665**
7-P	2/11 1950 U	2/15 1029 900	2/16 0931 2,976	2/16 1005 2,318	2/16 1040	**Cap**					**159,246**
8-P	2/11 1830 U	2/17 1421 1,376	2/17 1517 1,000	2/17 1612 2,867	2/18 0945	**Cap**					**48,088**
8-S		2/13 0820 2,820	2/13 0915 250	2/16 1328 1358	2/16 1542 2,045	2/16 1720 1432	2/17 0745 1845	2/17 1020 1,410		Subtotal 85,220	
		2/17 1309 1,348	2/17 1348	**Cap**						Subtotal 1,348	**86,568**
9-P	29,800	2/13 1617 645	2/18 0920 600	2/18 1126 600	2/18 1300 855	2/18 1640 7,376	2/18 1737 1,000	2/19 0755 6,122	2/19 0915	**Cap**	**46,998**
FOT-S	2/13 1930 U 85,760	2/14 0742 1,000	2/14 0917 800	2/16 1058 1428	2/16 1146 601	2/16 1514 2,500	2/16 1706 1398			Subtotal 93,487	
(2 Hot Taps)		2/17 1207 600	2/17 1235 225	2/17 1350* 8,293	2/17 1406* 3,000	2/17 1610 850	18 0955-1600	**Cap1-Cap2**		Subtotal 12,968	**106,455**
FOT-P	2/14 1410 64,862	2/14 1517 1690	1/18 1436 3,350	2/18 1513 2,611	2/18 1515	**Cap**					**72,513**
IBFO-P	2/14 1558 No Oil	2/15	**Cap**								**0**
IBFO-S	2/14 1615 No Oil	2/15	**Cap**								**0**
9-C	2/15 1722 99,843	2/16 0815 4,044	2/16 1032 1,775	2/18 0728 2,365	2/18 0915 3,127	2/18 1055 4,770	2/18 1240 5511	2/18 1330 3,000	2/18 1422	**Cap**	**124,435**
9-S	2/17 1235 27,518	2/18 0725 706	2/18 0929 3,068	2/18 1050 4,577	2/18 1238 3,745	2/18 1422	**Cap**				**39,614**
Pump Room	2/15 1748 6,500	2/16 0736 1,800	2/16 0907 1,500	2/19 0938 10,383	2/19 0950 2,950	2/19 1105	**Cap**				**23,133**
E Room	2/19 1410 No Oil	2/19 1530	**Cap**								**0**
F	2/17 ~1500 No Oil	**No Hot Tap**									**0**
4" Pipe	2/21 1100 600	2/21 1122 400	2/11 1340 **No Hot Tap**	**Cap Flange**							**1000**
RFO-1S	2/22 ~1700 No Oil	2/23	**Cap**								**0**
RFO-2S	2/22 ~1700 No Oil	**No Hot Tap**									**0**
RFO-1P	2/22 ~1700 No Oil	**No Hot Tap**									**0**
RFO-2P	2/22 ~1700 No Oil	**No Hot Tap**									**0**

Total Gallons of Oil/Water Pumped	**1,955,024**
(Estimate 7% Free Water)	**136,852**
Estimated Gallons of Oil/Emulsion	**1,818,172**

After flushing hoses: 7.5% water
149,056 gallons oily water
1,814,894 gallons oil
1,963,950 total oil & water pumped from Mississinewa

The following was the sequence of events culminating in a tank being pronounced closed:

1. Pumped, allowed to settle, and pumped again until only clear water was present at the discharge.

2. Confirmed that all pumpable oil had been removed as verified by the SUPSALV Representative.

3. Removed the valve from the flange bolted to the hull.

4. Inserted a threaded bolt with a toggle bar into the hole in the hull.

5. Placed a small cap over the bolt and tightened the nut, thus covering the pipe nipple and hot tap hole.

6. Placed a large cap over the entire flange and small cap assembly, and secured it with a tamper-proof nut.

7. Let sit and checked for a day or two.

8. Tightened as required.

9. Removed tightening handles from the tamper-proof nut and applied epoxy to seal the entire nut/bolt assembly.

4-6 ESSM Equipment Mobilized

Table 4-4 lists the major ESSM equipment mobilized for the *Mississinewa* project and points of origin.

Table 4-4. Major ESSM Equipment Mobilized from Various Locations

System	System Nomenclature	ESSM	ESSM Nomenclature	Qty	Origin
Containment Systems					
P16200	Salvage Support Skimmer System	VA2220	Van, Salvage Skimmer System	1	Cheatham Annex
P19900	Personnel Transfer Boats System	WB0736	Boat, 24’ Rigid Hull Inflatable	1	Hawaii
P20400	Debris Handling System	WB0750	Boat, 32’ Rigid Hull Inflatable w/Lori Skimmer	1	Cheatham Annex
POL Offloading System					
P17200	Submersible Hydraulic Pump System, 2” to 6”	VA0280	Van, Submersible, 2” to 6” Hydraulic Pump System	1	Cheatham Annex

Table 4-4. Major ESSM Equipment Mobilized from Various Locations (contd)

System	System Nomenclature	ESSM	ESSM Nomenclature	Qty	Origin
Communication Equipment					
P05100	Communication System	PH0940	Phone, Sea Pak-M Maritime, Minim	1	Cheatham Annex
		PH0935	Phone, SOLSAT Sys Minim	1	Cheatham Annex
		PH1730	Phone, Satellite, Iridium	1	Cheatham Annex
		RA1850	Radio, VHF Marine Walk/Talk Motorola, Secure	6	Cheatham Annex
		RA1855	Radio, VHF Marine Walk/Talk Motorola, Non-Secure	6	Cheatham Annex
Support Equipment					
P19700	Shop Van	VA0508	Van, Workshop	1	Hawaii
	Purpose assembled	TE1000	Oil & Water Test Kit	1	Cheatham Annex
	Purpose assembled	TE1010	Water Test Kit	1	Cheatham Annex
	Purpose assembled	TE1020	Oil/Water Interface Meter	1	Cheatham Annex
	Purpose assembled	TE1030	Rate Indicator, 8 Digit Display	1	Cheatham Annex
	Purpose assembled	TE1031	Flowmeter, 3”, 20-650 GPM	1	Cheatham Annex
	Purpose assembled	TE1032	Flowmeter, 4”, 50-1500 GPM	1	Cheatham Annex
	Purpose assembled		Flowmeter, 6”	1	Cheatham Annex
P06100	Fenders (LP Pneumatic, 10’ x 50’ 4/Sys)	VA2221	Fender LP Pneumatic 10’ x 50’	4	Cheatham Annex
S14100	Light Tower System, w/5-kW, Dsl, Generator	LT0430	Light Tower w/5-kW Generator	2	Singapore
		PW0040	Power Unit, Elect, Mod 11, 26 gpm	2	Cheatham Annex
		HT0006	Hot Tap, Lightweight	4	Cheatham Annex

Table 4-4. Major ESSM Equipment Mobilized from Various Locations (contd)

System	System Nomenclature	ESSM	ESSM Nomenclature	Qty	Origin
Support Equipment (contd)					
	Purpose assembled		Boring machine, underwater, w/4,000-lb. magnet	2	Cheatham Annex
	Purpose assembled		Magnets, high power, 1000#	10	Cheatham Annex
S29100	Welder, Diesel, 400-amp	WL0470	Welder, Diesel, 400 amp	2	Singapore
		WL0471	Spare Parts Kit	2	Singapore
		WL0472	Ancillary Kit	2	Singapore
S12300	Generator, 30-kW, Dsl, 120/240/480 V ac, 1-ph/3-ph	GE0460	Generator, 30 kw	2	Singapore
		GE0461	Spare Parts Kit	2	Singapore
		OB0850	Bladder, Oil Storage, 2000 Gal	1	Cheatham Annex
S01100	Air Compressor System, Portable, 175 cfm, 100 psi	AC0330	Air Compressor, 175 cfm	2	Singapore
		AC0331	Ancillary Set	2	Singapore
		AC0332	Spare Parts Kit	2	Singapore
S05100	Beach Gear System	AN0001	Anchor, EELLS	2	Hawaii
		BU0003	Buoy, 42”	8	Singapore
P03300	Boom Tending Boat (Inflatable)	WB0732	Boat, 23’, Inflatable, Mk IV	1	Hawaii
	Purpose assembled		Hose Van	1	Cheatham Annex
	Purpose assembled		Hot Tap Support Van	1	Cheatham Annex
	Purpose assembled		Pollution Support Van	1	Cheatham Annex
	Forklift, 6000 #		Forklift, 6000 #	1	Singapore
		DU0200	Dispersant Unit	2	Cheatham Annex

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER 5

5 LOGISTICS

5-1 Equipment Mobilization

Equipment mobilization took place from five primary locations: Williamsburg, VA, Broussard, LA, Hawaii, Guam, and Singapore.

Figure 5-1 shows the various mobilization locations in relation to the Ulithi operations area, in most cases thousands of miles from Ulithi.

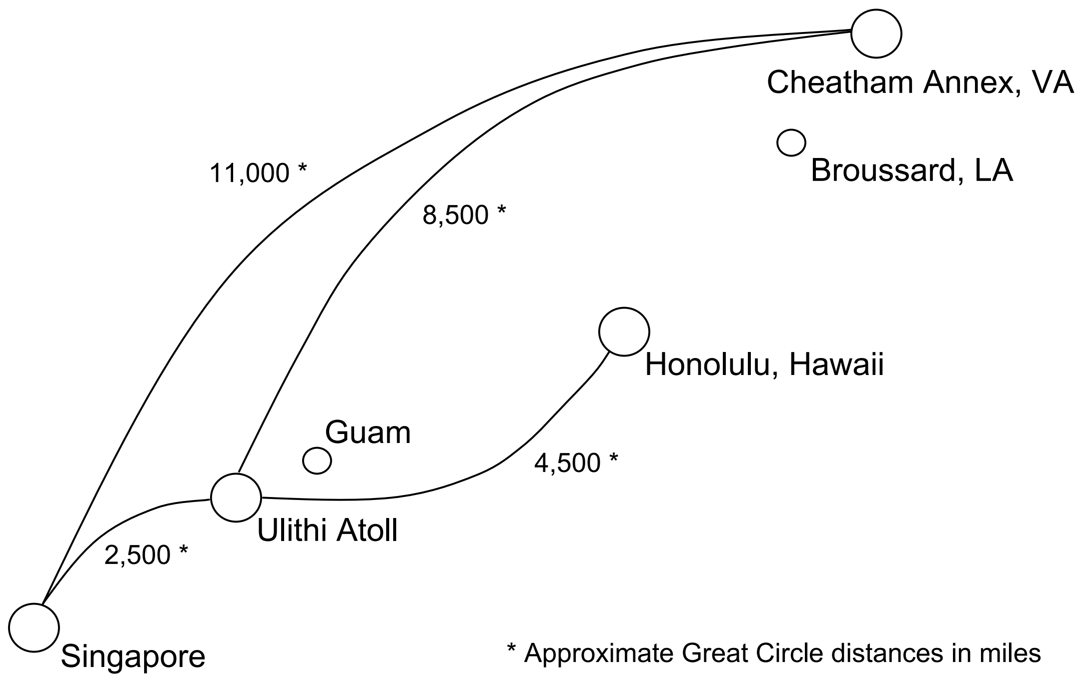


Figure 5-1. Mobilization Distances to *Mississinewa* Operations Area

In the initial planning stages at GPC's Williamsburg headquarters, chartering a tanker was considered as an alternative to hiring multiple platforms. Drawbacks of the tanker scenario included shortage of usable deck space, lack of available tankers at the time, and cost. Over time, GPC decided that two barges and two tugs were both suited for the task and cost-effective.

To conform to the SUPSALV Environmental Assessment (EA) and Operations Plan, the barges had to have a combined 200 percent of the capacity required to store and transport the anticipated 2.8 million gallons of *Mississinewa* product – a total storage capacity of nearly 6 million gallons – to accommodate NSFO, diesel, oil/water emulsion, and stripping water.

The U.S. Navy erred on the side of conservatism and leased two barges. In retrospect, the pumped volume could have been contained within a single barge. However, if the U.S. Navy had gambled that this would be the case and lost, the project would have been set back – at a considerable day rate – by a 16-day delay while the second barge was towed from Singapore, if a barge could even have been located and placed on charter on short notice. In addition, a single oil-laden barge might not have provided adequate freeboard for safe transit of all the deck-loaded equipment in potentially rough seas on the return trip between Ulithi and Singapore.

GPC gave Seacor Marine Asia, Inc., a Statement of Work to provide the tugs and barges, selected on the basis of several criteria:

- Number of people to be berthed on site
- Requirements for a work barge to function as the center of over-the-side operations
- Six-point mooring capability
- Need for an oil storage barge with appropriate capacity and cost

In addition, the barges were required to have space for oil spill response equipment staging, capability of supporting hot tapping and pumping operations, berthing (in vans on deck), and sufficient space to accommodate the two Marine Sanitation Devices (MSDs) and trash handling for the entire "floating village."

GPC chose Singapore as the outfitting and staging center because both tugs and barges were homeported there. In addition, Singapore's excellent seaport offered weekly vessel service from the U.S. as well as shipyards capable of outfitting the support vessels.

In all, GPC shipped over 100 tons of equipment, including hot tap, pumping, and support systems, to Singapore. This was broken down as follows:

Table 5-1. Weight of Cargo Shipped from U.S. to Singapore

Origin	**Equipment Shipped**	**Weight (tons)**
Cheatham Annex, VA	7 Containers of ESSM Gear	75
Hawaii	3 Containers of ESSM Gear	20
Broussard, LA	2 MSDs	6

GPC subcontractor Target Logistics, Inc. worked through a Singapore agent to transport all equipment sent from the U.S. to the mobilization site in Singapore.

The seven ISO shipping containers that were sent from the U.S. Navy's ESSM base, Cheatham Annex, outside Williamsburg, VA, were trucked to Portsmouth, VA, and moved by rail to Long Beach, CA. There the containers were loaded aboard the Maersk/SeaLand cargo vessel *Caroline* for the 34-day transit to Singapore.

After an exhaustive search in Singapore and the surrounding area, the closest MSDs were leased from HP Rentals, Broussard, LA. Shipment of the two units over the road to the Maersk terminal in Long Beach, CA (nearly 1,800 miles) was a challenge, since weight and dimension data provided by the leasing company was less detailed than required for wide-load shipment. In order to make the height of one of the units acceptable for shipboard loading, the top-mounted compressor had to be removed to save 2.5 feet of height. Target Logistics coordinated all phases of the transit – pickup in Louisiana, oversize-load permits to California (including escorts with flags and lights over the entire route), and all other details.

Table 4-4, right-hand column, lists the origin of equipment mobilized from each primary site. In addition, the four chartered vessels – *Seacor Rover*, *Jaya Marlin*, and deck barges *Fels* 20 and *Fels* 21 – were all based in Singapore. *Fels* 20 was outfitted with a 150-metric ton mobile (crawler) crane, three large mooring winches, the MSDs, six berthing modules, and an office van subcontracted from local Singapore resources.

To ensure that everything happened on schedule, with virtually no flexibility in the timetable, daily transoceanic phone communications linked GPC with senior officials of Maersk, Target Logistics, and Target's Singapore agent. The ocean shipment arrived in Singapore on January 13. It was offloaded on January 14 and was delivered to Seacor Marine in the Fels Shipyard for installation on January 15.

Salvor transported all the Hawaii-based MDSU-1 diving equipment and Pearl Harbor ESSM base equipment, transiting to Ulithi via Guam, where the vessel picked up EODMU-5 personnel and dive gear. Most of the equipment was stowed on *Salvor*'s aft deck and transferred directly to *Fels* 20 on arrival in the operations area.

5-2 Personnel Mobilization

MDSU-1 personnel flew from Hawaii to Guam, where they boarded *Salvor* for transit to the operations area. Personnel who did not transit aboard *Salvor* to Ulithi were routed via commercial air into Yap. From Yap, Pacific Missionary Air (PMA) shuttled them to Falalop Island in the Ulithi Atoll. The small PMA Beech aircraft had space for nine people with minimal baggage. Often, personnel arrived one day and their baggage would follow days later. Personnel transit had to be carefully coordinated, as daily service was not available to either Yap or Ulithi, and the arrivals in Yap did not always correspond with service to Ulithi.

From Falalop, personnel were transported to the *Mississinewa* site on small boats. Since no pier facility was available, personnel had to carry their baggage, wade waist-deep in the surf, and climb aboard 18- to 20-foot boats for the eight-mile trip to the site.

5-3 Vessel Mobilization

5-3.1 *Salvor*

See Section 4.1.

5-3.2 Chartered Platforms

Seacor provided a 200-foot, 5,506-Brake Horsepower (BHP) anchor-handling supply vessel, *Seacor Rover,* directly from its 100-vessel fleet. As subcontractor to GPC, Seacor also procured *Jaya Marlin*, a 112-foot, 5,000-BHP tug charter, and two identical 100' x 300' barges, *Fels* 20 and *Fels* 21, as third-party charters. Seacor assigned a dedicated project manager to work on behalf of GPC to locate all leased assets and equipment.

Seacor Rover had to support berthing for 18 additional personnel and tow one fully loaded barge. *Jaya Marlin* had to be able to tow the fully loaded *Fels* 21 barge. (At the mission's conclusion, the larger, more capable *Seacor Rover*, not *Jaya Marlin*, towed the recovered oil-laden *Fels* 21 back to Singapore.)

In early January 2003, GPC's Lloyd Saner and Project Engineer Jeff Cane spent 10 days at the Keppel Gul Shipyard in Singapore. Lloyd Saner coordinated chartering support tugs *Seacor Rover* and *Jaya Marlin* and outfitting the two barges for the operation. Jeff Cane assisted in locating local equipment for lease (including berthing vans, office vans and trash containers), and provided engineering input related to the mission configuration of the chartered vessels.

Seacor implemented the GPC deck loadout plan on the *Fels* 20 barge with respect to mounting the 150-metric ton crawler crane, piping and electricity for the MSDs, and berthing vans. Seacor also secured all winches and containers, as well as other equipment, to the deck for both the long round-trip sea voyage and the operation. A steel safety rail was welded around the entire 800-foot perimeter of that barge, with cutouts to allow for placement of brows for passage between platforms.

Two separate electrical power distribution centers were established on *Fels* 20. One distribution center consisted of two 30-kW generator sets that were dedicated to hotel and office services supporting the six berthing vans and the office van. These two generators were set up for parallel operations in the 220-volt, single-phase, 50-cycle mode. The parallel mode was necessary to accommodate peak usage of the hot water and air conditioning systems. The second distribution system consisted of one generator supplying 220-volt, 60-cycle, 3-phase power to the MSDs and 110-volt power for the office van.

MSD requirements were structured around *Salvor*'s estimated 6,000-8,000 gallons of sanitary wastewater generated per day. *Seacor Rover* and *Jaya Marlin* were self-sufficient with installed MSDs. *Fels* 20's berthing and sewer requirements were part of *Salvor*'s estimate and would have been handled easily by the portable plants if *Salvor* had been reassigned and left the area, with the EOD /MDSU divers remaining on station. The two MSDs shipped from Louisiana were two different sizes, with different capacities.

The 3,500-gallon-per-day (gpd) MSD measured:

Length:	17 feet, 7 inches
Width:	6 feet, 2 inches
Height:	7 feet, 6 inches

The 1,500-gpd MSD measured:

Length:	13 feet, 10 inches
Width:	5 feet, 2 inches
Height:	6 feet, 6 inches

As the Singapore advance team departed for the operations area days before the MSDs and containers had arrived aboard the *Maersk Caroline*, GPC entrusted final installation of the MSDs to shipyard personnel, overseen by Seacor officials, in accordance with footprint specifications left by GPC.

5-4 Resupply

USNS *Kiska* (T-AE 35) resupplied *Salvor* with perishables and mail on 18 February. *Kiska* entered Ulithi Atoll guided through an unmarked channel by *Jaya Marlin* and anchored in the NE corner of the Atoll. *Jaya Marlin* ferried supplies from *Kiska* to *Fels* 21 and from there they were lifted in a steel basket to *Salvor* by the crane on *Fels* 20. In a separate mission, *Jaya Marlin* also resupplied 15 drums of hydraulic oil from Yap to replenish the oil that was leaking internally from an over-pressured case drain on the bottom submersible transfer pump. Pacific Missionary Air (PMA), with service from Yap on a twice-weekly basis or a dedicated charter, provided resupply of small parts when needed. PMA also ferried all personnel into and out of the atoll on either their scheduled flights or special charter.

5-5 Oil Disposal

Seacor Rover towed the recovery barge, *Fels* 21, containing approximately 1.8 million gallons of NSFO and diesel oil to Singapore, where the oil was sold to help defray the cost of the oil removal.

5-6 Demobilization

When the mission ended, return shipment was more complicated than on the outbound leg. The ESSM cleaning, shop, and Zodiac vans that *Salvor* had brought out from the Pearl Harbor, Hawaii ESSM base, left the operations area aboard *Fels* 20 and were shipped back to Hawaii from Singapore. All ESSM gear and the MSDs that had been mobilized in Singapore were returned by ship, truck, and train to Williamsburg, VA, and Broussard, LA, respectively. All equipment passing through Singapore was subject to inspection, which added time on the front end of its return to the U.S.

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER 6

6 *MISSISSINEWA* LESSONS LEARNED

6-1 Weather

Lesson Learned: Planning tended to be focused on the most probable and optimistic weather conditions, not the more difficult conditions likely to be encountered. This was likely due to the relatively mild conditions encountered during the two previous SUPSALV *Mississinewa* operations. Vessels, moorings, personnel transfers and all systems must be structured to accommodate the more difficult weather that might be encountered during a particular season. Vessels were not optimally equipped to work efficiently in the prevailing sea states encountered during the operation.

Recommendation: Plan and outfit for the more difficult weather and the normal weather will take care of itself.

6-2 Personnel Transfers

Lesson Learned: Brows and gangways were neither sufficiently strong nor properly configured to withstand the weather and relative motion among vessels. No Billy Pugh (personnel transfer basket that provides a safe crane lift platform for transferring personnel between platforms in rough weather) or other transfer method was provided. In the end, personnel transfers between *Seacor Rover* and *Fels* 20 had to be carried out using a small boat and Jacob's ladders.

Recommendation: Gangways and brows need to be of steel construction for offshore work. Platforms need to have rollers and tiedowns to accommodate the brows. Consideration must be given to suspended brows for this environment. Consolidation of operations on fewer support vessels should be considered as long as all other operational requirements can be met.

6-3 Equipment Transfers at Sea

Lesson Learned: Crane transfer at sea of heavy equipment, such as a 30-ton recompression chamber, is more difficult and requires more advanced rigging skills than it would under flat, calm, harbor conditions.

Recommendation: To the extent possible, load heavy equipment on board destination platforms in port, where weather is usually less of a factor.

6-4 Leased Equipment

Lesson Learned: The leased mobile crane had deteriorated hydraulic hoses. One hose broke, spilling 50 gallons of hydraulic oil. A second hose would have broken within a short time had it not been replaced, and other hoses were worn to the point of questionable life expectancy. The two hoses were replaced with similar hoses from the ESSM shop van and lasted for the duration of the operation. In addition, fan belts on the leased mooring winches broke and no spares were aboard. Operations continued by switching belts between units until spares arrived from Hawaii.

Recommendation: Leased equipment needs to be quality-checked before deploying on extended missions, especially in remote areas. Adequate spare parts (belts, filters, injectors, etc.) must accompany the leased equipment.

Lesson Learned: The leased 150-metric ton crawler crane came equipped with six sections of 30’ x 6’ landing mat to protect *Fels* 20’s deck as the crane traversed the deck. The quantity of mat was insufficient to permit the crane to travel the entire length of deck without stopping, retrieving mats from the distance already traveled, and putting them down ahead of the crane. This cumbersome evolution complicated the exercise of moving the crane and stopped all other deck operations, as these mats were repositioned on the deck area in rolling seas.

Recommendation: If a crawler crane is used in the future and there is a need to protect a platform deck, adequate mats should be taken aboard during mobilization to satisfy this requirement without shifting mats.

Lesson Learned: The planned combination of the one 20-foot van serving as both the operations van and the rest/recreation van proved unworkable. Continuous flow of numerous personnel, with differing objectives, in the single van resulted in some inefficiency. Rest/recreation activities were moved outside. The sunny, hot weather enabled this option; however, in a different climate, two separate areas would be required.

Recommendation: Plan and configure future operations with separate vans in mind.

6-5 Fender Systems

Lesson Learned: The 10’ x 50’ inflatable fenders worked well; however, forward and aft securing lines unwound and broke strands on the three-strand line. Lines had to be replaced on the forward end of the fender due to this unwinding, as the fender spun due to vessel or barge motion.

Recommendation: Use only double-braid line and a swivel on the fender mooring lines.

Lesson Learned: The single shop vacuum from the shop van deflated the fender more rapidly than two eductors and was much quieter. A pair of shop vacuums would probably reduce deflation times by half.

Recommendation: Consider adding vacuums to the system or, at a minimum, fabricating adaptors that would easily connect to the shop vacuums in the support systems.

6-6 Pumps

Lesson Learned: The 4-inch Hydratech pump performed admirably in most respects. However, excessive back pressure in the return line caused an internal hydraulic leak. Hydraulic oil consumption was approximately 500 gallons during the course of pumping 1.8 million gallons of *Mississinewa* oil. In talking with the manufacturer, it was determined that installing a separate case drain instead of plumbing the case drain into the return line would alleviate the problem. The manufacturer also recommended installing a Viton motor seal to replace the PTFE seal and replacing the discharge camlock with a U.S.-manufactured one.

Recommendation: Add the case drain and update the motor seal on all of these pumps.

Lesson Learned: Not all of the camlock fittings procured were very compatible, even though they were of the same size. It appears that the camlocks from foreign sources were just different enough in size to cause a weep under high pressure at the O-ring seal. This weep was remedied on the spot by cutting and inserting a thin, 1/16” gasket in addition to the normal gasket, which tightened the joint sufficiently to stop any weeping.

Recommendation: Replace the foreign camlock fittings on all of these pumps.

Lesson Learned: The mating of foreign and U.S. camlock fittings proved to be a small problem. It appears that the slight difference in size, perhaps caused by the metric/U.S. conversion, is enough to cause minor leaks. This was fixed on-scene by inserting a thin, 1/16-inch gasket behind the main gasket.

Recommendation: Use only U.S. camlock fittings when possible. Bring a gasket cutter and thin rubber to correct mismatches in foreign and remote operations. Always pressure-test the hose system with air or water and dye to ensure compatibility and integrity within the completed hose system.

Lesson Learned: The donut pump worked well in that the sea-surface positioning resulted in less hydraulic hose going to the bottom, as well as complete control within sight of the surface. While its efficiency was less than that of a bottom pump, it was particularly effective in small tanks and in stripping operations. The donut pump would benefit from a hose support on the top, so that both the discharge hose and hydraulic hoses would have a fairlead and support before running to the surface. In addition, hose floats on the suction side would enable the donut pump to float higher, with longer sections of suction hose attached.

Recommendation: Modify the donut pump to include a hose support tripod at the top and a hose float system.

6-7 Hot Tap System

Lesson Learned: This was the first oil operation for the new lightweight hot tap system. By all accounts, its performance was outstanding. Flange attachment and hot tapping were both in the 15-minute range through a 7/8-inch hull plate. None of the flange-to-hull seals leaked and no drill bits or cutters broke in the 20 hot taps accomplished.

Recommendation: Based on the success of the operation, configure the lightweight hot tap system as a full system and develop a training manual for its use.

Lesson Learned: Hot tap 4-inch valves were bought from two different suppliers, based on a small cost differential. The less expensive valve was of inferior quality, size and construction. This resulted in not only a valve sealing problem but also in the drill bit's interfering with valve closing. McMaster-Carr valves worked perfectly and sealed completely.

Recommendation: Standardize the 4-inch hot tap configuration and specify the McMaster-Carr valves, with no substitutions allowed.

Lesson Learned: Small zincs were added to all of the hot tap valves. After 2 to 3 weeks on the bottom, these zincs were essentially wasted. The valves, however, were in good, reusable condition.

Recommendation: Zincs work and need to be part of all fittings used underwater.

Lesson Learned: Flanges were attached using a Stanley DL 9 hydraulic drill, powered by the Mod 9 HPU. This HPU worked well, but was extremely noisy. The pumps were powered by the Mod 10 electric HPU, which was both efficient and quiet.

Recommendation: Procure a small electric HPU (12 to 15 gpm, 2,000 psi) to run off ship's power.

Lesson Learned: The blind-drilling, self-tapping bolt flange attachment method worked fine. It was lightweight and fast, and resulted in a tight seal, even when the tank was filled with air.

Recommendation: Standardize the lightweight hot tap system and configure with appropriate drawings and specifications.

Lesson Learned: The Stanley DL 9 drill could accidentally be put into reverse by simply setting it down or accidentally hitting the push-pull pin. In reverse or when mounted to the hot tap with the cutter engaged in the metal, the teeth on the cutter were instantly ruined. Fortunately, this lesson was learned in the training session, and a temporary fix was implemented before the operation.

Recommendation: A positive lockout is necessary. For the operation, a rubber bumper and a wire tie served the purpose.

Lesson Learned: The hot tap hole in the hull was closed using a double-cap method, with a 3/4-inch galvanized bolt through the middle. The flange gasket served as the sealing point for the outer diameter, and a small gasket was put under the tamper-proof sealing nut and coated with epoxy. All units sealed well; however, consideration should be given to a composite bolt assembly that would minimize the chances of galvanic corrosion around the threads.

Recommendation: Research composite materials for this application.

6-8 Hoses

Lesson Learned: New product discharge hoses, tested by the supplier, leaked at the hose-to-fitting banding at a fraction of test pressure. These hoses had to be recovered from the bottom and re-banded. To test the in-water system, dye was released in the pump inlet and back pressure applied via a valve at the discharge end of the system. A diver could readily see any leaks.

Recommendation: Regardless of hose test certification, always test the system before pumping oil. When possible, the test should be done before deploying the fully configured system. If that scenario is not feasible, the in-water dye method is effective.

Lesson Learned: Once the oil reached the surface, the distribution system involved a complex network of hoses and manifolds laid out over both barges. The result was a spaghetti-like array of hoses, manifolds and valves feeding two or three of the 20-plus barge manholes at a time. Tank changes were accomplished by moving the hoses to the next tank to be filled. In order to keep the barge in trim, the hose moves could cover a distance as great as 300 feet. Manifold systems provided were of such poor design that they resulted in excessive back pressure, reducing pump efficiency to the point where the manifolds essentially were removed from the system, and a manifold originally intended as a monitoring station was substituted.

Recommendation: On vessels not equipped with internal distribution systems, more attention is required to the construction of a supporting mobile distribution system. Manifolds need to be of a "Y" design as opposed to "T" designs. Valves need to be of the full port design, as opposed to the butterfly configuration. Drop pipes need to be lightweight and easy to handle. The system needs to incorporate a simple valve alignment to switch from slops to different fuel types without shutdown and manual reconfiguration.

6-9 Survey

Lesson Learned: In January to February 2002, a leak was repaired in *Mississinewa'*s number 4 port and starboard wing tanks. During this repair, a survey was conducted on a representative sampling of the remaining tanks. These tanks were surveyed by drilling 9/32-inch holes into the hull at approximately the 2/3-tank level. The survey confirmed the presence and type of oil and hull thickness. From this information, the tools and estimated quantities of oil remaining were developed.

Recommendation: The survey provided valuable information that enhanced overall operational efficiency. Surveys should be incorporated into all such operations when conditions allow.

6-10 Tool Development

Lesson Learned: Tools and pumping systems were developed that suited the mission with an emphasis on being simple, lightweight and easily handled by the divers. These tools were tested on mock hull sections and further verified in in-water training sessions.

Recommendation: The tools and pumping systems were ideally suited for the job. Their weight and maneuverability by a two-man dive team provided the flexibility to keep the operation moving. A balanced approach to fielding systems integrates human and mechanical elements. While larger hoses and pumps might have had greater throughput, time and effort required to install or reposition would have actually slowed the operation.

6-11 Training

Lesson Learned: Diver training was conducted in Hawaii about six weeks before the operation. This training served to both familiarize divers with the tools and identify potential tool and procedural problems that could be corrected before the operation. The training session was a sound investment.

Recommendation: Training is essential for all operations and contributed immeasurably to a smooth, efficient hot tap operation. Incorporate training into all future operations to the extent possible.

6-12 Models

Lesson Learned: The 3-D computer model served to graphically portray the vessel in briefings, etc.; however, the scale model is best suited to briefing operational personnel on placement of hot taps, pumping systems, etc. Only the main hull section scale model was built; we should also have built the bow and after sections as diver orientation aids.

Recommendation: Future operations should have both the 3-D graphics and scale models of the vessel for orientation purposes.

THIS PAGE INTENTIONALLY LEFT BLANK

CHAPTER 7

7 CONCLUSION

As a result of the month-long (on-scene) *Mississinewa* project, nearly two million gallons of oil were successfully removed from the wreck, with only an occasional, minor sheen on the water and no apparent adverse effects on the surrounding environment.

Yap government officials and the general population were highly appreciative of the efforts of the U.S., particularly the U.S. Navy, to remove the oil, as noted in Yap State Resolution No. 6-19 in April, 2003 (see Section 8-4).

A detailed survey of the vessel and a subsequent reasonable amount of time to develop the operations plan and the proper tools for the job, coupled with the ability to modify planned approaches in the field, contributed to a successful outcome.

U.S. Navy Fleet and contractor personnel worked effectively together under a command structure that assigned tasks based on which organization was most experienced or otherwise best-equipped to do it. For example, the mooring system was conceived and executed by contractor personnel who deploy anchors as part of their daily routine, and U.S. Navy divers were assigned underwater tasks based on their relative competency in the skills required for those tasks.

The *Mississinewa* project demonstrated that with proper planning, effective communications, enlightened leadership, and commitment to a common goal throughout the chain of command, limiting factors such as a long and difficult logistics trail and the necessity of mobilizing equipment, personnel and other assets from multiple countries can all be overcome and result in a successful mission.

Despite the level of pre-planning, equipment failure and unforeseen obstacles should be expected in open-ocean operations. Flexibility of approach, mutual deference to participants' respective strengths, and use of proven tool technology all contributed to achieving the desired result.

U.S. Navy Fleet and SUPSALV resources – vessels, personnel and specialized tools – are routinely mobilized worldwide. When demands of scheduling or logistics dictate, local charters can be effectively integrated into organic U.S. Navy assets to accomplish the mission. The *Mississinewa* project showcased the effective coordination of resources from multiple sources to successfully remove the threat of long-term pollution to an island community and economy.

All participating U.S. Navy Fleet, SUPSALV, contractor, and subcontractor personnel and equipment performed in an outstanding manner, under the exceptional leadership of the U.S. Navy On-Scene Commander (OSC), LCDR John Carter, Commanding Officer, *Salvor*. However, we must guard against this success breeding overconfidence as we approach future submerged vessel oil offloading operations. Except for her remote location and resultant logistics challenges, *Mississinewa* could not have presented a more benign scenario for the U.S. Navy's first operation of this kind. Deeper, colder, lower-visibility water, more viscous oil, higher currents and sea states, deteriorated hull, unfavorable vessel attitude, etc., could have resulted in a much less favorable outcome. The next operation will present a new set of challenges to be acknowledged and overcome, but a well-equipped team and continued emphasis on detailed mission planning will result in continued U.S. Navy salvage successes.

CHAPTER 8

8 ATTACHMENTS

8-1 Predicted Vs. Recovered Oil Quantities

Table 8-1. Estimated Tank Content vs. Actual Tank Content

Tank/Compt. Fwd to Aft	20 Nov 1944 Cargo Loaded	Gallons Quantity	Maximum Initial Assumption	Tank Drilling Feb 2002	Maximum Revised Estimate	Actual Pumped Volume
4 S 4" Valve						**1,000**
5S	NSFO	234,969	234,969	½ full	117,485	**88,164**
5P	NSFO	234,969	234,969	no oil	0	
5C	NSFO	370,724	370,724		370,724	**125,366**
6S	SW Ballast	SWB	empty	no oil	0	
6P	SW Ballast	SWB	empty		0	
6C	Diesel Oil	378,084	378,084		378,084	**273,388**
7S	NSFO	175,742	175,742	has oil	175,742	**188,084**
7P	NSFO	175,742	175,742		175,742	**159,246**
7C	NSFO	370,581	370,581		370,581	**360,493**
8S	NSFO	166,886	166,886	has oil	166,886	**86,568**
8P	NSFO	166,886	166,886		166,886	**48,088**
8C	NSFO	374,456	374,456		374,456	**193,919**
9S	NSFO	143,630	143,630	no oil	0	**42,824**
9P	NSFO	143,630	143,630		143,630	**55,213**
9C	None	0	empty		0	**124,435**
ER-FO Tk-S	NSFO	73,341	73,341		73,341	**106,455**
ER-FO Tk-P	NSFO	73,341	73,341		73,341	**72,503**
ER-FO Tk-C	NSFO	163,011	163,011		163,011	**0**
ER-DB Tk-S	NSFO	11,623	11,623		11,623	**0**
ER-DB Tk-P	NSFO	11,623	11,623		11,623	**0**
LO-Tk-P	LO	2,604	2,604		2,604	
LO-Tk-Sump	Unkn	0	empty		0	**0**
Pump Room						**23,133**
		3,271,842	**3,271,842**		**2,775,759**	***1,948,879**

* 1.95 million gallons includes approximately 0.15 million gallons of water. Oil content was approximately 1.8 million gallons.

8-2 *Salvor* SITREP, Final Report on Defueling of *Mississinewa*, February 26, 2003

```
From:        SUPSALVMESSAGES NSSC
Sent:        Wednesday, February 26, 2003 7:18 AM
To:          SUPSALV 2 NSSC; SUPSALV 3 NSSC; SUPSALV 4 NSSC; SUPSALV 5 NSSC; Asher
             Richard C NSSC; Buckingham Richard T NSSC; MessageArchive (E-mail);
             Hopson Karen B NSSC
Subject:     FW: USS SALVOR 262100Z FEB 03 R FINAL REPORT DEFUELING OF > PUBLIC VESSEL
             MISSISSINEWA//

From:        DMDS Profiler
Sent:        Wednesday, February 26, 2003 7:18:16 AM
To:          DMPS 00C; DMPS 00; DMPS 09AOSH
Cc:          DMPS 00R; DMPS 09A; DMPS 5D4MED; DMPS 00D; DMPS PMS308; DMPS  04A; DMPS
             PMS395
Subject:     DMS:USS SALVOR 262100Z FEB 03 R FINAL REPORT DEFUELING OF PUBLIC VESSEL
             MISSISSINEWA//

             RATUZYUW RHVDLNB5092 0572100-UUUU--RULSSEA.
             ZNR UUUUU ZUI RHHMMCB0628 0571144
             R 262100Z FEB 03 ZYB PSN 059564M29
             FM USS SALVOR
             TO RUSICWP/CTF 73

             PAGE 02 RHVDLNB5092 UNCLAS
             BT
             UNCLAS
             MSGID/GENADMIN/SALVOR/026//
             SUBJ/FINAL REPORT DEFUELING OF PUBLIC VESSEL MISSISSINEWA//
             REF/A/DOC/COMSEVENTHFLT/01MAR1998//
             AMPN/REF A IS C7F OPORD 201.//
             POC/SHONING/LT-OPS/SALVOR/-/E-MAIL:SHONINGP SALVOR.NAVY.MIL//
             RMKS/
             1. GENERAL SITUATION AS OF 26 1900(L) FEB 2003
                    A. UNITS ON SCENE:
                           1. NAVSEA 00C DET
                           2. SEACOR ROVER
                           3. PRIMARY SUPPORT BARGE
                           4. SECONDARY SUPPORT BARGE
                           5. JAYA MARLIN
                    B. WEATHER OBSERVED:
                           1. TEMP:  85 F
                           2. WINDS: EASTERLY AT 25 KTS

             PAGE 03 RHVDLNB5092 UNCLAS
                           3. SEAS: 4 FT
                           4. CLOUDS: PARTLY CLOUDY.
                           5. VISIBILITY: UNRESTRICTED.
             2. OPERATIONS
                    A. DIVE TOTALS
                           1. MK 21: 147 DIVES, 9489 MIN TOTAL BOTTOM TIME
                           2. SCUBA: 66 DIVES, 1448 MIN TOTAL BOTTOM TIME
                    B. TASKS COMPLETED:
                           1. SALVOR DEPARTED ULITHI ATOLL 0900 (L).
                    C. TANK STATUS:
                           1. PRIORITY I AND II TANKS:
                                  A. TOTAL TANKS: 10
                                  B. TANKS HOT-TAPPED: 10
                                  C. TANKS PUMPED: 10
                                  D. TANKS STRIPPED: 10
                                  E. TANKS CLOSED-OUT: 10
                                  F. PERCENT COMPLETE: 100 PERCENT
                           2. PRIORITY III TANKS
                                  A. TOTAL TANKS: 4
                                  B. TANKS HOT-TAPPED: 4

             PAGE 04 RHVDLNB5092 UNCLAS
                                  C. TANKS PUMPED: 4
                                  D. TANKS STRIPPED: 4
```

```
                    E. TANKS CLOSED-OUT: 4
                    F. PERCENT COMPLETE: 100 PERCENT
             3. PRIORITY IV TANKS
                    A. TOTAL TANKS: 6
                    B. TANKS HOT-TAPPED: 6
                    C. TANKS PUMPED: 6
                    D. TANKS STRIPPED: 6
                    E. TANKS CLOSED-OUT: 6
                    F. PERCENT COMPLETE: 100 PERCENT
      D. ESTIMATED GALLONS PUMPED:
             1. TOTAL: 1,948,000 GAL
      E. PROBLEMS ENCOUNTERED: NTR
      F. FUTURE INTENTIONS:
             1. SALVOR ENROUT GUAM.
             2. AFTER PULLING 6-PT MOOR, CONTRACTED VESSELS WILL RETURN
             TO SINGAPORE FOR FINAL DEMOBILIZATION OF NAVSEA EQUIPMENT.
      G. OVERALL PROJECT STATUS: AHEAD OF SCHEDULE
      H. ESTIMATED COMPLETION DATE: 28 FEB 03

PAGE 05 RHVDLNB5092 UNCLAS
3. ENVIRONMENTAL:
      A. OIL RELEASED: NTR.
      B. MEASURES TAKEN: NONE.
      C. ENVIRONMENTAL IMPACT: NONE.
4. PUBLIC AFFAIRS: NTR.
5. COMMENTS:
      A. OTC:
             1. ALL ON-SCENE NAVY OPERATIONS ARE COMPLETE.  THIS IS THE
             FINAL SALVAGE REPORT FOR THE DEFUELING OPERATION.
             2. CONTRACTED VESSELS WILL RETURN TO SINGAPORE FOR THE FINAL
             DEMOBILIZATION OF NAVSEA EQUIPMENT.
             3. THANKS TO THE SUSTAINED SUPERIOR EFFORT AND INGENUITY OF
             ALL  HANDS INVOLVED, THE DEFUELING TEAM COMPLETED 213 DIVES,
             ACCESSED 22 TANKS, PLACED 19 HOT-TAPS, CUT AND WELDED CLOSED
             2 ACCESS HOLES, AND > RECOVERED 1.95 MILLION GALLONS OF OIL.
             THE OPERATION WAS COMPLETED SAFELY AND 30 PERCENT FASTER
             THAN EXPECTED.
      B. MODIVSALU ONE DET FIVE OIC: NTR
      C. NAVSEA OIC: NTR.//
BT
#5092
NNNN

ACTION:
DMPS 09AOSH
DMPS 00
DMPS 00C
```

8-3 Summary Log of Significant SUPSALV/GPC Events

Tuesday 1/28/03

- 1230 – To COMNAVMARIANAS with LT Shoning (*Salvor* Ops). Met with CDR Ben Fegurer and others, Supply department, COMNAVMARIANAS. Jeff Anongos, logistics specialist, has contractor (Quality Distributors) POC for GPC/Seacor to arrange food delivery with *Salvor* deliveries via AFS. AFS delivery of contractor materials requires CTF-73 (CAPT Wagner) approval.
- 1300 – Briefed RADM Dunne (COMNAVMARIANAS) & staff with CO *Salvor*, Master Diver Nichols, etc.

Wednesday 1/29/03

- 0630 – CO 891 flight to Yap. Arrive 0800. Taxi to Governor's office.
- 0900 – Briefed Governor Ruecho, Jesse Raglmar-Subolmar, John Sohlith, etc.
- 1300 – PowerPoint presentation to a Yap spills task force. Met Sefanaia Nawadra, Marine Pollution Advisor for South Pacific Regional Environment Programme (SPREP). Arranged to have Yap customs officials fly to Falalop to clear contracted vessels vice sail vessels to Yap (GPC to charter plane).

Thursday 1/30/03

- ~1500 – Met with John Sohlith, 5 customs, quarantine, transportation officials, etc. to arrange for officials to fly to Falalop.

Friday 1/31/03

- En route to Ulithi on PMA flight. Arrived Ulithi ~ 1030.
- 1045 – Took a small boat to *Seacor Rover*. Commenced set up on barge. One mooring winch has broken fan belt. No spare parts. Rick Groen (Barge Master) reports swells at *Mississinewa* site excessive for safe mooring ops. Will check in AM.

Saturday 2/1/03

- 0700 – *Seacor Rover* underway to *Mississinewa* site. Swells marginal after 22- to 25-knot winds all night. *Salvor* and *Jaya Marlin* with barge *Fels* 21 arrived Ulithi and entered the atoll. Asked *Salvor* to pick up Yap customs agents and deliver them to *Jaya Marlin* and *Seacor Rover* later when those vessels are ready to receive. *Salvor's* RHIB to pick up. *Seacor Rover* is alongside *Fels* 20 for rigging and maneuvering to drop anchors.
- 1415 – Released S-1 crown buoy.
- 1420 – Dropped S-3 anchor (starboard after on *Fels* 20).
- 1505 – Dropped S-1 anchor (starboard forward on *Fels* 20).
- ~1700 – Yap customs and CO *Salvor* aboard *Seacor Rover* from *Salvor* 1 (RHIB). Deployed anchors S-3, S-1, S-2, P-1 in that order. Secured mooring operations due to darkness with *Fels* 20 in 4-point moor.
- 1930 – *Seacor Rover* anchored in the vicinity of *Fels* 20 with *Salvor* anchored about 1 mile north and *Jaya Marlin* with *Fels* 21 anchored in the NE corner of the atoll. Will set anchors P-2 and P-3 tomorrow AM and bring *Salvor* alongside *Fels* 20 to starboard.

Sunday 2/2/03

- *Seacor Rover* is underway for *Fels* 20. Alongside rigging P-2. Anchors P-2, P-3 deployed in that order.
- 0940 – *Salvor* 1 alongside to pick up Ron and SUPSALVREP for Ulithi VIP reception on *Salvor*.
- ~1000 – Villagers from all inhabited islands are aboard *Salvor* for reception on bridge. John Sohlith (on-scene Yap representative) is also on board and will return to *Seacor Rover* with us.
- 1208 – P-3 on bottom. *Fels* 20 in 6-point moor over *Mississinewa*. All anchors right on!
- 1330 – *Seacor Rover* standing off as *Fels* 20 is positioned in moor directly over *Mississinewa*. Ends up with yellow (*Mississinewa* bow) buoy directly under starboard bow of *Fels* 20 and white (*Mississinewa* stern) buoy about 20 feet off the center of *Fels* 20's stern.
- 1400 – Placed two fenders on *Fels* 20's starboard side.
- 1500 – *Salvor* is underway.
- 1530 – *Salvor* is moored alongside *Fels* 20.

Monday 2/3/03

- 0630 – *Seacor Rover* is underway for *Fels* 20.
- ~0700 – *Seacor Rover* is alongside. *Salvor* is still alongside and riding well – less motion than *Seacor Rover* (*Seacor Rover* is half her displacement). Ron held briefing on *Seacor Rover*. The plan this AM is to offload *Salvor*'s fantail and launch the debris boat for a run to the beach to pick up the remainder of the GPC crew flying in from Yap. The oil containment boom and two boats (debris and Zodiac) will likely be kept on *Seacor Rover*'s fantail for launch by ship's crane when needed. Spent the day working with *Salvor* to offload her fantail, break out remaining equipment from the vans and set up the barge for operations.
- ~1200 – The debris boat is back with eight GPC crew arriving from Yap. Finished rigging the CHT system on *Fels* 20. Shifted the 23-foot Zodiac, dispersant systems and boom to *Seacor Rover*'s after deck.
- 1800 – Secured on barge.
- 1900 – Ron, Rick, Paul and SUPSALV Representative to *Salvor* for meeting with CO, Shoning, Cassels, MDV, etc. The plan for tomorrow is to shift *Fels* 20 by 100 feet to port, shift *Seacor Rover* to moor stern to *Fels* 20, finish offloading and set up *Salvor*'s fantail with diving, hot tapping, & pumping gear. Plan to splash divers at 1300.

Tuesday 2/4/03

- *Salvor* and *Seacor Rover* alongside *Fels* 20.
- 0745 – Broke a hydraulic line on the crane. Cleaned up the spill. Replaced two hydraulic lines with spares from ESSM.
- 0800 – Transported the Executive Officer (XO) and his crew to Mangejang Island to start construction of the *Mississinewa* memorial.
- 1000 – The crane is back on-line. There was some delay in moving *Fels* 20 pending the crane boom being put in the cradle.

- ~1100 – The crane is secure. *Seacor Rover* is repositioning anchor S-3. Repositioning *Fels* 20.
- ~1300 – *Fels* 20 is in position for the first dive. CO reports *Salvor* complement: 13 MDSU, 2 EOD Guam, and 92 *Salvor* for a total of 107 mustered. SUPSALV complement is 1 SUPSALV Rep, 1 Yap Rep, 15 GPC, 20 *Seacor Rover*/*Fels* 20, 12 *Jaya Marlin* for a total of 49. (Total personnel on-scene is 156.)
- 1448 – Divers are in the water. They are on *Mississinewa*'s bottom in 90 feet of water and in the vicinity of tank 5. This was a 20-minute first dive. During the second dive, the divers positioned a partial grid and started cleaning the hull for hot tap in 5-S.
- 1900 – Briefing with OSC. The plan is to continue cleaning, position the manifold on the bilge keel, rig the hoses, and make all pumping preparations topside before hot tapping. *Seacor Rover* is making up stern to *Fels* 20. Moored stern to *Fels* 20.
- 2000 – Secured.

Wednesday 2/5/03

- 0700 – Get to work. Having *Seacor Rover*'s stern to *Fels* 20 does not allow leaving the brow over. Too rough. Divers are putting the hose manifold on the bottom. Inflated and launched boom, and secured to S-3 crown buoy. Ron, Jon and I discussed what the spill response options would be without *Salvor*'s RHIB. Placed two fenders on the port side of *Fels* 20. The ESSM debris boat made three runs to Mangejang Island delivering memorial materials.
- 1600 – *Fels* 21 is alongside *Fels* 20 with a second set of fenders between.
- 1900 – Meeting: Tomorrow we will move the pump to bottom (vice donut pump) and test for leaks prior to hot tapping 5-S. Secured flanges to 6-C. Checked #4 tanks for oil leaks since last year. Ambassador Dinger (or Tom Hushek) is due Friday. Discussed dumping garbage (fish food) from *Fels* 20 but decided not to due to shark attraction. John Sohlith had told Ron it would be OK today with Yap government.

Thursday 2/6/03

- ~0730 – Ron reported that *Salvor*'s diver's air system was down due to a cracked fitting on HP air line (chamber and scuba charging are OK). (The XO is to carry the part to Guam for repair/replacement – ETR is 1 week). Moved the pump monitoring manifold to *Fels* 20 and placed the Fly-Away Recompression Chamber (FARC) system on *Salvor*'s fantail to support diving. Rigging hoses on the barges and rigging the RHIB Lori brush skimmer system on *Fels* 21. Repairing the trash compactor dropped yesterday while being moved by the crane. Placed the submersible pump on the bottom and tested the hose with dye marker. Re-banded a couple of leaking camlock fittings on the new hose (air tested by manufacturer to 150 psi. We air tested older ESSM hoses at CAX.) Ron will not allow hot tapping until hose tests OK. Pulled all hoses up on deck to conduct pressure tests (bled air from hose and dead-head to desired pressure for hose test). Checked for leaks. Divers recorded temperature gradient every three feet as follows:
    - 3 feet to 6 feet – 84°
    - 9 feet to 78 feet – 81°
    - 81 feet to 90 feet – 80°

- ~1200 – Sefanaia Nawadra (SPREP), PMA Pilot and three Yap EPA and Water Resources representatives came aboard by a small boat. Provided a tour, explained pumping system and Jon demonstrated RHIB/Lori system still on deck. Sefanaia gave us a copy of a *Mississinewa*/Ulithi modeling report produced by Asia-Pacific Applied Science Associates.
- 1325 – A hot tap cut through in 5-S in about 15 minutes.
- 1327 – Closed the hot tap and bled the valves. Disconnected the bleed hose – small oil burp.
- 1336 – Started pumping. The initial rate was about 350 gpm.
- 1555 – 39,403 gallons have been pumped. The gauge shows 274 gpm. The average since 1336 hours has been 286 gpm. The pumping rate is down to about 275 gpm. Discussed alternatives including the MPC 6-inch pump. Ron wants to try the donut pump in series with the pump on the bottom. Kevin suggested putting a second 4-inch pump on *Salvor*'s deck.
- 1800 – The flow rate is way down and the pressure is way up, which is unexplained. (We later determined that it is likely we were encountering a viscous layer of oil and water emulsion at the interface.)
- 1830 – Starting to get water. Secured pumping to allow settling (migration of oil remaining in tank to top for stripping).
- 1900 – Meeting: Divers searched, video taped and found no oil in #4 tanks (open to the sea). The plan is to continue pumping 5-S, and strip tonight and tomorrow. We will hot tap 5-C and pump tomorrow. Ron will rig pumps in series on the deck to increase the flow. Divers will clean shell plating on tanks 6-C through 9-C for hot tapping.

Friday 2/7/03

- Re-rig the second 4-inch pump on *Salvor*'s after deck. Divers are hot tapping 5-C.
- ~1030 – Pumping 5-C at 530 gpm and 30 psi. Improved flow with the second pump.
- ~1035 – HPU tripped off-line.
- 1040 – HPU is back on-line. Coming up slower.
- 1052 – Black oil on surface. Shut down pumping. RHIB is investigating. Scuba divers are getting ready to check. Found a leak at the pump discharge camlock fitting. Tried using shims to tighten the camlocks. Had to also insert an additional thin gasket. The leak was eliminated. Jon took the RHIB to Towachi channel and back. Saw only thin brownish oil, a little thicker than a sheen. Nothing recoverable.
- 1555 – Still pumping 5-C. 70,400 gallons have been pumped, now at 410 gpm and 28 psi.
- 1616 – Shutting down pumping. Have lost hydraulic fluid – noticed at HPU. Will check for blown seals, etc. Divers could not find a leak. Continued pumping. Do not seem to be losing additional fluid.
- 1710 – Pumping water. 101, 995 gallons were pumped from 5-C. Have shut down for settling.
- 1830 – Pumped additional oil, a total of 103,000 gallons from 5-C.
- 1900 – Four dives today. Tapped and pumped 5-C. Extended the grid. Tomorrow we will continue to strip 5-C, tap and pump 6-C, mark and clean 7-P, 7-C, and 7-S, and put

flanges on 7-C and 7-S. Started rigging for a second pumping system topside (using the donut pump).

Saturday 2/8/03

- 0730 – Stripping 5-C.
- 0800 – Secured pumping after alternately getting heavy oil and mostly water. Rigging second pumping system topside.
- 0945 – Divers hot tapped through hull, but apparently are hanging up. Determined that the pilot drill extends too far and the ball valve cannot close. Managed to close the valve and remove the hot tap, but test pumping at 1,000 psi on HPU yields only 40 gpm through the oil-monitoring manifold.
- 1000 – Tom Hushek and Islanders are on *Salvor* for the *Mississinewa* ceremony.
- 1100 – The *Salvor* chamber O_2 dump system is down. Have to do continuous venting. Secured from diving.
- 1330 – Divers have removed the hot tap and rigged a pump. (Divers are doing no-decompression dives). Tried pumping – very reduced flow (about 40 gpm at 1,000 rpm on the HPU). Shutting down. Divers are down with the hammer-ram (Bung Buster) tool. Cleared the obstruction with the second blow of sledge hammer on Bung Buster.
- 1440 – Pumping. Slowly bringing up the flow rate. Up to 485 gpm at 3,000 psi and 22 gpm on HPU. Pumping <u>black</u> diesel. Tank drawings indicate the #6 tank center contained diesel. Divers are back down cleaning the hot tap area for 7-C.
- 1900 – Meeting: OSC raised the issue of communication control on the diving side. Too many people were talking to the diving supervisor when he was trying to solve the hot tap problem today. Communicate to the diving supervisor through the Master Diver only. We will pump 6-C tonight until it is empty. Tomorrow, we will swap out the bottom pump to check for an internal hydraulic fluid leak. Then we will place a flange on 7-C (a flange is already on 7-S). We will hot tap and pump 7-C, then rig the donut pump on 7-S as time and conditions permit. Then we will continue prepping for hot taps on 7-P and the 8s.

Sunday 2/9/03

- 0138 – Secured pumping on 6-C. 265,000 gallons were pumped after a couple of short settlings and strippings.
- 0430 – *Seacor Rover*'s main engines lit off. Two 28-mm (2 1/4-inch) mooring wires in the towing pins chafed through and were about to part. Brought in the brow and slacked off the mooring lines between *Seacor Rover* and *Fels* 20.
- 0730 – Exciting transfer of GPC crew from *Seacor Rover* to *Fels* 20 with jury-rigged brow set just for quick transfer. Rick is working on alternate solutions. Stripped 6-C. Pumped approximately 2,000 gallons of brown emulsion. Divers are swapping out the bottom pump.

Monday 2/10/03

- Transferred the day and night crews between *Seacor Rover* and *Fels* 20 by Zodiac and Jacobs ladder. Night crew (Jeff Cane) reported that 355,000 gallons were pumped from 7-C before shutting down. The office van generator shut down. It is apparently sucking air. Mark later found that the main fuel filter was clogged. Changed it out. Back on-line.

- 0730 – Divers disconnected the pump and brought the whole system on deck to check for hydraulic leaks. The system was pressurized to 3,000 psi. No leaks were discovered; it must be internal to the pump(s). Ron will discuss this with the pump manufacturer tomorrow. We have expended about 100 gallons of hydraulic fluid to date. We have one 55-gallon drum left, having used one drum on the crane following the hydraulic hose failure earlier in the operation. *Seacor Rover* has 500 gallons of hydraulic fluid on board and can provide that if we need it.
- 0930 – 8-C is hot tapped. Started pumping. Alternately getting slugs of air and oil. A large bubble of air in the hose lifted "everything off the bottom" and caused an excessive oil flow rate into *Fels* 21's tank. Shut down.
- 1000 – Started pumping 8-C again. The flow meter is not registering. Apparently, it was damaged by the air surge.
- 1020 – Oil flow has averaged 200 gpm since 1000 by Ullage readings in *Fels* 21. The flow meter is not working. Coming up to 2,800 psi on HPU. Should get about 350 gpm.
- 1200 – Rigging the donut pump. It leaked black oil when it was lit off. European pump and American hose camlocks are not completely compatible. Had to cut an additional thin gasket.
- 1300 – Donut pump stripping on 5-S pumped about 1,500 gallons before getting mostly water.
- 1400 – 76,000 gallons on 8-C so far. Continued pumping.
- 1425 – Divers have shifted the donut pump to 5-C and stripping has started.
- 1512 – Divers started hot tapping 7-S.
- 1534 – Completed the hot tap.
- 1540 – Still stripping 5-C. Pumped about 9,000 gallons of mostly oil.
- 1547 – Securing the pump on 5-C. Shifting the donut pump to 7-S to pump all night (with the stripping pump).
- 1648 – Started pumping 7-S.
- 1651 – Getting oil at 150 gpm.
- 2030 – Completed pumping 8-C; 184,760 gallons pumped.

Tuesday 2/11/03

- ~0800 – Completed pumping 7-S. Pumped 184,000 gallons. During the first dive, divers hot tapped 7-P. No flow. Deployed a "Bung Banger" and cleared an opening with the second blow. Stripped 6-C; 1,000 gallons, but little oil.
- 1129 – Stripped 6-C again. All water. Declared victory; will cap.
- 1340 – Stripped 5-S. Pumped 1,000 gallons. No oil. Declared victory; will cap.
- 1230 – Pumping 7-P. Stripping 5-C; 2,500 gallons. Mostly oil. Will strip again. Flanged 8-P and 8-S. Preparing #9 tanks for flanges. During the next dive, we will cap 5-S and 6-C.
- 1430 – Craig reports average of about 3 percent water in all *Fels* 21's tanks.
- 1545 – Putting caps on 5-S and 6-C. A small amount of oil was lost when the wooden plug was removed.
- 1830 – Hot tapped 8-P.

- 1840 – Opened the valves. Lots of air. The night crew is taking over.
- 1950 – Finished pumping 7-P. 129,000 gallons (153,052 by Ullage; the meter is not reliable) were pumped. Pumped through a very viscous layer (emulsion?), then water. Secured pump. Pumped 1,303,000 gallons to-date. Tomorrow, the plan is to hot tap and pump 8-S, place flanges for #9 tanks, hot tap 9-P, and continue stripping tanks that were previously pumped but not closed out. Time permitting, we will prepare double bottom bunker tanks for hot tapping, and drill into 9-C and the pump room to ensure they are free of oil. Discussed access to after center bunker tank.

Wednesday 2/12/03

- The night crew finished pumping 8-P. (At 1830 on the 11th) – 42,845 gallons (by Ullage). Needs stripping.
- 0730 – Called CAPT Wilkins (SUPSALV). Bravo Zulu (BZ, i.e., good job) on job-to-date. Passed this on to the crew. Discussed safety issues and corporate liability. Four (4) nuts that were holding the donut pump in the tire backed off; bolts and pump separated. Fixed the pump and re-deployed it.
- 0915 – Hot tapped 8-S.
- 0925 – Pumping 8-S.
- 1100 – Stripping 5-C again. Pumped 3,000 gallons, mostly oil.
- 1220 – Bob Cassels (MDSU-1) reports the divers are standing down. Had to run treatment table 5 due to omitted decompression when one diver could not clear in the chamber. He did not get to 50 feet soon enough. The CO decided that everyone needs a break. Good idea. We will continue pumping the current tanks and then stand down the GPC crew.
- 1345 – Secured pumping 8-S. Getting water. Pumped 71,196 by meter (74,060 by Ullage). Stripping 5-C again. Pumped oil, emulsion and water; got 800 gallons by meter.
- 1530 – Meeting: Pumped 162,000 gallons today. The total is now 1,465,000 gallons. Tomorrow, the plan is to hot tap and pump 9-P. Drilled 9-C to check for oil, stripped 5-C again. Stripped #7 tanks and placed flanges on the double bottom tanks.

Thursday 2/13/03

- Ron's Briefing.
- 0700 – Turn to. Bob Cassels reports that the supply ship now is due on the 20th. Ron discussed pump problems with Hydratech.
- 0741 to 0820 – Stripped 8-S. Pumped 2,800 gallons.
- 0758 to 0815 – Stripped 5-C. Pumped 2,250 gallons.
- 0935 – Stripped 250 gallons from 8-S to clear the hose.
- ~1000 – The divers moved the pumping manifold 50 feet aft.
- 1145 to 1155 – Stripped 1,142 gallons from 5-C.
- 1210 – Hot tapped 9-P.
- 1230 – Pumping 9-P.
- 1440 – Placed a flange on 9-S.
- 1505 to 1515 – Stripped 2,000 gallons from 5-C.
- 1520 – Hot tapping SFO-S.

- 1540 – Getting water on 9-P. Pumped 29,425 gallons.
- 1617 – Stripping 9-P. Getting water, and then mixed fuel and water. Pumped 650 gallons.
- 1642 – SFO-S tapped.
- 1648 – Started pumping
- 1658 – Stripping 7-C. Getting water and a little oil.
- 1705 – Getting mostly water; securing. 1,000 gallons were pumped.
- 1900 – 40,000 gallons were pumped and we were still pumping at the time of the meeting.
- 1900 – The plans are to complete pumping SFO-S, tap SFO-P and the inner bottoms, continue stripping, and flange 9-C.

Friday 2/14/03

- 0700 – The night crew reports 85,000 gallons (~84,000 by barge Ullage) by 1900.
- 2100 – Stripped to 90,600 gallons and secured. Eric Kraan (Seacor Singapore) reported aboard *Fels* 20 from *Jaya Marlin*, back from a Yap run with hydraulic oil, barge spares, and some provisions.
- 0730 – Stripped 1,200 gallons from 7-C; mostly water.
- 0742 – Stripping FOT-S; 1,200 gallons, mostly water, some black water.
- 0917 – Stripping FOT-S; 800 gallons, mostly water.
- 1105 – Hot tapped FOT-P.
- 1110 – Pumping FOT-P.
- 1249 – Stripping 7-C; 800 gallons. All water with some black residue and flakes. Took a photo of a sorbent pad that had a sample poured over it. We will strip one more time and probably close out. Chris Etelmal and Joe Sinisi from Yap EPA arrived on *Fels* 20 by small boat from *Seacor Rover*. We provided them with a tour of *Fels* 20 and *Salvor*. They departed at approximately 1600. Sent current and temperature information to NOAA.
- 1505 to 1517 – Stripped FOT-P; mostly water. Pumped 1,690 gallons. Divers are mounting flanges on the double bottom tanks and 9-C, which are believed to be empty.
- 1558 – Hot tapped the port double bottom FO tank. Water only. No oil.
- 1615 – Hot tapping the starboard double bottom FO tank. It was empty also. Lots of air. No oil.
- 1720 – Early meeting tonight on *Fels* 20. Total oil/water pumped to date: 1.66 million gallons (1,662,295). Plans for tomorrow: Hot tap and pump 9-C (believed to be empty), strip and close out 7-C, strip 7-P, 7-S, and 8-C, hot tap 9-S and the pump room, and survey for access to the center fuel oil tank (aft). OSC changed the completion date to 7 March instead of 15 March because we are considered to be ahead of schedule and, in part, to eliminate the requirement for the Fleet to provide additional provisions as scheduled on 8 March.

Saturday 2/15/03

- 0720 – Stripping 7-C. I observed and photographed what appeared to be pure water from the sampling valve on *Fels* 21. Pumped 1,100 gallons. We will close out 7-C and cap it during the next dive.

- 0729 – Stripping 8-C. Pumped 1,500 gallons of mostly water.
- 0818 – Divers are shifting the donut pump to 7-S.
- 0823 – Stripping 1,200 gallons. Very little oil. Stripped an additional 1,100 gallons from 7-S. Decided to close it out. Jeff reports 40,000 gallons in CHT tank and holding.
- 0920 to 0926 – Stripping 8-C. Pumped 1,300 gallons, approximately 2 percent of which is oil.
- 1000 – Hot tapped 9-C. Getting lots of air.
- 1020 to 1029 – Stripping 7-P. Pumped 900 gallons. Started out all oil, but shifted to mostly water.
- 1202 – Started pumping 9-C (Captain's log reported empty). Not so!
- 1300 – Hot tapped 9-S. Gulping water and burping air.
- 1322 – The scuba divers are out of air. Securing 9-S before it is fully vented.
- 1350 – Divers are to cap the double bottom tanks. No oil was discovered when they were hot tapped. The scuba team is venting 9-S again. Ran out of bottom time again; more air. The hard-hat divers flanged the forward pump room. One bolthole penetrated the tank and revealed oil before it was secured. Preparing to hot tap.
- 1705 – Start pumping the forward pump room using the donut pump. Still pumping 9-C using the main pump. (Both pumps are going into the same tank on *Fels* 21.) Getting good oil from the pump room.
- 1722 – Hit water on 9-C. Shutting down at 100,000 gallons (99,843).
- 1748 – Hit water on the pump room. Shutting down. Estimate 6,500 gallons pumped.
- 1750 – Final dive to camlock cap 9-S. Have not completed bleeding the air in 9-S yet. Cancelled the night crew.

Sunday 2/16/03

- 0700 – The divers are starting an hour late today (0900).
- 0730 – Stripping the pump room and 9-C, still aligned since last night. Getting good oil from 9-C.
- 0815 – Secured. Pumped 4,044 gallons.
- 0744 – Securing pump room strip after getting 1,800 gallons. Will strip more.
- 0907 – Secured another strip on the pump room. Got 1,500 gallons.
- 0920 – Stripping 7-S again prior to close out. Pumped 2,365 gallons. Closed it out. Will cap it during the next dive, which occurs at 0935. Stripping 7-P.
- 0931 – Secured. Pumped 2,976 gallons. Stripping 7-P.
- 1005 – Secured. Pumped 2,318 gallons. Closed it out.
- 1030 – Secured stripping 9-C. Got 1,775 gallons.
- 1040 – Divers capped 7-P.
- 1050 – Stripping 8-C.
- 1054 – Stripping FOT-S. Still venting air from 9-S.
- 1100 – Secured stripping 8-C; pumped 1,890 gallons. Secured stripping FOT-S; pumped 1,428 gallons. Stripped FOT-S again.
- 1146 – Secured stripping FOT-S; pumped 601 gallons.
- 1148 – Stripped 8-C again. Got 849 gallons of water.
- 1315 – Capped 8-C.
- 1328 – Completed another strip on 8-S; got 1,358 gallons.

- 1514 – Secured on stripping FOT-S again; got 2,500 gallons.
- 1542 – Stripped 8-S again; got 2,045 gallons.
- 1700 – Stripping FOT-S again.
- 1706 – Completed stripping 1,398 gallons from FOT-S.
- 1720 – Completed stripping 1,432 gallons from 8-S (Today, capped 8-C, 7-S and 7-P.)

Monday 2/17/03 (Presidents Day)

- 0738 – Stripping 8-S.
- 0745 – Stripped 1,845 gallons. Needs another stripping.
- 0915 – Cleared air on 9-S and started pumping.
- In preparation for burning an access hole in FOT-S, Ron decided to put another hole as close to the top of FOT-S as possible, as we had previously discussed. At first, we planned to drill and place a magnet/hole over the drilled hole, sealed with monkey stuff or alternate sealant to prevent oil leaks. After some discussion, Ron decided it would be best to place another hot tap at the highest point (Chris's computer-generated cross sections gave us a better picture of the tank than before we placed the first hot tap in FOT-S.) We discussed this with the OSC, who felt that another hole was unnecessary based on his Master Divers' opinions, which were to cut at least 3 feet below the top of the tank because of potential vapors. I explained that the Masters might be right, although the Navy does not do much of this kind of work, but that the U/W C&W Manual indicates a danger of H2 and O2 bubbles spontaneously igniting. SUPSALV/GPC would feel more comfortable with another hole. The OSC will go along with it.
- 1020 – Stripped 1,410 gallons from 8-S.
- ~1300 – Divers started cutting access into FOT-S using Broco rods. Nearly continuous stripping on the highest hot tap using a 2-inch hose and the peristaltic pump (to get oil and vapor/O_2), and on the other hot tap to pump oil and water. To avoid putting oil and oxygen into *Fels* 21's tank, strippings are being pumped into the portable, open-top tank on *Fels* 21's deck and are being gravity-fed to *Fels* 21's tank.
- 1348 – Capped 8-S.
- 1413 – Stripping 8-P with the donut pump.
- 1422 – Stripped 1,376 gallons from 8-P.
- ~1500 – Completed the cuts. A diver entered FOT-S and drilled three vertical holes about three feet apart. No oil was detected in the center fuel oil tank. Also, it was later reported that the diver-cam showed FOT-S to be remarkably clean and relatively free of oil clingage to the tank walls.
- 1710 – Divers have moved the pumps. Now stripping 9-C and 9-S. Pumped 1.86 million gallons to-date. Tomorrow, the plan is to continue stripping 9-P, 9-C, and 9-S, and close out and cap FOT-P when it is considered clean. After confirming closeout of FOT-C, plan to weld a plate over the access hole that was cut.

Tuesday 2/18/03

- 0725 – Stripped 9-S. Pumped 706 gallons.
- 0728 – Stripped 9-C. Pumped 2,365 gallons of mostly water. There have been 18 hot taps to date (one per tank/pump room except FOT-C and two on FOT-S). Drilled only

one 2 3/8-inch water inlet in FOT-S with the boring tool to speed venting. Boring a hole could probably have accelerated the pumping of FOT-P, but the flow was adequate if a little slow. Divers welded a 2' x 3' x 3/8" plate over the access hole in FOT-S.

- 1330 – Completed stripping 9-C and 9-S. Will close it out. Scuba divers will move the main pump from 9-C to FOT-P, and the donut pump to 9-P.
- 1420 – Craig reports 109,400 gallons of free water on *Fels* 21, six percent of the total liquid.
- 1422 – Capped 9-C and 9-S. Shifting the main pump to 9-P and the donut pump to FOT-P.
- 1436 – Stripped 9-P. Pumped 3,350 gallons.
- 1513 – Stripped 9-P again. Pumped 2,611 gallons, all water. Closed out 9-P.
- ~1600 – The donut pump is now on 9-P. The tank we closed out was not 9-P. Trying to figure it out. We had pumping reports for 9-P and FOT-P reversed. We closed out FOT-P, not 9-P. Now pumping with the donut pump on 9-P and the main pump on 5-C. Tomorrow, the plan is to continue stripping, close out, and cap 5-C, pump room, and 9-P. Also plan to enter 4-S to remove the cap and pump the 4-inch pipe that was previously leaking. Then move to the bow section to check it and, if necessary, pump the four Reserve Fuel Oil/Ballast tanks. *Jaya Marlin* is to assist with transferring stores from *Kiska* to *Salvor* in the Ulithi Atoll anchorage.

Wednesday 2/19/03

- Lloyd forwarded an e-mail from Bob suggesting that FOT-C oil may be in the engine room. Ron and the engineers determining where to tap. I discussed this with the OSC on *Salvor* and prepared him for our proposal for his consideration. The OSC agrees. Stripping 5-C and 9-P. Closed out both before 0800. Moving the main pump to the strip pump room. The pump room was closed out by 0930. All three were capped.
- 1410 – Hot tapped into the engine room at frame 34, just above the double bottom tanks. Pumped pure water from the engine room. No oil. Drilled an additional hole three feet forward to be sure we were in the engine room. No oil! Recovered the bottom manifold and pumps for maintenance prior to moving. Need to replace a kinked section of hose on the main pump line. Pumped 1.95 million gallons to-date. Tomorrow will be a no-dive day. Plan to reposition *Fels* 20 to put *Salvor*'s dive station over the #4 tanks. Friday, the plan is to enter the #4 tanks, remove the flange and plug on the previously leaking pipe, and pump any accessible oil remaining. We should be able to move to the bow section by Saturday.

Thursday 2/20/03

- Today was a no-dive day to give the divers a break. Seacor repositioned *Fels* 20 in the moor to place *Salvor*'s dive station over the #4 tanks. Tomorrow, the plan is to enter the #4 tanks and remove any oil remaining in the previously leaking pipe. With no topside work to be done, GPC personnel also had time to go fishing or diving or beach walking. We had charcoal-grilled ahi for dinner. Everyone needed and enjoyed the break from the long 12-hour plus days every day since we arrived.

Friday 2/21/03

- Getting the 2-inch hose on the peristaltic pump ready to pass back down to the divers. The divers swam the wreck and found no caps leaking. (We had noticed drops of oil surfacing alongside *Seacor Rover* and were trying to determine the source.) The divers did not check the access hole cut in FOT-S. Passing the 2-inch hose to the divers for pumping in the pipe in 4-S.
- ~1040 – Took the blank flange off, top-bolted the flange with a valve, pulled the plug, and swung the valve flange into position, holding it with vice grips until other bolts could be secured. Now pumping through the open valve.
- 1100 – Pumped 600 gallons (an estimated 100 gallons of oil).
- 1122 – Stripped 400 gallons from the pipe. Secured.
- 1340 – Divers put the plug back in the 4-inch pipe and replaced the blank flange. Divers started placing navigation grid wires on the bow section's starboard side in preparation for positioning hot taps in two starboard (top) side tanks.
- 1622 – *Fels* 20 has been shifted over the bow section. Pumped 1,000 gallons today from the pipe in open tank 4-S. Estimate 100 gallons of pure oil. Tomorrow, the plan is to finish positioning the navigation grid, hot tap two starboard tanks in the bow section, and pump and strip as required. If no oil is discovered on the starboard side, or after pumping and stripping the starboard tanks, the divers will cut an access hole into the starboard tanks to reach from the centerline bulkhead into the port side tanks. Plan to drill into the high points of the port side tanks to check for oil. If oil is detected, will hot tap these tanks, pump, and strip. The number of days required to close out the four bow section tanks will depend on the presence/volume of oil encountered. PH1 Vann from Combat Camera will leave the site on Monday. Seacor's Eric Kraan departed for Singapore with oil samples to determine the market value of the oil with Singapore oil brokers.

Saturday 2/22/03

- Divers finished positioning the navigation grid on *Mississinewa*'s bow and hot tapped into the forward, starboard side tank. No oil was detected. Divers cut an access hole into the forward starboard tank, entered the tank and burned a hole into the forward port side tank and after starboard tank using a Broco rod. No oil was detected. Finally, a diver cut a reach hole into the after starboard tank and burned a hole down into after port tank. No oil was detected. *Salvor* concludes that the bow section tanks contain no oil.
- Started pumping between tanks on *Fels* 21 to remove and consolidate free water from the oil tanks prior to the transit to Singapore. <u>No</u> decanted water was discharged overboard.
- No oil was detected in the bow section today. The final estimated volume of oil and water pumped from *Mississinewa* remains 1.95 million gallons, including approximately seven percent of free water. Actual volumes of oil and water pumped will be determined by tank soundings and sampling when *Fels* 21 is in flat calm water in Singapore. Tomorrow, the plan is to weld a plate over the access hole cut in the forward, starboard bow tank, perform a final inspection and close out of all capped tanks and spaces, and commence preparations for demobilization. *Salvor* anticipates getting underway on the 26th. *Jaya Marlin* and *Fels* 21 will likely depart sooner. *Seacor Rover* and *Fels* 20 will depart Ulithi following the recovery of the six-point moor, and the cleaning and re-packaging of all ESSM equipment. ETD to be provided in the next status report.

Sunday 2/23/03

- Divers capped the hot tap opening placed in the starboard side, forward reserve fuel/ballast tank and welded a plate over the access hole cut into this tank.
- Divers performed a final check of all hot tap caps and sealed them with epoxy.
- *Salvor* and GPC/Seacor continued demobilization efforts on site.
- *Salvor* plans to be underway from the site not later than mid-day on Wednesday, 2/26. *Jaya Marlin* with oil barge *Fels* 21 will be underway shortly thereafter and *Seacor Rover* with support barge *Fels* 20 will likely depart the area on Thursday the 27th.

Monday 2/24/03

- Demobilization continues with the breaking down and re-stowing of equipment on all vessels.
- Brian Lajoie (SUPSALV) and LCDR Tony San Jose (new CTF-73 salvage officer) came aboard just in time to make the last dive from *Salvor*.
- Governor Ruecho is due for a visit on *Salvor* tomorrow. *Salvor* should be underway for Guam by mid-day on Wednesday, 2/26.
- The plan now is for *Seacor Rover*, the larger, more capable tug, to tow the oil barge, *Fels* 21, to Singapore instead of *Jaya Marlin* for liability reasons. This makes good sense for all. *Jaya Marlin* will tow the primary work barge, *Fels* 20, with all SUPSALV ESSM equipment, but no oil. Anticipate both tugs will depart Ulithi Friday.

Tuesday 2/25/03

- Continued demobilization on *Salvor* and on the Seacor vessels. Waiting for *Salvor* to get underway in order to move *Fels* 21 to Urushi Anchorage and take in all four fenders on *Fels* 20.
- The Lt. Governor is reported to be aboard *Salvor* for a presentation.
- Scott Pretlow, Joe Stewart, and Dave Vore (all GPC) departed to return home. Brian Lajoie also went ashore. (Jason Thompson (GPC) had left a few days ago due to his ailing mother.)
- Debriefed the divers on lessons learned and feedback on the tools. (See notes.)

Wednesday 2/26/03

- Went aboard *Fels* 20 as usual to prepare for *Salvor*'s departure.
- 0830 – *Seacor Rover* is underway. *Jaya Marlin* is alongside to assist *Salvor*. Slacked off the starboard #3 mooring wire from *Fels* 20 to provide maneuvering room for *Salvor* astern. *Jaya Marlin* held *Salvor* alongside *Fels* 20 to allow safely taking in the mooring lines in the typically high wind and swell conditions.
- 0923 – *Salvor* is underway from *Fels* 20 for the first time since she moored alongside on 2 February.
- 1200 – *Fels* 20's port side #2 and #3 anchors have been recovered and starboard side fenders have been recovered and re-stowed.
- 1423 – *Fels* 21 (with 1.95 million gallons of oil and about 7% water) is underway and under tow by *Seacor Rover*, bound for Urushi Anchorage in the NE corner of the Ulithi Atoll.
- 1630 – All four fenders are now stowed in the fender van.

- 1730 – The shop van compressor and generator are stowed in the van. *Jaya Marlin* transferred all *Fels* 20's personnel to *Seacor Rover*. *Fels* 20 remains in a three-point moor at the *Mississinewa* site. Part of the GPC crew will travel by small boat tomorrow to Falalop for a charter flight to Yap. The remainder of the GPC crew and the SUPSALV Representative will travel from Falalop to Yap on a regularly scheduled flight on Friday.
- *Jaya Marlin* will be towing *Fels* 20 (the primary support barge with the ESSM Equipment) and *Seacor Rover* will be towing *Fels* 21 (with the recovered oil); they should be underway for Singapore on Friday, 2/28.

Thursday 2/27/03

- *Seacor Rover* is anchored in Urushi Anchorage with *Fels* 21 astern and *Jaya Marlin* alongside.
- *Jaya Marlin* is taking part of the GPC group to Falalop to fly out this morning on a chartered flight – Kevin, Gil, Jim, Jonathan, Mark, and Matt.
- Rick, the barge crew, and Craig continued with *Jaya Marlin* to *Fels* 20 to recover the three remaining anchors and secure for sea.
- 1830 – Last three anchors have been recovered. *Jaya Marlin* with *Fels* 20 in tow is anchored with *Seacor Rover* and *Fels* 21 at Urushi Anchorage in the NE corner of Ulithi Atoll.

Friday 2/28/03

- 0700 – *Jaya Marlin* is underway to transfer the anchor to *Fels* 20.
- ~0900 – *Jaya Marlin* and the Zodiac transport the SUPSALV Representative and the GPC crew to Falalop for the flight to Yap.
- ~1100 – Flight to Yap.
- 1130 – Arrive at Yap. Taxi to Traders Ridge hotel.

Saturday 3/1/03

- 1400 – Met with John Sohlith and others for the final debrief. Rick reported that *Seacor Rover*, *Jaya Marlin* and the two barges got underway at 2400.

Sunday 3/2/03

- 0140 – Flight from yap to Guam, etc.
- 1730 – Arrived in Norfolk on Sunday (next day; 32 hours of travel time).

8-4 Yap State Resolution No. 6-19, April 17, 2003

— Amb
— DCM
— file

SIXTH LEGISLATURE OF THE STATE OF YAP

P.O.Box 99
Colonia, Yap
Federated States of Micronesia
96943

Cable Address: Gov't Yap
Telephone: (691)350-2400/1
Facimile: (691)350-4106
E-Mail Addres: legisyap@ mail.fm

April 17, 2003

Speaker:
TONY GANNGIYAN
Vice Speaker:
James Mangefel
Floor Leader:
Sabino S. Sauchomal

COMMITTEE ON FINANCE

Chairman:
Clement Mulalap
Vice Chairman:
Sabino S. Sauchomal
Member:
Raymond Igechep

COMMITTEE ON GOVERNMENT, HEALTH & WELFARE

Chairman:
Stan D. Kensof
Vice Chairman:
Anthony M. Tareg
Member:
James Mangefel

COMMITTEE ON RESOURCES, EDUCATION AND DEVELOPMENT

Chairman:
Ted Rutun
Vice Chairman:
John Masiwemai
Member:
Charles S. Chieng

His Excellency Larry M. Dinger
U.S. Ambassador to the FSM
Palikir, Pohnpei
Federated States of Micronesia
FM 96941

Dear Mr. Ambassador Dinger:

I hereby transmit herewith certified copy of Yap State Resolution No. 6-19, which was adopted by the Sixth Legislature of the State of Yap, First Regular Session, 2003.

Respectfully,

Chipin
for **Aggie Kotnay**
Chief Clerk

SIXTH LEGISLATURE **YAP STATE RESOLUTION NO. 6-19**

STATE OF YAP

FIRST REGULAR SESSION, 2003

A RESOLUTION

Expressing deepest appreciation and gratitude to the United States Navy for the complete and safe removal of the oil and all hazardous liquid and other contaminants in and around the sunken US Navy oiler USS Mississinewa in Ulithi Atoll, Yap State, Federated States of Micronesia.

WHEREAS, on November 19, 2001, the Governor of the State of Yap issued a Request for Proposal on the complete and safe removal of the oil and all hazardous liquid and other contaminants in and around the sunken United States Navy oiler USS Mississinewa in Ulithi Atoll, Yap State; and

WHEREAS, the United States Navy responded and they have completed the de-fueling operation for the USS Mississinewa which was sunk on November 20, 1944, with 3,780,000 gallons of oil on board; and

WHEREAS, the residents of Ulithi Atoll, the people and Government of the State of Yap are grateful to the United States Navy for the safe completion of the de-fueling operation for the USS Mississinawa; now, therefore,

BE IT RESOLVED by the Sixth Legislature of the State of Yap, First Regular Session, 2003, that on behalf of the people and residents of Ulithi Atoll and the State of Yap the Legislature hereby expresses deepest appreciation and gratitude to the United States Navy for the complete and safe removal of the oil and all hazardous liquid and other contaminants in and around the sunken US Navy oiler USS Mississinewa in Ulithi Atoll, Yap State, Federated States of Micronesia; and

BE IT FURTHER RESOLVED that certified copies of this Resolution be transmitted to His Excellency, Ambassador Larry M. Dinger, United States Ambassador to the Federated States of Micronesia; the President of the Federated States of Micronesia; the Secretary of the Department of Foreign Affairs of the

YAP STATE RESOLUTION NO. 6-19

PAGE 2

Federated States of Micronesia; the Governor of the State of Yap; the Director of the Office of Planning and Budget; Chief Pisente Talugyor; the Chairman of the Council of Pilung; and the Chairman of the Council of Tamol.

Adopted : April 08, 2003

Sabino Sauchomal

fr **Tony Ganngiyan**
Speaker

Attested to fr **Aggie Kotnay**
Chief Clerk

8-5 *Fels* 20 Mooring Arrangement

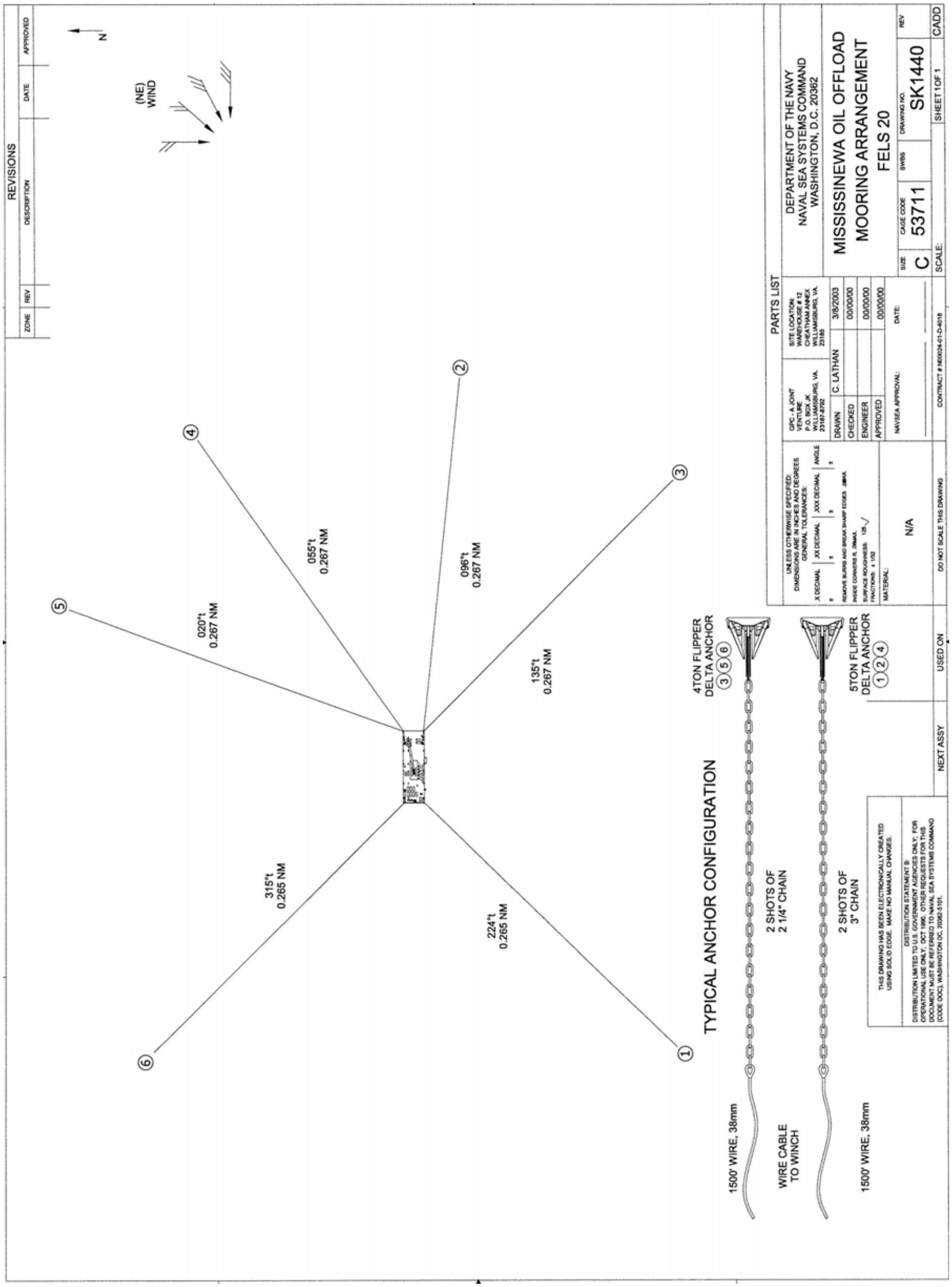


Figure 8-1. *Fels* 20 Mooring Arrangement

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION II

UNDERWATER SURVEY REPORT I
USS *MISSISSINEWA* (AO 59)
ULITHI ATOLL

17 August – 17 September 2001

Prepared by:

U.S. NAVY
SUPERVISOR OF SALVAGE AND DIVING
NAVAL SEA SYSTEMS COMMAND

Naval Sea Systems Command
Code 00C, Supervisor of Salvage & Diving
1333 Isaac Hull Avenue SE, Stop 1072
Washington Navy Yard, DC 20376-1072

THIS PAGE INTENTIONALLY LEFT BLANK

OIL SPILL RESPONSE OPERATION
USS *MISSISSINEWA* (AO 59)
Ulithi Atoll
17 August 2001 – 12 September 2001

TABLE OF CONTENTS

APPENDICES

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION A – EXECUTIVE SUMMARY

On August 17, 2001, the Supervisor of Salvage and Diving (SEA00C) tasked the Global PCCI joint venture (GPC) to survey an oil spill and the wreck of USS *Mississinewa* (AO 59) sunk during World War II in the Ulithi Atoll, Federated States of Micronesia (FSM). Oil had been reported leaking from the wreck and impacting several nearby islands. GPC responded with technical personnel and a subcontracted dive team.

The assigned tasks were as follows:

- Provide an assessment team with commercial divers.
- Remain approximately 4 or 5 days in the Ulithi area.
- Perform an environmental survey of accessible oil impacted beaches.
- Perform an underwater survey of the bow section and assess the amount of oil product remaining in the tank. Survey the main hull if the leak was not from the bow section.
- Prepare a report of findings.

The location of the sunken *Mississinewa* had been recently established, and several reports describe the sinking and her current condition. A team from the Government of Yap (FSM) had investigated an oil spill from the wreck in early August. A U.S. Coast Guard team visited Ulithi just prior to the GPC team arrival. These prior survey reports are listed in Appendix A.

The dive team located the wreck in 130 feet of water and observed oil leaking from a crack in the hull plating (see Figure 1). The source of the oil leak was a stripping line suction found in the aft section of the hull in the cargo oil tank, #4 starboard wing (COT 4-S). The oil leak rate was measured at approximately one quart per minute of what had been reported as Navy Special Fuel Oil (NSFO). A subsequent valve leak was also plugged several days later. Approximately 6,300 gallons of oil and water were removed from the damaged tank and stored in barrels for disposal in Guam.

The survey of the forward and aft portions of the wreck was performed to establish the condition of the hull and extent of cargo tank damage. A beach survey was accomplished on four islands showing little evidence of oil impact. Samples of the recovered oil, contaminated beach sand, and hull steel were obtained and are stored at the SEA00C ESSM Williamsburg base.

Original construction drawings of the AO 51 class and other documentation were found to help assess the hull structure and oil loading condition of the wreck. The Capacity Plan may be found in Appendix A. Program of Ship Salvage Engineering (POSSE) computer models were prepared to help estimate loading conditions at the time of the torpedo attack and probable remaining oils.

The survey discovered there is as much as 3,271,842 gallons of various oil products remaining onboard and local government officials have expressed a desire that the oil be removed. The hull structure of *Mississinewa* aft of OTB 73 is in good condition and there appears to be sufficient shell plating thickness to contain oil in the tanks for several years to come; however, further deterioration of the exposed cargo piping system remains a concern.

Beach surveys of four islands exposed to recent oil leaks found little evidence of significant oil impacts. At most, only scattered small weathered oil drops (tar balls) could be found along the inter-tidal line on a few beaches.

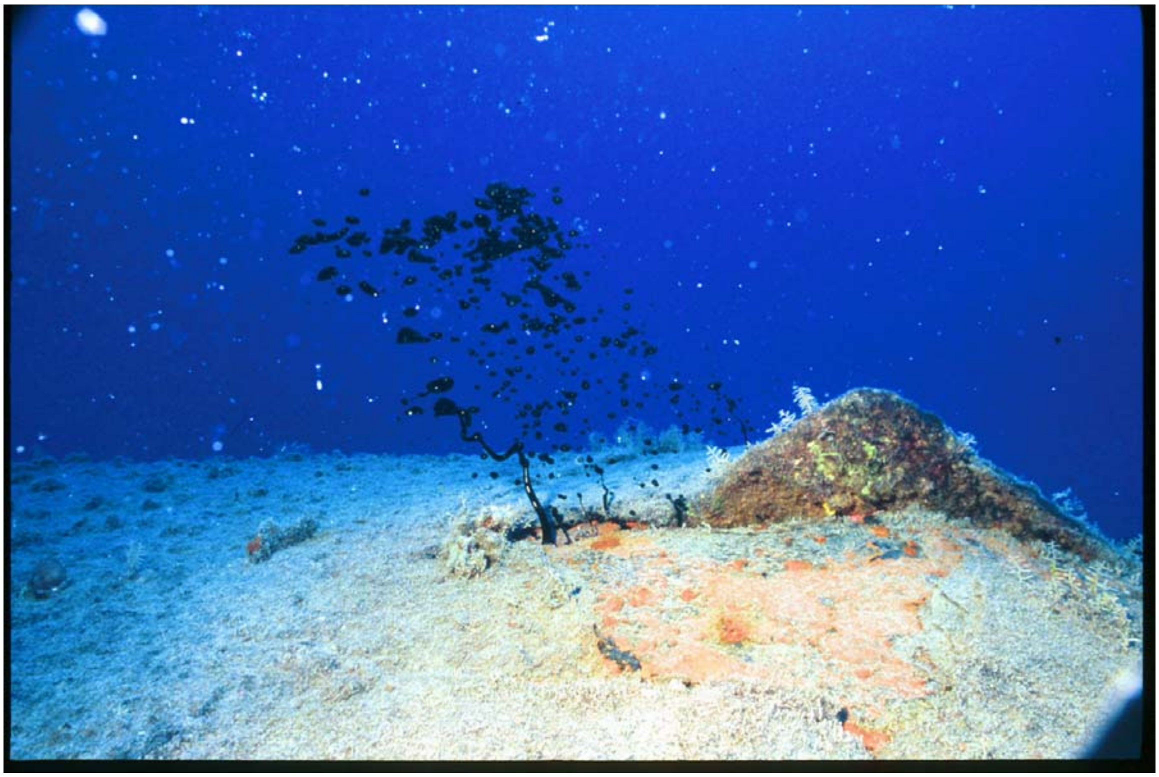


Figure 1. Oil Leak from Crack in COT 4-S

SECTION B – CHRONOLOGY OF EVENTS

Friday – 8/17/01
Supervisor of Salvage and Diving (SEA00C) verbally tasks GPC to provide an assessment team with divers to proceed to the Ulithi Atoll, Federated States of Micronesia (FSM), to perform a survey of the sunken *Mississinewa*, from which oil was reported leaking into the waters of the lagoon.

Monday – 8/20/01
Lloyd L. Saner and Chip Lambert depart Hawaii for Ulithi Atoll via Guam.

Tuesday – 8/21/01
Layover on Guam. Saner contacts CDR Lynch, a Navy legal representative on Guam, and meets with the subcontractor dive team.

Wednesday – 8/22/01
Saner and Lambert arrive in Yap and brief U.S. and Yap Government officials. Arrive Ulithi Atoll, observe oil slick from the air. Saner meets local leaders.

Thursday – 8/23/01
In poor weather the local dive master and Lambert dive on the vessel and measure the actual discharge rate to be approximately 15 gal. per hour. The ultimate source of the leak cannot be determined.

Friday – 8/24/01
GPC personnel Jeff Cane and Paul Schadow along with two of the dive team arrive. Poor weather prevents diving.

Saturday – 8/25/01
The first dive was made. Oil is possibly coming from # 4 starboard wing tank. A tank suction pipe in the open tank is seen leaking oil. ESSM equipment requested to pump off trapped oil.

Sunday – 8/26/01
The Yap Government vessel, MV *Micro Spirit*, is offered as a support platform for diving and pumping. Dive team plugs the pipe suction with rags and concrete.

Monday – 8/27/01
Poor weather prevents diving.

Tuesday – 8/28/01
Diver checks patch that had been installed in the pipe suction. Divers fill the crack in the overhanging plate to stop remaining trapped oil from leaking out into the water. Saner departs for Yap.

Wednesday – 8/29/01
The divers complete measurements on the hull for reference points for tank locations.

Saner briefs the Governor of Yap and heads of all Government agencies. Governor agrees to accept recovered oil on Yap for transport to Guam for disposal. The ESSM Hawaii shipment had arrived and loaded on the *Micro Spirit*. *Micro Spirit* departs for Ulithi.

The dive team continues to patch the hull crack in the COT 4-S wing tank with more cement. Divers observe that the remaining #4 tanks are open to the sea.

Thursday – 8/30/01
The vessel, *Micro Spirit*, arrives at Ulithi and moors over the wreck for surface supplied dive operations. Divers survey tanks using surface supplied air. Oil leak patching is improved. On Yap, Saner prepares an agreement with the Government to remove oil from Yap in 90 days and charter fees for *Micro Spirit*.

Friday – 8/31/01
Jim Ruth arrives on Yap. Saner departs. Ruth and Jeff Cane meet with the Governor of Yap and his staff. They arrive in Ulithi. The dive team continues hull survey.

Saturday – 9/1/01
The team pumps over 3500 gallons of oil from the #4 starboard tank into 70 barrels. A diver discovers that a 4-inch valve bonnet is broken and leaking oil.

Sunday – 9/2/01
The team continues to pump oil from the #4 tank. An additional 45 empty drums are filled. Divers install a patch on the valve bonnet. A total of 117 drums of oil are removed, including three or four contaminated with a salt water and oil mix.

Monday – 9/3/01
The valve patch is improved to stop a small leak. A beach survey is conducted on Falalop and Asor Islands.

Tuesday – 9/4/01
Beach surveys are conducted on Pao and Losiep islands. The 4-inch valve is further patched by using a concrete-filled, plastic barrel to encapsulate the valve. No further oil leak is observed.

Wednesday – 9/5/01
ESSM pumping equipment is flushed, cleaned and secured for trip back to Yap. *Micro Spirit* departed to Yap.

Thursday – 9/6/01
The team returns to Falalop. All rented dive equipment is returned, and local expenses are settled.

Friday – 9/7/01
Team flies to Yap. Arrangements are made for shipping of ESSM gear and recovered oil.

SECTION C – HULL SURVEY RESULTS

Diver Hull Survey

A survey of *Mississinewa* was performed to determine the remaining structural integrity after nearly 57 years on the bottom of the lagoon. The process of locating and securing the oil leak source in the Cargo Oil Tank (COT) 4-S piping provided insight to the deterioration of the ship's cargo oil piping system and clear identification of what residual structure remains intact. In addition to still photographic documentation, a video record of the hull's general status was made.

The wreck lies in about 130 feet of water in the Ulithi Lagoon. The hull is broken in two parts. The bow is intact and lying on its port side (see Figure 2). This bow section extends from the Forward Perpendicular (FP) about 85 feet aft to the first Cofferdam at frame (Fr) 83. The starboard side of the Fore Peak and Reserve Fuel Oil/ Saltwater Ballast (FO/SWB) Tanks from Fr-84 to102 appear to be intact. Depth of the bow at the sand line varied from 127 to 133 feet.

Figure 2. *Mississinewa*'s Bow

Continuing the survey aft of Oil Tight Bulkhead (OTB) 76, the hull is intact to its stern but is completely upside down. Diver measurements of hull attitude as she lies are 3 degrees down by the bow (i.e., the keel slopes downward from the AP forward to OTB-76) and 5 degrees list to the port side (i.e., the wreck's port side is about 4 feet lower than the starboard side). A sandline survey on the wreck's starboard side indicates that the deck edge is visible and not buried in the sand. Therefore, the main hull appears to rest on the Midship Island superstructure and Poop

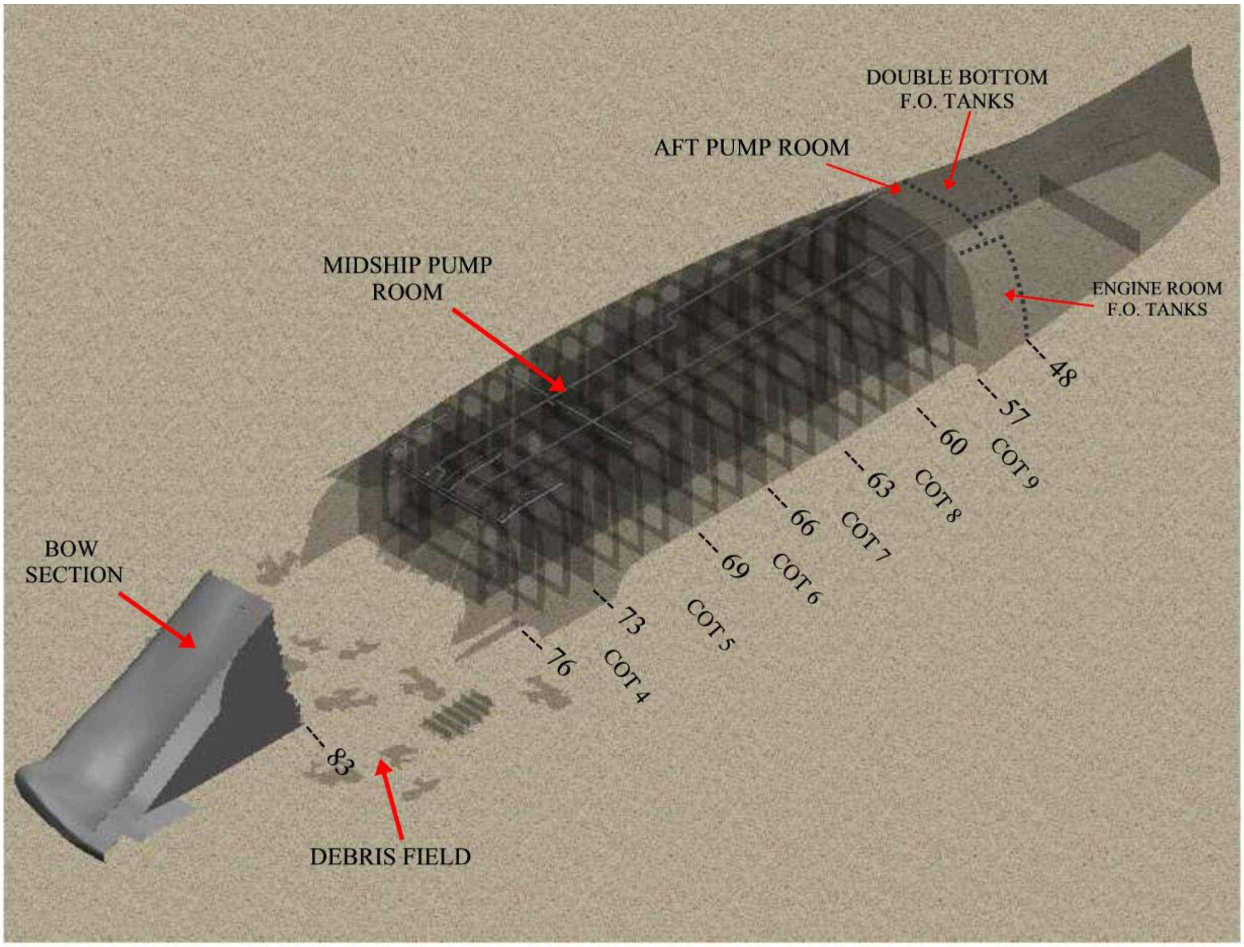


Figure 3. Overview of *Mississinewa*

Deck aft rather than on its Upper Deck. Structurally, the main body of cargo tanks from OTB-73 aft to Fr 48 may be considered simply supported in way of COTs 5, 6, 7, 8 and 9, as well as the Fuel Oil Tanks forward of the Engine Room (Frs. 48-56). See Figure 3 showing arrangement of tanks and the ship's Capacity Plan in Appendix A.

Divers took fore and aft measurements to identify precisely which tanks are intact. This process involved identification of the crack and leak as being in COT 4-S by measuring the OTB location to be 358 feet forward of the Aft Perpendicular (AP) as shown on the plans. Divers then proceeded to determine the incremental distances aft of this reference point for each tank, locating each tank's docking plug for future reference and identifying the ship's longitudinal and transverse bulkheads. The hull plating survey could then be cross-referenced with a specific tank.

Cargo Piping Integrity

Further inspection determined that the region from OTB-76 forward to OTB-83 (i.e., COTs 1, 2 and 3) is destroyed and only twisted rubble exists for this span of tanks. There is an overhanging portion of bottom shell plating bent downward and extending some 30 feet forward of OTB-76. This plating contained the crack in way of COT 4-S that was originally identified by the Yap scuba divers as the leak source. Interior dives under the overhang and into the tank itself revealed that the actual leak emanated from the bellmouth at the 4-inch stripping line suction (see Figure 4). This bellmouth was plugged with rags and capped with concrete, thus stopping the leak.

Figure 4. COT 4-S, Bellmouth Oil Leak Source

Further dives on the area of OTB 76 indicated that the bulkhead is ruptured in way of COT 4-C and 4-P. There is no evidence of the 12-inch cargo oil piping mains that branch off inside COT 4-C and elbow into the forward cargo oil wing tanks COT 3, 2 and 1 P&S. These 12-inch mains connect to the Midship Pump Room cargo oil pumps, which in turn connect to the Aft Pump Room. Depending upon the valve settings, it is possible that oil/water communication extends throughout the wreck.

Stopping the leak in the 4-inch bellmouth put static pressure on the line's gate valve. This valve's bonnet was dislodged due to the wastage of its bolts and the forces of its reach rod extending to the main deck. The dive team encased this valve in concrete, as described in Appendix E. The deteriorated condition of the valve's bolts, gaskets and support structure is a sign that progressive failure of the piping system is the most likely source for future leakage. The cargo piping arrangement is shown in Appendix A, Figure A-4.

Hull Deterioration

Table 1 lists the readings obtained by the divers in three hull locations using ultrasonic measurements. Deterioration of plating in way of the COT 5-C, which is presumed to still retain its NSFO, shows 13 percent wastage. In addition, the Midship Pump Room space also indicates 13 percent wastage. This space presumably contains seawater; however, it may be flooded with NSFO feeding back through the cargo oil piping system. In contrast to these readings, COT 6-S, which is presumed to have contained saltwater ballast (SWB) at the time of the torpedo attack, shows a 67% loss of thickness. These figures are factored into the overall assessment of the hull's structural integrity.

Table 1 - Diver Ultrasound Readings on Hull

Location Relative to OTB 76 at CL				Thickness (Inches)		
Aft	Outboard	Tank No.	Cargo Type	Dwg	Ultrasonic	% Loss
38'	CL	COT 5C	NSFO	1	0.87	13
72'	CL	Pump Rm	None	0.89	0.79	12
95'	Side Shell	COT 6S	SWB	0.69	0.224	* 67

* % loss may be due to local plate delaminations instead of general wastage

Hull Integrity

*Mississinewa'*s hull was launched in 1944 by Bethlehem Sparrows Point for the Maritime Commission T3-S2-A1 design of 1938. The AO 51 (*Ashtabula*) Class tankers, which include AO 59, were built of combined welded and riveted mild steel to American Bureau of Shipping Rules of the era. The shell plating is riveted with 6-inch typical laps and a double row of 1-inch rivets, and the shell stiffeners are welded to the hull plating.

The survey revealed some wastage in hull plating thickness of the tanks; however, overall the hull bottom structure appears sound in way of COTs 5 through 9 and the ship's Fuel Oil Tanks (FOTs) aft in the Engine Room. Calculations based upon the hull's structural plans and factoring plate wastage indicates that there is adequate residual strength to contain a full load of oil in all of the intact tanks.

Estimate of Remaining Oil

Appendix B to this report contains a detailed description of how the ship is presumed to have been loaded at the time of the torpedo attack and sample output from the Program of Ship Salvage Engineering (POSSE) model of the ship's sinking. Cargo distribution for this modeling is based upon the Commanding Officer's report. The model shows that AO 59 could have sunk with the entire load of NSFO in COT 5-P/S/C, 7-P/S/C, 8-P/S/C and 9-P&S intact (9,243 LT or 60,911 bbls). In addition, the 9,000 bbls of Diesel Oil in COT 6-C likely remains. Further inspection of the ship piping drawings indicates that the Fuel Oil fill and transfer system is probably isolated from the Cargo Oil piping system; accordingly, it is believed that a full load of ship's bunkers remain in the various Engine Room Fuel Oil Tanks. Additionally, some quantity of lube oil may also remain in Engine Room Lube Oil Tanks (LOTs). A summary of possible oil remaining on board AO 59 is shown in Table 2.

Table 2 - Summary of Oil Remaining

Product	Tanks	Bbl/LT	L. Tons	Bbls.	Gallons
NSFO	COTs	6.59	9,243	60,911	2,558,262
Diesel	COTs	7.48	1,203	9,000	378,000
AvGas	COTs	8.72	None	None	None
Fuel Oil	FOTs	6.59	1203	7,928	332,976
Lube	LOTs	6.89	9	62	2,604
	Total		**11,658**	**77,901**	**3,271,842**

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION D – ENVIRONMENTAL SURVEY

Beach surveys to locate stranded oil were performed by GPC's Jeff Cane with personnel from *Micro Spirit*. Surveys were conducted on Falalop, Asor, Pao (Yao) and Losiep Islands (see Figure 5). The surveys concentrated on beaches facing the wreck site. The islands were selected for survey because they were likely impacted from the recent oil leak from *Mississinewa* due to the prevailing west to southwest winds experienced during recent months.

Falalop and Asor are neighboring islands 8 miles northeast of the wreck and have the majority of Ulithi's population. Pao (known locally as Yao) and Losiep Islands are reported as prime turtle nesting areas and are east of the wreck about 10 miles.

Only in a few areas was any sign of oil found. Considerably less oil was found than had been previously reported by the Yap Government and the subsequent USCG surveys. Recent storms with winds exceeding 35 knots had likely scoured the beaches of any significant remaining oil. There was no evidence that oil was buried. The largest oil deposits observed were from smaller than an inch to several inches across. The distance between patches was from 3 feet to 10 feet over a typical distance of 100 feet on a single exposed beach. The largest deposits were found on Falalop Island. Most beaches were oil free. The oil that was found consisted of a few isolated weathered patches. Figures 6 and 7 show typical remaining oil deposits.

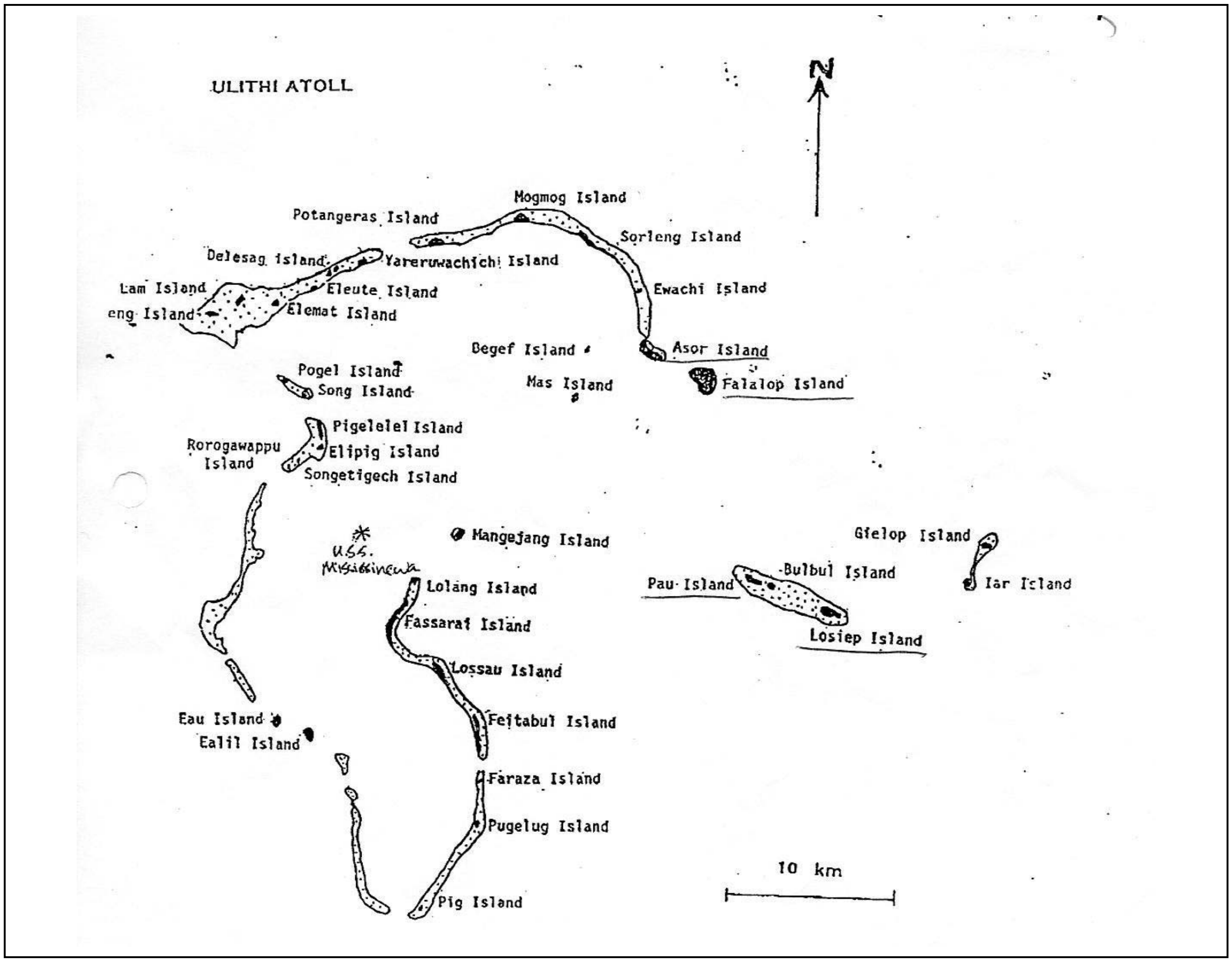


Figure 5. Falalop, Asor, Pao (Yao), and Losiep Islands

Figure 6. Oil Patch, 4” Across – Falalop Island

Figure 7. Scattered Oil Deposits – Asor Island

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION E – CONCLUSIONS

Hull

The hull structure of *Mississinewa* aft of OTB 73 is in good condition considering its years on the bottom of the lagoon. Wastage of shell plating is less in those tanks presumed to contain oil. There appears to be sufficient shell plating thickness to contain oil in the tanks for some years to come. However, any movement may compromise hull integrity.

Cargo

There could be as much as 77,901 barrels of various oil products remaining on board *Mississinewa*. Some oil losses may have occurred over time through the cargo piping system. There was no evidence of hull damage that might have emptied the remaining tanks beyond the known failures.

Piping

The cargo oil piping system in way of COTs 4-S/C/P remains the weakest point in containing the remaining oil. There is no way of knowing which tanks are interconnected through the piping system to estimate the total possible loss if such piping fails. Diver reports and the necessity of patching a leaking valve emphasize the vulnerability of the piping system exposed to seawater. The two emergency patches are considered permanent, but do not provide a remedy to prevent other piping leaks that may occur at any time due to further piping deterioration.

Environment

Beach surveys of four islands exposed to recent oil leaks found little evidence of significant oil impacts. At most, only scattered small weathered oil drops (tar balls) could be found along the inter-tidal line on a few beaches.

Local Concerns

Local Yap Government officials repeatedly expressed their desire that the oil be removed from *Mississinewa* rather than waiting for a catastrophic release of oil due to a hull breech from corrosion or a typhoon. The people of Ulithi are particularly concerned about the possible severe impact a large or chronic release of oil might have on their way of life.

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix A

Executive Summary AO 59 Technical Information

AO 59 (*Mississinewa*) Class Information

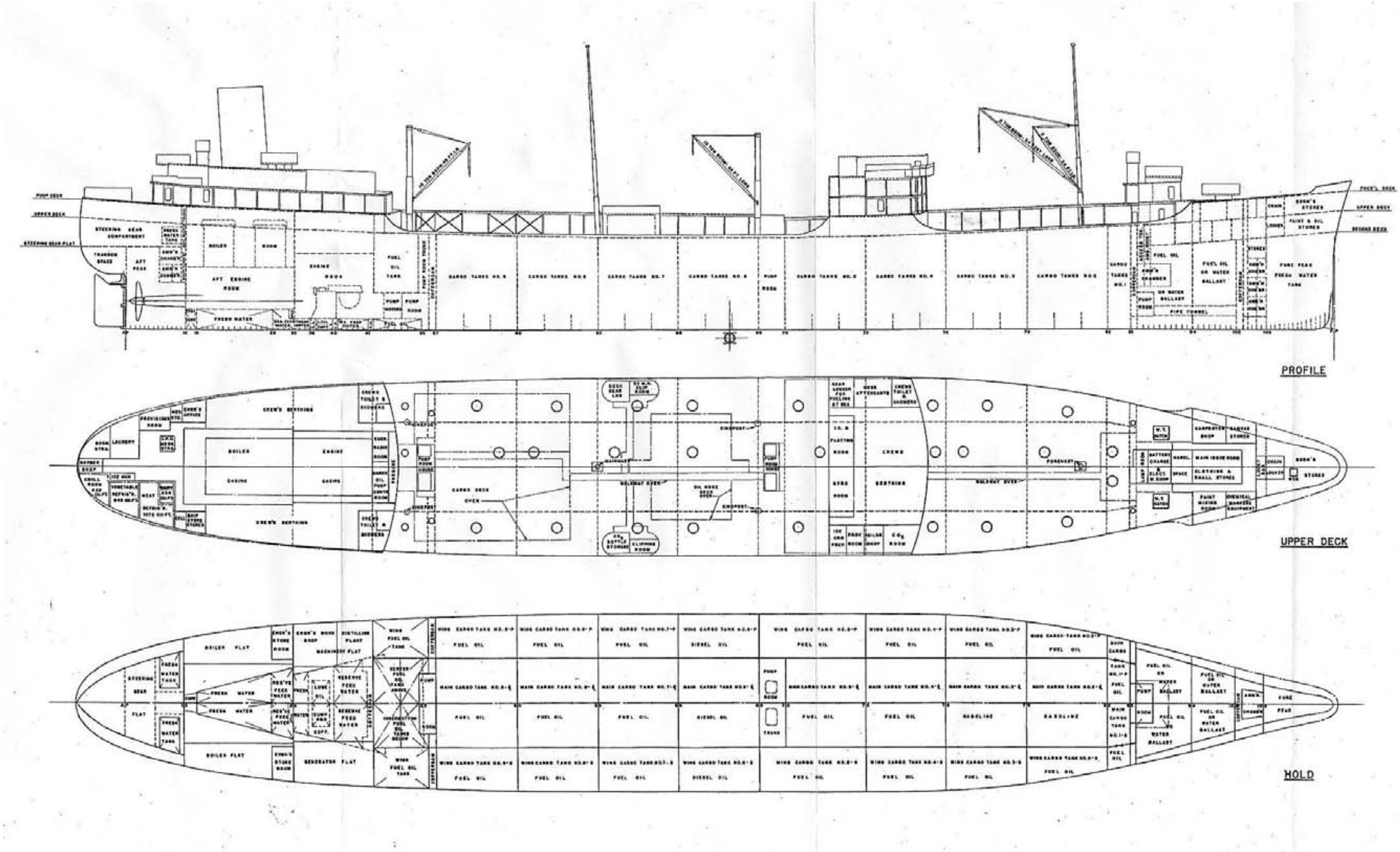
AO 59 (*Mississinewa*) is an AO 51 Class (*Ashtabula* class) Navy Auxiliary Oiler delivered in 1944 by the U.S. Maritime Administration (MARAD) as part of the WWII war effort. Bethlehem-Sparrows Point Shipyard, Inc., Baltimore, Maryland, built the vessel in a construction program covering AO 51/64, then later AO 97/100 and finally AO 105/109. The Maritime Administration type designation for this design is T3-S2-A1, which was started in 1938. Principal characteristics of the AO 51 are as follows:

Dimensions:	553-FT LOA	525-Ft. LBP	75-Ft. Beam	39-Ft. Molded Depth
Tonnage:	7,136 LT Light Ship	15,900 LT Deadweight at Full Load Displacement		
Design Draft:	30-Ft 0-5/8-Inch at Full Load Displacement of 23,000 LT Seawater			
Machinery:	Twin Boiler/Twin Turbine	13,500 H.P. Total		
Propellers:	Twin Screw			
Design Speed:	18 Knots			

Note: Some records list *Mississinewa* as a version A3. The MARAD drawings, Fahey, and *Janes'* list her as an A1.

Documentation

Detailed drawings for the AO 51 class initially consisted of a single General Arrangement Inboard and Outboard Profile for AO 97/100 copied from the National Archives. Further research at the National Archives turned up microfilm drawings of the AO 51 Class; however, they reflected the class after it had been "jumboised" by the Navy in the 1960s. Carefully used, these drawings are of some value as the ends of the original ship were retained. Baltimore Marine Inc., Sparrows Point, Maryland, made a search of old blueprint boxes at the request of Bethlehem Steel Corp., who still own the drawings at the old shipyard, but failed to discover any of the AO 51 original ship drawings. This dead-end effort led to a visit to the shipyard's vaults, where original General Arrangement and Capacity Plan drawings for the AO 97/100, as well as the Capacity Plan for the AO 63/64, were discovered. The January 1945 Capacity Plan (H-4410-SM40-11-10(NC)) follows on the next pages. These drawings were invaluable for estimating the initial loadout capacities of the tanks. Also, an extensive effort on the part of MARAD naval architects found a microfilm reel of T3-S2-A1. Although not a complete documentation of the AO 59, these microfilm plates identify the principal structural and piping characteristics of the AO 59 for validating the survey record. They form the backbone for understanding the structural and piping arrangement of the AO 59 as it lies in the Ulithi Atoll.


PROFILE
UPPER DECK
HOLD

CARGO TANKS

CARGO FUEL OIL			CU.FT.	GALLONS	BARRELS	TONS
NO.1 WING TANK	PORT	FRS.82-83	10,627	79,491	1892.64	287.22
NO.1 WING TANK	STBD.	FRS.82-83	10,454	78,198	1861.85	282.54
NO.2 WING TANK	PORT	FRS.79-82	15,407	115,240	2743.82	416.41
NO.2 WING TANK	STBD.	FRS.79-82	15,407	115,240	2743.82	416.41
NO.3 WING TANK	PORT	FRS.76-79	23,038	172,326	4103.00	622.65
NO.3 WING TANK	STBD.	FRS.76-79	23,038	172,326	4103.00	622.65
NO.4 MAIN TANK	C.L.	FRS.73-76	53,342	398,993	9499.83	1441.68
NO.4 WING TANK	PORT	FRS.73-76	25,695	192,198	4576.15	694.46
NO.4 WING TANK	STBD.	FRS.73-76	25,695	192,198	4576.15	694.46
NO.5 MAIN TANK	C.L.	FRS.70-73	51,707	386,770	9208.80	1397.49
NO.5 WING TANK	PORT	FRS.69-73	34,013	254,412	6057.44	919.27
NO.5 WING TANK	STBD.	FRS.69-73	34,013	254,412	6057.44	919.27
NO.7 WING TANK	STBD.	FRS.63-66	25,368	189,748	4517.82	685.62
NO.7 MAIN TANK	C.L.	FRS.63-66	52,481	392,555	9346.54	1418.41
NO.7 WING TANK	PORT	FRS.63-66	25,368	189,748	4517.82	685.62
NO.8 WING TANK	STBD.	FRS.60-63	24,344	182,090	4335.48	657.95
NO.8 MAIN TANK	C.L.	FRS.60-63	53,039	396,730	9445.96	1433.49
NO.8 WING TANK	PORT	FRS.60-63	24,344	182,090	4335.48	657.95
NO.9 WING TANK	STBD	FRS.57-60	21,220	158,722	3779.10	573.51
NO.9 MAIN TANK	C.L.	FRS.57-60	53,164	397,665	9468.22	1436.86
NO.9 WING TANK	PORT	FRS.57-60	21,220	158,722	3779.10	573.51
TOTAL CARGO FUEL OIL			622,984	4,659,874	110,949.46	16,837.43
CARGO DIESEL OIL			**CU.FT.**	**GALLONS**	**BARRELS**	**TONS**
NO.6 WING TANK	PORT	FRS.66-69	25,871	193,510	4607.40	615.98
NO.6 WING TANK	STBD	FRS.66-69	25,871	193,510	4607.40	615.98
NO.6 MAIN TANK	C.L.	FRS.66-69	52,570	393,223	9362.46	1251.67
TOTAL CARGO DIESEL OIL			104,312	780,243	18,577.26	2483.63
CARGO GASOLINE			**CU.FT.**	**GALLONS**	**BARRELS**	**TONS**
NO.2 MAIN TANK	C.L.	FRS.79-82	56,173	420,172	10004.10	1146.39
NO.3 MAIN TANK	C.L.	FRS.76-79	54,778.	409,734	9755.57	1117.92
TOTAL CARGO GASOLINE			110,951	829,906	19759.67	2264.31
TOTAL CARGO TANKS			838,247	6,270,023	149,286.39	21,585.37

FUEL OIL

COMPARTMENT		CU.FT.	GALLONS	BARRELS	TONS
FUEL OIL TANK - CENTER	FRS.48-56	20,511	153,423	3652.94	554.35
FUEL OIL WING - PORT	FRS.48-56	11,323	84,698	2016.63	306.03
FUEL OIL WING - STBD	FRS.48-56	11,323	84,698	2016.63	306.03
F.O. DOUBLE BOTTOM - PORT	FRS.48-55	1,603	11,991	285.50	43.32
F.O. DOUBLE BOTTOM - STBD	FRS.48-55	1,603	11,991	285.50	43.32
RESERVE FUEL OIL - PORT	FRS.84-94	12,902	96,508	2297.81	348.70
RESERVE FUEL OIL - STBD	FRS.84-94	12,605	94,286	2244.90	340.68
RESERVE FUEL OIL - PORT	FRS.94-102	8,783	65,696	1564.18	237.38
RESERVE FUEL OIL - STBD	FRS.94-102	8,329	62,298	1483.28	225.11
TOTAL FUEL OIL		88,982	665,589	15,847.37	2404.92

FRESH WATER

COMPARTMENT				CU.FT.	TONS
FORE PEAK			FR.108-STEM	10,772	299.22
DRINKING WATER	DOUBLE BOTTOM	PORT	FRS.15-29	1,551	43.07
DRINKING WATER	DOUBLE BOTTOM	STBD	FRS.15-29	1,551	43.07
RESERVE FEED WATER	DOUBLE BOTTOM	PORT	FRS.29-33	764	21.23
RESERVE FEED WATER	DOUBLE BOTTOM	STBD	FRS.29-33	698	19.39
DRINKING WATER	DOUBLE BOTTOM		FRS.33-36	596	16.60
RESERVE FEED WATER	DOUBLE BOTTOM	PORT	FRS.41-47	857	23.88
RESERVE FEED WATER	DOUBLE BOTTOM	STBD	FRS.41-47	856	23.85
FRESH WATER ON S.G. FLAT		PORT OR STBD	FRS.6-12	951	26.50
TOTAL FRESH WATER				19547	543.31

SALT WATER BALLAST

COMPARTMENT			CU.FT.	TONS
BALLAST TANK	PORT	FRS.84-94	12,888	368.23
BALLAST TANK	STBD	FRS.84-94	12,595	359.86
BALLAST TANK	PORT	FRS.94-102	8,746	249.88
BALLAST TANK	STBD	FRS.94-102	8,303	237.22
AFTER PEAK TANK		FRS.0-13	9,051	258.60
TOTAL BALLAST			51,583	1473.79

Sources for drawings used in this report are as follows:

- National Archives and Records Administration
  Special Media Archive Services – H-4436-11-3
  POC – Dr. Henry Gwiazda – (301) 713-7030 Ext. 226
  General Arrangement of Decks & Profile – AO 97/100

- Bethlehem Steel Corporation
  Mr. Jay Lazar – (610) 694-2558
  Stored at Baltimore Marine Inc., Sparrows Point, Maryland
  H-4409-SM40-11-3A General Arrangement of Decks & Profile – AO 63/64
  H-4410-SM40-11-10 Capacity Plan AO 64

- Maritime Administration (MARAD) – Office of Shipbuilding & Marine Technology
  Mr. Dave Heller, Naval Architect – (202) 366-1850
  T3-S2-A1 Maritime Administration Microfilm Reel M.C. 22-1

- Computer Sciences Corporation – Arlington, Virginia
  POC – Mr. John J. Slager, Naval Architect – (703) 413-9200
  BUSHIPS 800-2277076 AO 22 Class Lines Forward of Midship

Other References

In addition to the reference drawings obtained from sources cited above, a variety of sources were used to evaluate the shipbuilding practices used for the AO 59 construction and to sort out which ships were built or modified over time.

Principal Hull and Cargo References

Rules for Building & Classing Steel Vessels, American Bureau of Shipping, 1942

Shipfitting Practice, Bulletin 345, Sun Shipbuilding & Drydock Company, 1941

Janes' Fighting Ships, Jane's Publishing Co., 1976-1977

Ships of the U.S. Navy 1940-1945, http://www.ibiblio.org/hyperwar/USN/ships/ships-ao.html.

The Ships and Aircraft of the U.S. Fleet/War Edition/Victory Edition, James C. Fahey, http://www.amazon.com

The Search for U.S.S. Mississinewa, The Bent Prop Project, http://bentprop.org/miso1.htm

Commanding Officer's Action Report (Ex-U.S.S. Mississinewa (AO59), Captain Phillip Beck, 1944

The U.S.S. Mississinewa Web Site, http://www.ussmississinewa.com

Recent Reports on the Ulithi Oil Spill

U.S.S. Mississinewa Oil Spill Ulithi Atoll, Yap State FSM, Assessment Team Report; 24 August 2001, Commander Meredith Austin (Coast Guard Pacific Strike Team (PST)

Assessment of the Oil Spill from the U.S.S. Mississinewa Auxiliary Oiler, Ulithi Atoll, Yap State, FSM; August 6-7, 2001, Marine Resources Management Division Department of Resources and Development, Yap State, FSM

Developed Models

Estimates of the remaining cargo oil volume on board the AO 59 depend on the results of the hull survey and the distribution of cargo oil, aviation gasoline, diesel oil, and fuel oil at the time of the torpedo attack. Two computer-generated models were made of AO 59. POSSE was used to determine how much cargo could have remained on board after the attack and still allow for the vessel's progressive flooding and capsize as documented in the Sid Harris photographs (see http://bentprop.org/mis07.htm). A parallel hull model was made using Solid Edge to permit a 3-D virtual survey of the ship in its present state. This model will enhance general understanding of the complexity of structure and piping found at the wreck site.

Program of Ship Salvage Engineering (POSSE) Model

POSSE V2.2 was used and the hull representation (file AO59.HUL) offsets were developed from the General Arrangement and Capacity Plan drawings to develop and check tankage and spaces for the POSSE.CMP files, and the lightship weight shown on the drawing's Deadweight Scale. Once the .CMA and .SDA files were completed, Captain Beck's official report provided the basis for loading the ship with 90,000 Bbls of NSFO, 9,000 Bbls of Diesel Oil, and 404,000 gallons of Avgas distributed in the tanks he had identified. An assumption was made that she had at least a 90% load of fuel oil for ship's bunkers for wartime readiness. Several iterations in lightship centers were required to trim the vessel in a realistic representation of its likely trim for the morning of November 20, 1944, when the torpedo struck. The POSSE model shows the ship loaded almost to her maximum deadweight limit. Metacentric height (GM) was shown within acceptable limits for the operating conditions. The microfilm T3-S2-A1 provided detailed views of the hull's shell expansion and structural sections and was used to create a POSSE.SMD file for structural integrity calculations.

With a working model of the AO 59 developed, POSSE's Salvage subroutine was used to imitate the likely torpedo damage and sinking of the ship through progressive flooding and eventual rollover. The Sid Harris photographs, showing AO 59 upright with her decks awash with the bow under, suggest that the ship still had positive GM even as it was going under at the bow. This condition is matched in successive POSSE runs by assuming initial torpedo damage (TORPEDO.SAL), then allowing progressive flooding of the focsle spaces and downflooding of the Forward Pump Room and Ammunition spaces in the forebody (DWNFLOOD.SAL). Progressive flooding of the Midships Pump Room, via the Pump Room House and its ventilation ducts and possible backflooding of the No. 6 P/S SWB/DOT (PHOTO-C.SAL), brings the ship's trim to a condition similar to that shown in the Sid Harris photograph (see Figures A-1 and A-2).

Figure A-1. Sid Harris Photo of *Mississinewa* – Going Down by the Bow

USS MISSISSINEWA (TORPEDO ATTACK on NOV 20, 1944) OOC POSSE-SALV V2.2
Rev. C (by: RMW/JAK) SEPT 20, 2001

FREE-FLOATING DAMAGED CONDITION
PHOTO-C: PROGRESSIVE & DOWN FLOODING - FIREFIGHTING WATER

Damaged Compartments:

STORES1	CD-FR102	AMMOCHAMBER1	STORES-2S	STORES-2P	PIPETUNNEL
STORES-3S	RSF084-S	RSF084-P	STORES-3P	AMMOCHAMBER2	PUMPRM-F
AMMOHOIST	ACCESSTRUNK	CD-FR83U	CARGO-1S	CARGO-1P	CARGO-2S
CARGO-2C	CARGO-2P	CARGO-3S	CARGO-3C	CARGO-3P	CARGO-4S
CARGO-4C	PUMPRM-M	SWB-6-S	SWB-6-P		

	DISPLACEMENT LTons	DRAFT AFT ft	DRAFT FWD ft	TRIM ft	HEEL deg.	UPRIGHT GMt ft
INTACT	25,527	32.713	32.094	0.620A	0.0S	3.528
DAMAGED	31,113	24.853	54.905	30.052F	1.3S	3.572

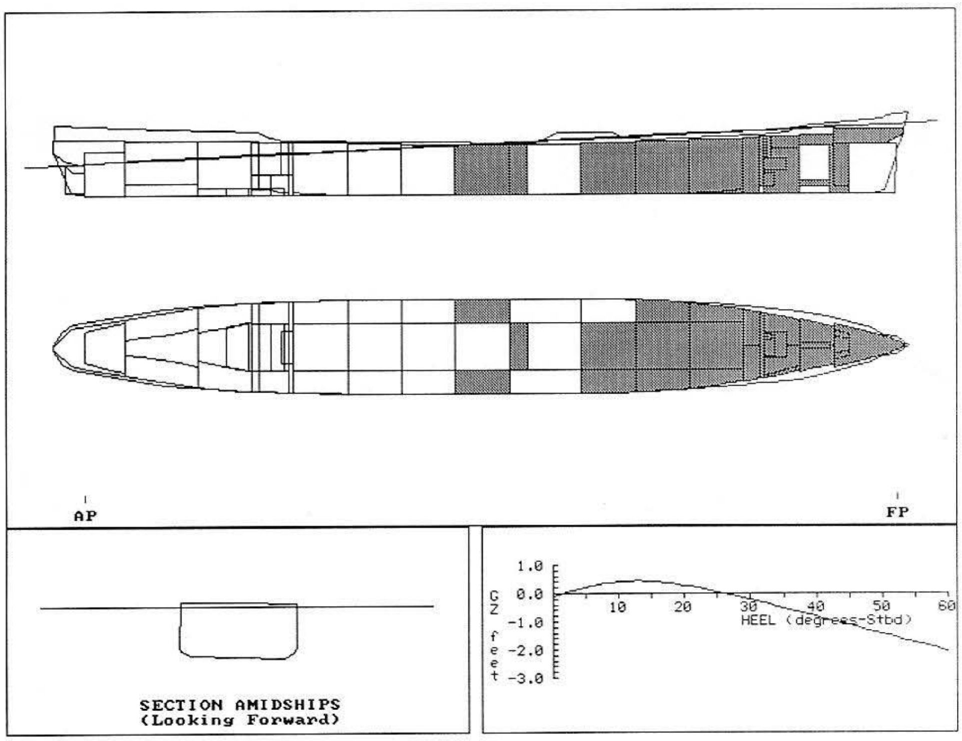


Figure A-2. POSSE Output – PHOTO.SAL

Even in this condition, POSSE indicates that the ship has a range of positive stability between 0 and 25 degrees. It is speculative whether the ship capsized first from Engine and Boiler Room downflooding and accumulated firefighting water on upper decks (see CAPSIZE.SAL), or the roll was completed when the bow hit bottom in 130 feet of water (at a vessel trim of about 15 degrees by the bow). This latter condition (see ROLLOVER.SAL) has the capsize roll generated by the coral reaction at the bow, which would have twisted the bow to port. The remainder of the ship could have completed its roll as shown in the dramatic Sid Harris photograph (see Figure A-3) with the propellers up and the ship rolled 135 degrees or so to port.

Photographic documentation of the latter Sid Harris photo shows that the Engine Room would have flooded through the port side through downflooding, or it may have been filled by firefighting water. No one knows, but in any case, the ship sank within a few minutes of its final roll. The fact that the empty Cargo Oil Tank, COT 9-C, shows no sign of having imploded at the current depth indicates that progressive downflooding into this tank probably accelerated parallel sinkage and the loss of freeboard. The POSSE documentation contained in Figure A-2 illustrates this plausible hypothesis, and the hull survey bears out the damage extent.

Under either scenario, the POSSE modeling shows that the ship could have sunk without any loss of its NSFO in COTs 5-P/S/C, 7-P/S/C, 8-P/S/C, 9-P&S, the Ship's Fuel Oil Tanks aft in the Engine Room Deep Tanks and Double Bottom Tanks, or 9,000 bbls of Diesel Oil in COT 6-C. In fact, it is believed that the presence of oil in these tanks helped arrest the ship's roll at 180 degrees and allowed it to settle on the bottom upside down, as it lies today.

Solid Edge Model

Solid Edge is a powerful 3-D parasolid modeling computer program used to simulate any three-dimensional object or assemblage of objects. Figure A-4 shows a model of the piping in COTs 4-P/C/S. This figure has been annotated to show where the leak sources were encountered as described in the front sections of this report.

Stern view as ship rolls to port – S. Harris, 1944

Figure A-3. Sid Harris Photo of *Mississinewa* – Stern View as Ship Rolls to Port

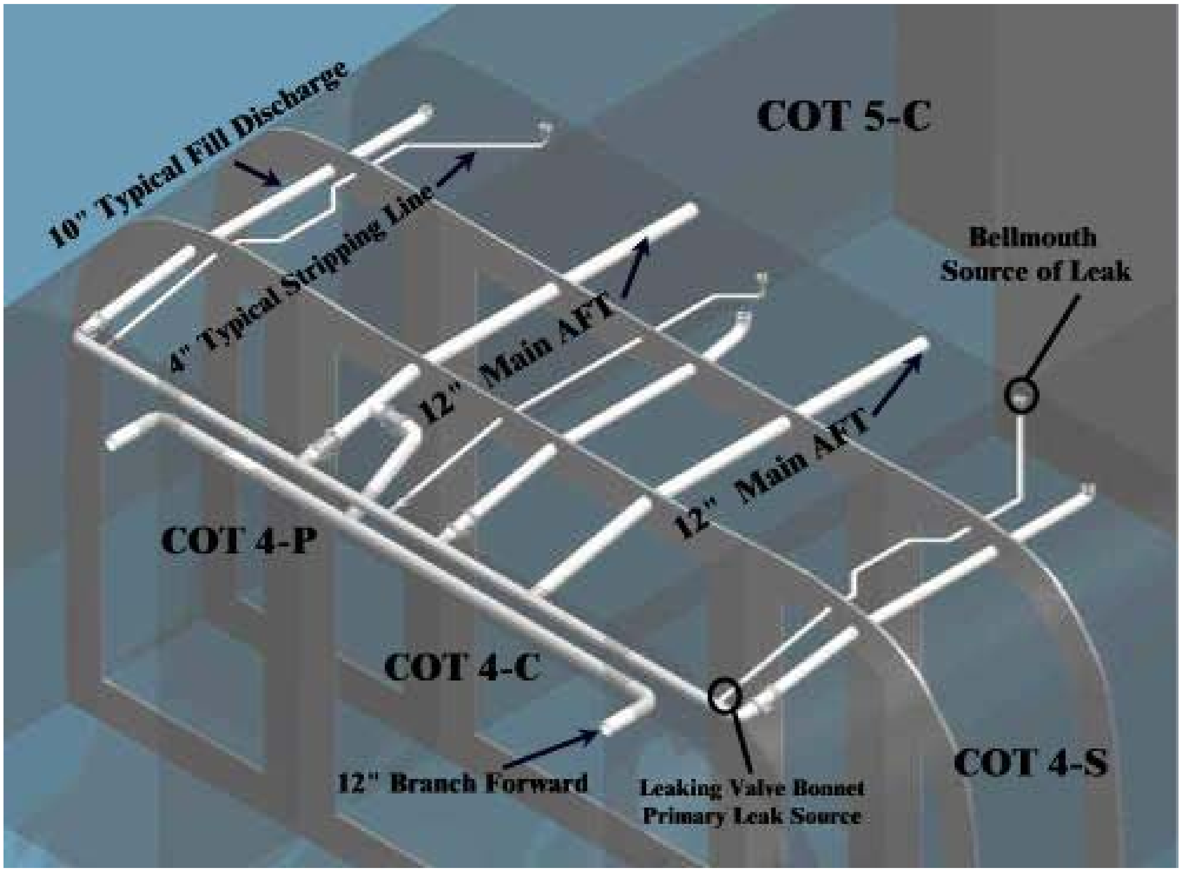


Figure A-4. Model of Cargo Oil Tank #4

Appendix B

Cargo Condition

Captain's Report of Loading

From Captain Philip Beck's action report:

> The ship had arrived at Ulithi Atoll anchorage, Western Caroline Islands, Palau Group, on 15 November 1944, and anchored in 23 fathoms of water in berth #131, on the new chart. There was on board, at arrival,-404,000 gallons of aviation gasoline in #2 center tank and 9,000 barrels of Diesel Oil in #6 center tank. The #6 wing tanks, port and starboard, had sea water ballast in them to an ullage of 12 feet. A merchant tanker came alongside immediately after anchoring, and we started to load Navy Special Fuel Oil from this tanker. Loading was completed 16 November 1944 and the ship reported ready for sea with a standard load, to ComServRon TEN. Standard load for this type of ship was 404,000 gallons of aviation gas in #2 center tank; 9,000 bbls of diesel oil in #6 center tank and 90,000 bbls of Navy Special Fuel Oil in all remaining tanks, except #1 port and starboard and #3 and #9 center tanks, which were empty, but not gas free.

Volume Analysis

The report does not say how the NSFO is distributed among the tanks, nor how much Fuel Oil (assumed to also be NSFO) was aboard the ship. Ninety thousand barrels of NSFO equates to 13,660 LT of cargo oil, with average tank capacities at 97-98%. This capacity allows for an expansion margin for ambient temperatures in the Pacific, and it represents a full load of fuel. In addition, it is assumed that readying the ship for sea with a "standard load" would have required nearly full Fuel Oil tanks for its mission to "ComServRon Ten." The assumption is made that the Fuel Oil Tanks Aft also contained NSFO, but that the volume (1203 LT) is not part of the 90,000 Bbls mentioned "…in all remaining tanks…"

Further, it is unknown how much Fuel Oil was carried in the Reserve Fuel Oil Tanks Forward (Frs 84-102). However, the photographs show that the ship stayed for some time with her Focsle deck awash, and in order not to have gone under immediately, the POSSE model suggests that the ship needed net buoyancy forward in this downflooded condition (i.e., after downflooding the Focsle and the spaces below deck) to remain afloat as long as it did. The estimate of the total NSFO on board (Cargo and Fuel Oil) at the time of the torpedo attack is therefore taken as 14,863 LT (97,947 Bbls). To this is added 9,000 Bbls of Diesel Oil in COT 6-C, and the 404,000 gallons of Avgas in COT 2-C. Table B-1, Tank Weight Summary AO 59, from POSSE shows the assumed breakdown of NSFO, Diesel Oil and Avgas.

Estimate of Maximum Residual Oil

It is conjectured from the Captain's description of a port side hit with an immediate follow-up explosion that all NSFO cargo from tanks COT 4-S/C, 3-P/S and 2-P&S was immediately released, ignited and then consumed in the fire generated by the Avgas explosion and fireball. This conjecture is consistent with the diver's survey of the condition of OTB-76, which is open to the sea in way of COT 4-C/S. The survey revealed COT 4-P forward bulkhead at OTB-76 to be intact, but cracks exist in the shell plating aft of the bulkhead. These cracks suggest that the NSFO in COT 4-P seeped out over time rather than being immediately released to feed the fire. The 404,000 gallons of Avgas provided the bulk of the fireball that consumed the ship and ignited the NSFO released by the torpedo damage.

From the dive team's assessment of the shell plating aft of COT 4-P/S/C as intact and sound, it is plausible to conclude that nearly all of the NSFO distributed aft of the OTB-73 remains on board the AO 59. Subtracting out the NSFO lost in the fire and immediate release to the sea, as well as seepage over time, it is estimated that there may remain as much as 9,243 LT or 60,911 bbls. of NSFO Cargo Oil and 1,203 LT or 7,928 bbls. of Fuel Oil (likely also NSFO) within the wreck. In addition, there is reason to assume that all 9,000 bbls. of Diesel Oil in COT 6-C remain, as well. An amount of Engine Room lube oil may remain of approximately 9 LT or 62 bbls. Table 2 in Section C summarizes remaining oil volumes.

An estimate of residual oil in the bow section is more difficult to grasp. The diver survey found the bow plating forward of the CD at Fr. 83-84 to be intact. The documentary photographs and written accounts suggest that the ship stayed afloat for two hours, a fine testimony to its subdivision and sound construction. It is entirely plausible that the empty or lightly filled Reserve Fuel Oil (RFO) tanks forward (Frs 84-102) resisted the increase in hydrostatic head until they failed, burst, or downflooded progressively through the tank vent piping. Either way, the vessel sank by its head from progressive flooding of forward spaces, as documented in the photographs. It is estimated that the RFO tanks' collective contribution to the total remaining NSFO, if any, is small.

The diving survey did not assess the condition or location of any remaining munitions or hazardous materials on board the vessel.

AO-51 CLASS -- USS MISSISSINEWA
Rev. C (by: RMW/JAK)

OOC POSSE-LOAD V2.2
SEPT 20, 2001

TANK WEIGHT SUMMARY
AO-59

AVIATION GAS Tanks

TANK NAME	WEIGHT LTons	% Full	CAPACITY LTons	VOLUME Bbls	NET VOL. Bbls	API GRAV.	TEMP. oF	SP.VOL. Bbls/LT	KG ft-BL	LCG ft-AP	TCG ft-CL	F.S. ft-LTons
CARGO-2C	1,102	98.8	1,115	9,617	0	----	0.0	8.7273	20.431	409.137F	0.000	2,655
CARGO-3C	0	0.0	1,080	0	0	----	0.0	8.7273	20.938	374.167F	0.000	0
TOTALS	1,102	50.2	2,195	9,617	0				20.431	409.137F	0.000	2,655

Cargo Oil Tanks

TANK NAME	WEIGHT LTons	% Full	CAPACITY LTons	VOLUME Bbls	NET VOL. Bbls	API GRAV.	TEMP. oF	SP.VOL. Bbls/LT	KG ft-BL	LCG ft-AP	TCG ft-CL	F.S. ft-LTons
CARGO-1P	0	0.0	272	0	0	----	60.0	6.5900	23.712	431.573F	12.131P	0
CARGO-1S	0	0.0	272	0	0	----	60.0	6.5900	23.712	431.573F	12.131S	0
CARGO-2P	366	97.1	377	2,412	2,412	----	60.0	6.5900	24.872	407.153F	24.476P	164
CARGO-2S	366	97.1	377	2,412	2,412	----	60.0	6.5900	24.872	407.153F	24.476S	164
CARGO-3P	543	97.0	560	3,578	3,578	----	60.0	6.5900	22.651	373.512F	26.740P	362
CARGO-3S	543	97.0	560	3,578	3,578	----	60.0	6.5900	22.651	373.512F	26.740S	362
CARGO-4C	1,355	98.0	1,383	8,929	8,929	----	60.0	6.5900	20.250	339.167F	0.000	3,391
CARGO-4P	622	97.0	641	4,099	4,099	----	60.0	6.5900	20.976	338.865F	27.908P	491
CARGO-4S	622	97.0	641	4,099	4,099	----	60.0	6.5900	20.976	338.865F	27.908S	491
CARGO-5C	1,339	98.0	1,366	8,824	8,824	----	60.0	6.5900	20.000	304.167F	0.000	3,367
CARGO-5P	849	97.0	875	5,595	5,595	----	60.0	6.5900	20.344	298.324F	28.161P	680
CARGO-5S	849	97.0	875	5,595	5,595	----	60.0	6.5900	20.344	298.324F	28.161S	680
CARGO-7C	1,339	98.0	1,366	8,824	8,824	----	60.0	6.5900	20.000	222.500F	0.000	3,367
CARGO-7P	635	97.9	648	4,185	4,185	----	60.0	6.5900	20.559	222.584F	28.083P	509
CARGO-7S	635	97.9	648	4,185	4,185	----	60.0	6.5900	20.559	222.584F	28.083S	509
CARGO-8C	1,353	98.0	1,380	8,916	8,916	----	60.0	6.5900	20.208	187.500F	0.000	3,387
CARGO-8P	603	98.1	615	3,974	3,974	----	60.0	6.5900	21.601	187.840F	27.695P	500
CARGO-8S	603	98.1	615	3,974	3,974	----	60.0	6.5900	21.601	187.840F	27.695S	500
CARGO-9C	0	0.0	1,405	0	0	----	60.0	6.5900	20.630	152.514F	0.000	0
CARGO-9P	519	97.1	535	3,420	3,420	----	60.0	6.5900	23.549	153.101F	26.850P	444
CARGO-9S	519	97.1	535	3,420	3,420	----	60.0	6.5900	23.549	153.101F	26.850S	444
TOTALS	13,660	85.7	15,946	90,019	90,019				21.112	272.209F	0.000	19,812

Fuel Oil Tanks

TANK NAME	WEIGHT LTons	% Full	CAPACITY LTons	VOLUME Bbls	NET VOL. Bbls	API GRAV.	TEMP. oF	SP.VOL. Bbls/LT	KG ft-BL	LCG ft-AP	TCG ft-CL	F.S. ft-LTons
FO48-S	265	96.5	275	1,746	1,746	----	60.0	6.5900	27.009	120.852F	25.863S	243
FOTANK-48CU	589	96.7	609	3,882	3,882	----	60.0	6.5900	27.948	120.000F	0.000	2,685
FO48-P	265	96.5	275	1,746	1,746	----	60.0	6.5900	25.744	120.922F	25.726P	240
FOTANK-48CL	84	96.7	87	554	554	----	60.0	6.5900	2.555	118.780F	0.000	1,045
RSFO84-P	0	0.0	334	0	0	----	60.0	6.5900	19.383	451.576F	9.932P	0
RSFO84-S	0	0.0	339	0	0	----	60.0	6.5900	19.549	451.453F	9.887S	0
RSFO94-P	0	0.0	224	0	0	----	60.0	6.5900	20.279	472.043F	6.519P	0
RSFO94-S	0	0.0	224	0	0	----	60.0	6.5900	20.279	472.043F	6.519S	0
TOTALS	1,203	50.9	2,367	7,928	7,928				25.483	120.306F	0.030S	4,213

Table B-1. Tank Weight Summary for *Mississinewa*

AO-51 CLASS -- USS MISSISSINEWA
Rev. C (by: RMW/JAK)

OOC POSSE-LOAD V2.2
SEPT 20, 2001

TANK WEIGHT SUMMARY
AO-59

Diesel Oil Tanks

TANK NAME	WEIGHT LTons	% Full	CAPACITY LTons	VOLUME Bbls	NET VOL. Bbls	API GRAV.	TEMP. oF	SP.VOL. Bbls/LT	KG ft-BL	LCG ft-AP	TCG ft-CL	F.S. ft-LTons
CARGO-6S	0	0.0	578	0	0	----	60.0	7.4805	20.350	257.508F	28.160S	0
CARGO-6C	1,203	100.0	1,203	9,002	9,002	----	60.0	7.4805	19.000	257.500F	0.000	0
CARGO-6P	0	0.0	578	0	0	----	60.0	7.4805	20.350	257.508F	28.160P	0
TOTALS	1,203	51.0	2,359	9,002	9,002				19.000	257.500F	0.000	0

Fresh Water Tanks

TANK NAME	WEIGHT LTons	% Full	CAPACITY LTons	VOLUME ft3	SP.VOL. ft3/LT	KG ft-BL	LCG ft-AP	TCG ft-CL	F.S. ft-LTons
FOREPEAK	150	50.0	301	5,411	36.0000	19.222	506.641F	0.000	156
RFWATRER-41	40	80.0	50	1,434	36.0000	2.803	98.950F	0.000	1,023
TOTALS	190	54.3	351	6,846		15.782	421.236F	0.000	1,179

SW Ballast Tanks

TANK NAME	WEIGHT LTons	% Full	CAPACITY LTons	VOLUME ft3	SP.VOL. ft3/LT	KG ft-BL	LCG ft-AP	TCG ft-CL	F.S. ft-LTons
RSFO84-P	0	0.0	353	0	35.0063	19.383	451.576F	9.932P	0
RSFO84-S	0	0.0	353	0	35.0063	19.383	451.576F	9.932S	0
RSFO94-P	0	0.0	237	0	35.0063	20.279	472.043F	6.519P	0
RSFO94-S	0	0.0	237	0	35.0063	20.279	472.043F	6.519S	0
AFT PEAK TK	0	0.0	272	0	35.0062	25.916	15.357F	0.000	0
SWB-6-P	416	60.0	694	14,570	35.0062	20.350	257.508F	28.160P	539
SWB-6-S	416	60.0	694	14,570	35.0062	20.350	257.508F	28.160S	539
TOTALS	832	29.3	2,840	29,139		20.350	257.508F	0.000	1,078

Table B-1 (continued). Tank Weight Summary for *Mississinewa*

01X AO-51 CLASS -- USS MISSISSINEWA OOC POSSE-LOAD V2.
Rev. C (by: RMW/JAK) SEPT 20, 2001

TRIM & STABILITY SUMMARY
AO-59

ITEM	WEIGHT LTons	KG ft-BL	LCG ft-AP	TCG ft-CL	FSmom ft-LTons
Light Ship	7,136	37.000	230.000F	0.000	
Constant	0	0.000	262.500F	0.000	0
Misc. Weight	0	0.000	262.500F	0.000	0
AVIATION GAS	1,102	20.431	409.137F	0.000	2,655
Cargo Oil	13,660	21.112	272.209F	0.000	19,812
Fuel Oil	1,203	25.483	120.306F	0.030S	4,213
Diesel Oil	1,203	19.000	257.500F	0.000	0
Fresh Water	190	15.782	421.236F	0.000	1,179
SW Ballast	832	20.350	257.508F	0.000	1,078
TOTALS	25,327	25.601	258.996F	0.001S	28,937

STABILITY CALCULATION

KMt	30.393	ft
KG	25.601	ft
GMt	4.791	ft
FSc	1.143	ft
GMt Corrected	3.649	ft

TRIM CALCULATION

LCF Draft	32.201	ft
LCB (even keel)	260.30	ft-FWD
LCF	244.938	ft-FWD
MT1in	2,286	ft-LT/in
Trim	1.206	ft-AFT
Prop. Immersion	180	%
List	0.02	deg-STBD

DRAFTS

A.P. 32ft- 9.16in (9.986m)
M.S. 32ft- 1.92in (9.802m)
F.P. 31ft- 6.69in (9.619m)

Table B-1 (continued). Tank Weight Summary for *Mississinewa*

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix C

Field Reports

Friday – 8/17/01
Supervisor of Salvage and Diving (SEA00C) verbally tasks GPC to provide an assessment team with divers, to proceed to the Ulithi Atoll, Federated States of Micronesia (FSM), to perform the following on the sunken vessel *Mississinewa*, which has been leaking oil into the waters of the atoll.

1. Survey accessible beaches for oil impact.
2. Perform underwater survey of the bow section and assess the amount of product that may be in the tanks.
3. Conduct survey of the main hull if the leak was not from the bow section.
4. Prepare a report on the findings.

Arrangements were made for Lloyd L. Saner, the GPC ESSM Program Manager, to depart from Hawaii on the first available flight which was not until Monday 8/20/01. Arrangements were also made for Mr. Chip Lambert to join the team. Mr. Lambert had located the wreck in the Ulithi lagoon in April of this year and could provide assistance and recent knowledge of the area and local contacts. A commercial dive team from Guam, Pacific Foundation, Inc., was subcontracted to provide the diving support.

Monday – 8/20/01
Lloyd L. Saner and Chip Lambert departed Hawaii 1:35 PM August 20, 2001 for Ulithi Atoll to assess *Mississinewa* leaking oil and oil spill.

Tuesday – 8/21/01
Arrived in Guam at 4:55 PM on August 21, 2001 (Guam time) and had to layover for flight to Yap at 6:30 AM the next day. Contacted CDR Lynch , a Navy legal representative on Guam, but he had no further information to provide. Met with Matt Kahler of Pacific Foundation, Inc. who provided the dive team. The Guam region was experiencing its monsoon rainy season with poor weather and local storms. Ulithi was only about 350 miles southwest of Guam and was having similar poor weather.

Wednesday – 8/22/01
Lloyd Saner and Chip Lambert departed for Yap at 6:30 AM August 22, 2001, and arrived on Yap at approximately 8:00 AM. They were met by Mr. Victor Hobson of the U.S. Department of the Interior (Federal Programs Coordinator for Micronesia) and Chief Bruce Cotter of the USCG Pacific Strike Team. They checked on the chartered flight to the island of Falalop, Ulithi Atoll and were informed that the weather was too bad to fly and should check back that afternoon.

A meeting was planned for 10:00 AM with the Yap Government agencies. Saner and Lambert were asked to attend the meeting and brief them on the Navy's plan. The meeting chairperson was Jesse Raglmar, Director of Planning and Budget; attendees were Anthony M. Tareg, Fifth

Legislature of Yap; Member Government Health & Welfare Committee, J. Victor Hobson, Jr., U.S. Department of Interior, Federal Programs Coordinator for Micronesia; Chief Bruce Cotter of the USCG; Mr. Lambert GPC consultant; and Lloyd Saner.

Mr. Saner briefed the meeting on U.S. Navy plans that included: assessment of the vessel to determine the condition of the hull, attempt to patch the leak, the determination of what could be done to clean up the spilled oil, and the assessment of the oil damage to beaches. The USCG representative said they had done a beach assessment and concluded there was no need to attempt any beach cleaning. All seemed pleased with the plan and understood that weather would slow or delay action.

Upon arrival at the atoll, the aircraft flew over the oil slick to determine extent and movement of the oil. The slick appeared to be in windrows with the widest point being approximately 30' to 50' across and stretching about 3/4 to 1 mile down wind. Upon landing on Falalop Island, a meeting was held with the Island Chief and the local leaders. Talked to the local dive master about his last dive on the vessel and what he observed. After talking to him, it became apparent that the leak was not coming from the bow section but from the after part of the vessel.

Thursday – 8/23/01
Winds on Island were approximately 35 mph with rainsqualls.

Mr. Saner reviewed the diving equipment and boats available on island for possible use of the dive team. Set up communications via the Land SATCOM and reported to SUPSALV. Divers were reported to be arriving in Yap at approximately 10:00 PM, along with two GPC personnel, Jeff Cane and Paul Schadow.

The local dive master and Mr. Lambert made recreational dive on the vessel and provided some additional information on their observations. They measured the discharge rate by collecting oil at the release point into a quart jar and timed how long it would take to fill the jar. This produced a calculated rate of release to be approximately 15 gal. per hour. The point of the oil release was a crack in an overhanging piece of hull plating at the forward part of the broken hull. Oil was accumulating inside of the open, blown-out tank and leaking out of the crack. The ultimate source of the leak could not be determined.

We were notified that the dive team support vessel from Guam, with additional diving and repair equipment, had broken down and had turned back. Plans were made for all equipment to be flown from Guam. The Yap State vessel, *Micro Spirit*, in the Ulithi Lagoon was offered as a diving support vessel. Since the equipment would not arrive in Yap until the evening of August 25, the dive team was to be flown to the Island of Falalop. The diving survey could begin using scuba gear rented from the island's recreational shop.

Friday – 8/24/01
Winds on Island were still approximately 35 kts. with rainsqualls. GPC personnel, Jeff Cane and Paul Schadow, along with two divers arrived on the Island (Falalop) at approximately 10:00 AM. We made an attempt to get a dive in this day; however, the weather and seas were too bad to

launch the small boats. There is no harbor on the island, and all boats must be launched off the beach and through the surf.

Saturday – 8/25/01
Winds on Island are still approximately 30 kts. with rainsqualls. We tried to get out for a dive to the site approximately 8 miles away through mostly open water. At approximately 11:00 AM, the wind and seas subsided somewhat; however, still quite rough. The dive team with their equipment was launched through the surf in the 20-foot open boat. The team included Matt Kahler and one of his divers, an Ulithi diver, and a diver off the *Micro Spirit*.

After completing the first dive, it was concluded that the source of the oil was possibly coming from what appeared to be # 4 starboard wing tank; however, they had still not located the actual oil release point. On the second dive after further exploring in wing tank # 4, they discovered a tank suction pipe was leaking oil. The pipe was discharging into the tank and feeding the accumulation of oil behind the cracked overhanging plate. The discharge rate from this pipe approximated the rate being discharged into the water from the crack. This pipe appeared to be a bell reducer from 8" to 4" pipe. Because of limited air, the team had to depart and return to Falalop for the day.

The plan for the next day was to take patching material and attempt to stop the leak. Rags would be pushed into the 4" pipe, then plastic bags with cement would be inserted, and the plug would be secured with plywood placed over the opening and fastened with a line to the 4" pipe. All material was to be found and procured on the Island.

ESSM equipment had been requested from Hawaii that included: 1 peristaltic pump with suction and discharge hoses; one 500-gal. Bladder; 4 bundles of sorbent boom; 2 bales of sorbent pads; and one scuba bottle compressor. The shipment was to arrive in Yap on Monday, August 27. Jeff Cane and one member of the dive team were sent back to Yap to coordinate equipment shipment and to locate a support vessel. Jeff Cane surveyed the vessel, *Cecilia*, a 160-foot landing craft type vessel. It was determined that it was not suitable. The Yap State vessel, *Micro Spirit*, was offered but had no tanks for recovered oil.

Sunday – 8/26/01
Winds on Island still approximately 35 kt. On Sunday, the entire Island goes to church, and no work gets accomplished until after 10:30 AM. After church services, it took approximately 1 1/2 hours to get the boats and equipment ready and launched.

Weather was very bad with choppy seas; however, we were able to get the dive team underway by 12:30. It took approximately 1 1/2 hours to transit the eight miles to the site in bad weather.

Saner had a conference call with U.S. Interior Department representative, several Yap government agencies, and Jeff Cane. They had not yet been briefed on our findings and patching plan. I briefed them on the previous day's results and the plan to stop the leak. They again offered up the State vessel and made a commitment to send the vessel back to Yap tonight and load out all the equipment for surface supplied diving and for pumping. They also would look for some way to store the recovered oil even if it is in 55-gal.drums. We agreed to accept the offer and would work with the personnel on Yap to load out all the equipment on Monday and send it back that night. With the *Micro Spirit* as a support platform, we would be able to complete the survey and pump off the trapped oil in the #4 starboard tank.

Later in the day, the dive team returned and reported that they had plugged the pipe suction and that oil had stopped leaking. They were able to push rags into the 4” pipe and install two layers of cement over the top. They could not place the plywood cap on the pipe, since after closer inspection there were small extrusions on the top, which would not allow the plywood to seal. The diver measured the oil in the aft overhead at 16” and it would be checked again on next dive. If the oil level is lower, it would indicate that the leak from the ship has been stopped. After the pipe patching, there was not enough air supply remaining to plug the crack in the overhanging hull plate.

Monday – 8/27/01
Winds on Island were still very bad – approximately 35 to 40 kt seas and very choppy. Weather is too bad to launch the small boats, and operators would not go out. We have not had any good days, but the dive team and the small boat personnel do an outstanding job of fighting the weather, which has allowed us to accomplish what has been done thus far.

We had a conference call with U.S. Interior Department representative and Jeff Cane. We briefed DOI on the previous day’s results and the plan to return to do the patching of the crack in the overhanging hull plate. However, at the time we were not sure if we could get out due to weather. The ESSM equipment shipment was delayed in Guam and would not be delivered to Yap until the Wednesday flight. This in turn would delay the *Micro Spirit*’s departure and the start of the surface supplied diving operations.

Since no boats could be launched, we requested the Pacific Missionary Aviation (PMA) pilot to over fly the spill site during his regular flight schedule and give us an assessment of the spill. He stated that the surface oil appeared not to be as heavy or have a defined point of release and seemed to be moving away from the original release point. The pilot had been observing the spill three times a week since it started, so was familiar with changes in the oil slick on a daily basis. This observation would indicate that the oil release may have been stopped and the remaining oil on the surface of the water is being carried away and dissipated by the rough seas.

Saner was notified that Mr. Jim Ruth, a SUPSALV representative, would be arriving on the Wednesday flight to relieve the ESSM project manager. Saner would fly to Yap Tuesday afternoon so as to be there to brief him and introduce him to all the players. Jeff Cane and Paul Schadow would remain at the atoll to complete the survey and oil removal.

Tuesday – 8/28/01
Winds on Island had dropped off considerably to approximately 12 to 25 kts. with seas much less choppy.

Dive team got underway for wreck at approximately 9:00 AM. Dive team returned at 12:30. Diver checked patch that had been installed in the pipe suction on the last dive two days ago. There was no leak and the cement had hardened. They measured the remaining depth of oil in the overhead; it was 11" in the aft of the tank and 4" at the crack in the overhang. This depth was down from the previous dive by 5", indicating that the leak into the overhead had stopped.

Divers proceed to fill the crack in the overhanging plate to stop remaining trapped oil from leaking out into the water. The crack was stopped using socks filled with cement and placed into the crack. They placed more cement on top of the socks to hold the patch in place. The patching stopped the oil in the overhead from leaking, and no more oil was being released.

Saner was scheduled to depart Falalop for Yap at 2:30. When the aircraft arrived, the pilot stated that he could not detect any oil on the water in his over flight. When we departed for Yap, we flew around the area of the wreck in an effort to locate an oil slick. After approximately 20 minutes of circling, we could not see any oil on the surface of the water.

Wednesday – 8/29/01
The dive team got underway for wreck at approximately 8:00 AM and returned at approximately 12:30.

The divers checked the patch installed in the pipe suction and saw no leak. They also checked the patch in the crack and saw no leak. The divers completed hull measurements for future reference.

Saner met with the Governor of Yap and heads of all Government agencies. He briefed them on where we were at this time and expressed to them that the only remaining holdup for us to complete our work was the disposition of trapped oil to be pumped from the open tank. We estimated this to be approximately 2500 gals.

Saner stated that if we were not allowed to put it on the *Micro Spirit* and bring it to Yap, it would delay our completion. We may have to leave the trapped oil in the damaged tank until some other arrangements could be made, and we could not ensure that the oil would not leak out. The governor was very happy with our progress to date and thanked us for our work. He directed that the *Micro Spirit* could receive the oil, and it could be brought to Yap for future shipment. He requested that a written agreement be drawn up with some time frame that the oil must be removed from Yap; he indicated 90 days. Saner agreed that we could work that agreement out and would get back to him tomorrow.

The ESSM Hawaii shipment had arrived and was being loaded on *Micro Spirit*. All equipment was operated and inspected to ensure all was there and in good working order. We engaged freight forwarder, WAAB Shipping Agency of Yap, in regard to transport of the recovered oil to Guam and return shipment of the ESSM equipment.

We completed the load out of *Micro Spirit*, and it departed at 6:00 PM for Ulithi. One diver and one diver tender from subcontractor rode the vessel.

On Ulithi, the weather was also improving. The dive team continued to patch the hull crack in wing tank #4 with more cement. Divers observed that the #4 port and center transverse bulkheads were damaged and open to the sea. A tape measure was pulled from the aft perpendicular to the #4 fwd bulkhead. This measured approximately 358 ft., confirming the actual bulkhead location. Divers verified that the weather deck edge stbd. side is not buried in the sand.

As divers were inspecting tank #4 forward bulkhead, the divers air was aggravating the release of oil from the crack in the hull bottom plate. Depth of bow section is 133 ft. and 127 ft. aft as determined by diver's depth gauge.

Thursday – 8/30/01
Jim Ruth arrives on Yap to supervise on-site operations. Saner and Ruth discuss the project and effect a smooth turnover.

The vessel *Micro Spirit* arrived at Ulithi at approximately 7:00 AM and proceeded in close to the shore of Falalop to pick up Paul Schadow and the dive team. It then proceeded to the wreck site and went into a three-point moor for surface supplied dive operations over the wreck.

After assembling the necessary gear, the divers started to dive at approximately 12:00 noon.

On Yap, Saner prepared a letter for the Governor assuring that arrangements with WAAB Shipping Agency had been made for shipment of oil from Yap as soon as possible. He met with Mr. Gaw, the WAAB division manager, and showed the letter to him and requested that he sign it as assurance that he agreed to the terms and would move the oil as quickly as possible. He then took the letter to the office of Planning & Budget to present it to Mr. Jesse Raglmar; however, he had gone to another Island for the day.

At approximately 2:30 PM, Victor Hobson, of the U.S. Department of the Interior, visited Mr. Saner and stated that he had met with Jesse Raglmar on his return from the Island of Hasa some 45 miles east of Ulithi Atoll. The island had complained that there was oil on the beaches; Jesse collected samples and brought them back to Yap. They believed the oil came from *Mississinewa*. Saner did not see the oil and did not address it with any other personnel other than Victor Hobson. Hobson also stated that they had flown over the wreck site where diving operations were going on and noticed some very small amount of sheen.

The Government of Yap requested that there should be a 90-day limit for removal of the oil from Yap and further requested a charter fee of $3,000 per day for the vessel, *Micro Spirit*, starting yesterday, August 29. We agreed to these terms. Jesse Raglmar would meet him at the airport to sign an agreement to these conditions.

On Ulithi, Paul Schadow reported that after using surface supplied air, the divers found the following:

1. The crack in the overhang was leaking approximately 3 to 5 drops a minute; plans are to redo the patch in the morning.
2. After a better survey of tanks, it was discovered that # 4 port wing tank had an opening to the sea and there was no oil in it. There will be a better survey of this tank in the morning to determine the opening size and ensure that there is no oil in it.

3. In another check of the trim and list of the vessel, it was determined that the aft hull section is laying inverted, down by the bow 3 degrees and has a 5 degree list to port.
4. The side plate at the deck edge tightness was checked and was determined to be 1/2".
5. It was also determined that the superstructure is visible under the vessel.

Friday – 8/31/01
Ruth and Cane meet with Governor Figir, Lt. Governor Yatilman and members of the Yap State Disaster Coordinating Team. Ruth explains that the purpose of the mission is to assess the condition of *Mississinewa* and to stop the oil leak if possible. Ruth emphasizes the purpose of the mission is for fact finding and that future actions will be decided by higher authority.

Saner departed Yap for Guam and Honolulu on the midnight flight after meeting with Jim Ruth. In the morning, Ruth and Cane had a meeting with the Governor of Yap and his staff. Later in the morning, they took the charter flight to Ulithi and then caught the island launch to *Micro Spirit*, arriving on board in the afternoon.

The dive team found the following:

1. Hull preparations for the ultra sound readings on tank #5
2. Measured from #4 fwd bulkhead aft:
    - 0.87 in. @ 38 ft. along the bottom shell
    - 0.79 in. @ 72 ft. along the bottom shell
    - 0.224 in. @ 95 ft. aft, on side shell 15 ft. below the bilge keel (pneumo read 105 ft.)
        - Note: The 0.224 in. reading may be due to steel plate delamination.
3. Bottom shell crack on #4 stbd bottom shell still leaking approximately 12 gallons per day.
4. Cleaned and marked transverse bulkheads and tried to locate docking plugs.
5. Discovered tank #7's centerline docking plug.

Saturday – 9/1/01
Weather was marginal with winds 15 mph and seas 3 to 5 ft., very heavy rain and poor visibility requiring the use of GPS to locate *Micro Spirit*. The team began setting up of oil removal gear on *Micro Spirit*'s weather deck. Dive operations are undertaken to place the suction hose inside tank #4 stbd. The oil level measured 22 in. vs. the 11 in. from Tuesday's reading indicating a new oil leak.

Using the ESSM peristaltic pump on deck, the team filled more than 70 oil barrels with the trapped #4 tank oil. During the pumping work, the diver discovered that the 4-inch valve bonnet bolts and nuts assemblies had wasted away and there is a 1/2-in. to 3/4-in. gap in the bonnet, which allows oil to escape.

Sunday – 9/2/01
The weather had improved. Arrangements were made to obtain an additional 25 empty drums from the Mobile Oil facility on Ulithi. Church services again delay the morning start. Later the team filled 25 drums. Divers reported 6 inches of oil remaining in the space. The team

requested a second delivery of 20 additional drums from Ulithi. Twenty drums are delivered late AM.

The divers prepared a gasket and hose-clamp assembly to seal the 4" valve bonnet perimeter. The patch was installed and appeared to be effective. The divers installed 4-inch angle brackets with 5/8 in. threaded rod assembly to tighten the bonnet patch.

The remainder of day was spent removing oil from the #4 wing tank. A total of 117 drums of oil were removed, including 3 or 4 that were contaminated with a salt water and oil mix.

Monday – 9/3/01
Weather was clear with low winds in the morning. *Micro Spirit*'s starboard side mooring line parted during the previous evening. The team spliced and re-rigged the mooring before the dive operations could be started. With the mooring secured, a diver inspected the valve repairs. A small leak was detected and a decision made to use a 5-gallon plastic bucket and encapsulate valve with concrete.

The team conducted a beach survey for signs of oil deposition on Asor Island.

Tuesday – 9/4/01
Weather was clear and wind was calm in the morning. The divers located and cleared the docking plugs on entire stbd. side wing tanks and the #5 and 6 port wing tanks.

Beach surveys were conducted on Yao and Losiep islands, which were on a 110° heading from *Micro Spirit*.

After installing the 5-gallon bucket with concrete over the valve the day before, it was noted that there was still a small leak because the bucket was too small to encapsulate the entire valve. A 55-gallon plastic barrel was cut in half and installed so as to fit on either side of the valve. The barrel was filled with concrete. No further oil leak was observed.

Wednesday – 9/5/01
ESSM pumping equipment was flushed, cleaned and secured for trip back to Yap. The hull inspection was completed with video. Further ultrasound measurements were not possible because of an instrument malfunction. *Micro Spirit* departed to Yap at 4:00 PM.

Thursday – 9/6/01
The team returned to Falalop. All rented dive equipment was returned, and local expenses were settled. Arrangements made with PMA for AM pick-up the next morning.

Friday – 9/7/01
Ruth and Cane debrief Lt. Governor Yatilman and the Yap State Disaster Coordinating Team on the project. Ruth emphasizes leak has been stopped and sealed. Lt. Governor also told of ultrasonic readings and that hull appears to be in good shape for the conceivable future. Lt. Governor Yatilman wished to emphasize that the Yap government was grateful for the actions taken. He further emphasized that it is the Yap government's position that it is their desire the

oil be removed from *Mississinewa* under controlled conditions vice waiting for a catastrophic release of oil due to a hull breech from corrosion or a typhoon.

Team flew to Yap. Arrangements were made for shipping of ESSM gear from Yap to Hawaii. Followed up with the arrangements for shipping of all oil drums materials to Guam via the WAAB shipping agent. Flight arrangements off the island to Guam and beyond are not possible until Wednesday for Guam.

Ulithi Atoll Beach Survey Notes

On Monday, September 3, 2001 the GPC representative Jeff Cane and personnel from *Micro Spirit* conducted a beach survey of Asor Island, which is northwest of Falalop Island on the northern side of Ulithi Lagoon. The Dochirichi channel, shown below in Figure C-1, runs between these inhabited islands showing their close proximity.

Figure C-1. Dochirichi Channel

The southwest beaches of Asor Island, facing the wreck site, were surveyed (approximately 3/4 mile). There are rock ledges on the southeast end of Asor along the beach, see Figure C-2. These beach ledges are impacted by a perpendicular wave pattern along the beach, caused by the channel tidal flow. These ledge-flats at low tide did not exhibit any significant oil deposits. The largest oil deposits found were from the size of a dime to no larger than a quarter. The distance between the patches was from 3 feet to 10 feet distributed along approximately 100 yards of beach. Examples of this oil distribution are shown in Figures C-3 and C-4.

Figure C-2. Beach Ledge – Asor Island Southeast End

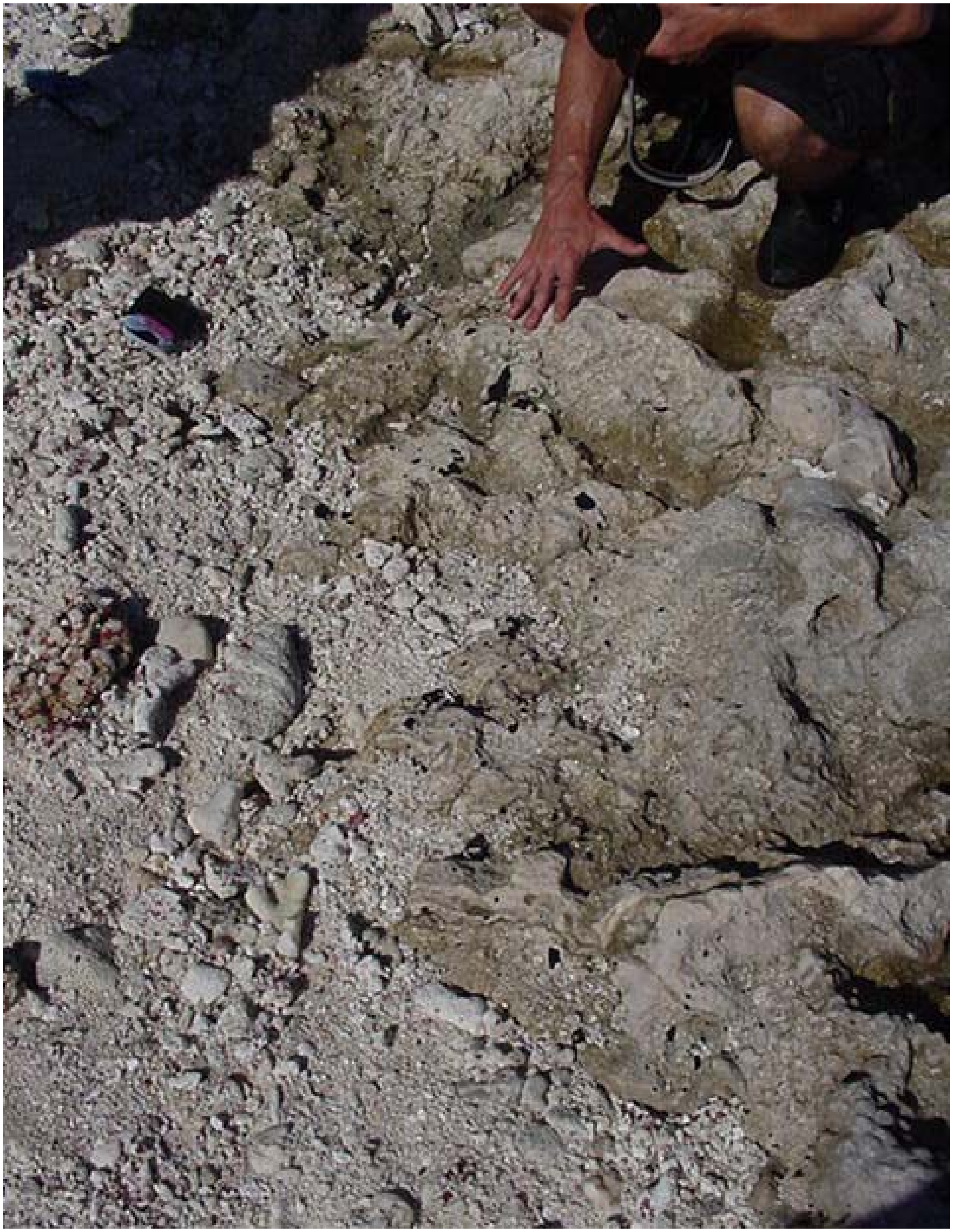


Figure C-3. Detail of Oil Deposits on Southeast Beach Ledge – Asor Island

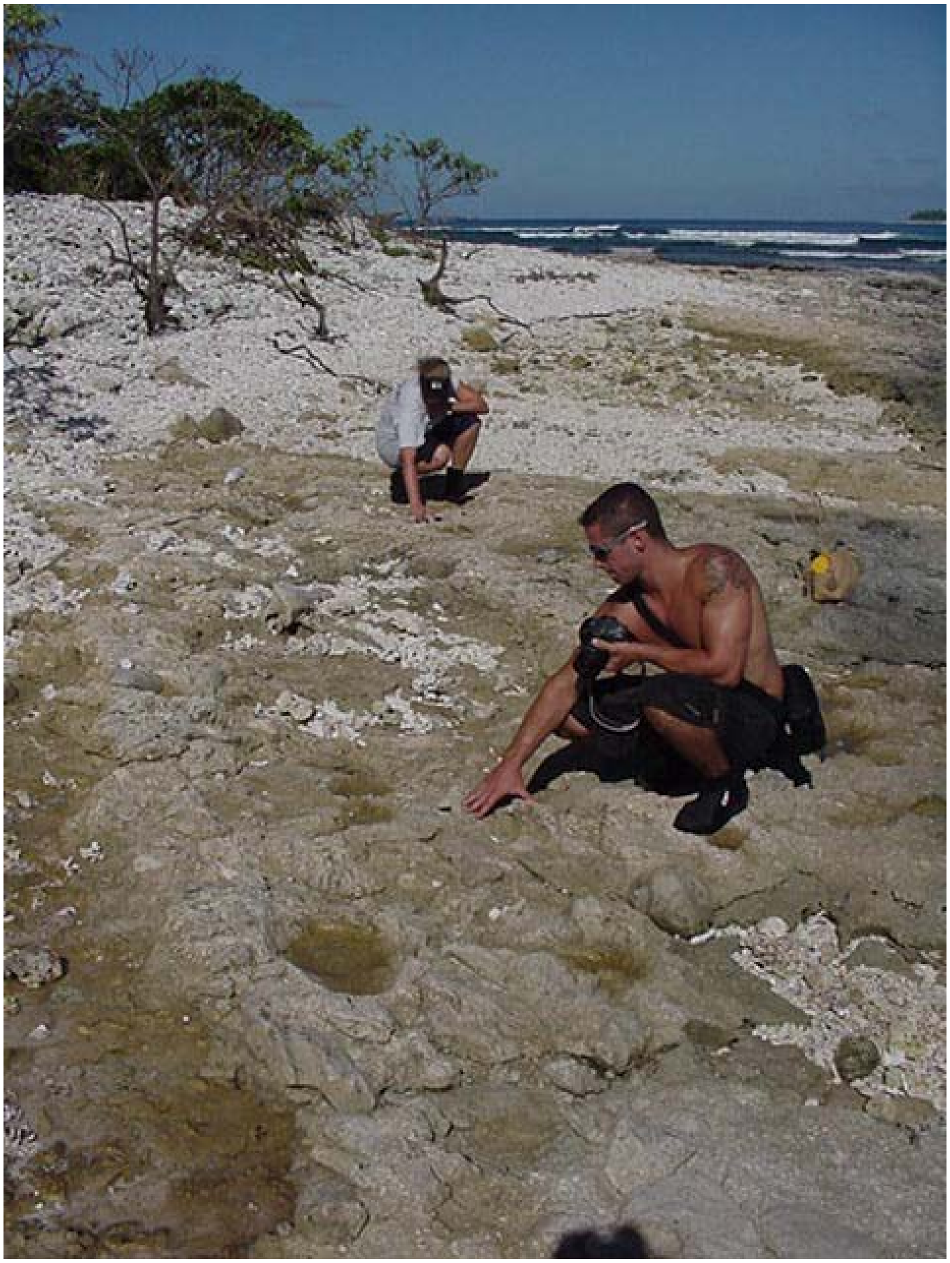


Figure C-4. Overview of Oil Deposits on Southeast Beach Ledge – Asor Island

After inspecting the channel side, the *Micro Spirit* launch took us to the northwest end to walk the sand/shell spit between Asor Island and Ewache Island, as shown in Figure C-5.

Figure C-5. Sand/Shell Spit – Asor Island to Ewache Island

We walked the tidal flats while the tide was out and found no oil residue. We uncovered the inter-tidal shells and sand to see if any oil had been covered by sand during the tide changes and again we found no oil deposits.

The old landing craft ramp area on the south beach had an old steel dock that extended out into the water, as shown in Figure C-6. The dock was severely deteriorated and contained numerous pockets that could have trapped oil in a receding tide. No oil was found to be trapped in these pockets.

Figure C-6. Asor Island South Beach Area – Landing Craft Dock (upper left)

After the survey was completed, it was the group's consensus that there was no significant oil impact on the beaches surveyed. Samples of the oil residue found were collected and saved for analysis.

Pao (Yao) Island Survey

Pao Island lies approximately 110 degrees and 10 miles from the *Mississinewa* site. Jeff Cane of GPC conducted the beach survey accompanied by local residents. Some very small tarry deposits of oil on the higher tidal portions of the beach sand were found. These small tar balls were found clinging to a piece of coral or fallen palm tree trunk. The oil would be the size of a penny with some the size of a quarter. Groups of these oil deposits were found sporadically along the beach.

Before we arrived at the ledges, we encountered a number of turtle trails to and from the beach and along the edges of the palm tree area. We found two baby turtles that must have not made the night transit to the surf. One was upside down but very frisky; therefore, we gave it a lift to the surf and released it. The other was busy getting its bearings in the nest recesses, so we left it to fend for itself. No oil residue was noted anywhere in the area of the turtles.

As the ledges became more pronounced with the dropping tide, we began to see the tidal pools. As the tops of the ledges dried, there was some evidence of oil tar balls. They were in advanced stages of weathering, in some cases dried, and tightly adhered to the rock.

After transiting the ledges, we waded across the channel to some tidal rocks/ledges where there was some shore bird activity. We thought there might be some egg laying/nesting going on because of all of the racket they made as we approached them but none were discovered. There also was a large contingency of black tern-looking birds sitting on a point overlooking the channel. We waded the channel back to Pao Island to see if there were any oil deposits between the beach and reef line. No oil was found.

There appeared to be little oil impact on this island. Storm wave and tidal action is likely removing the oil from the beach shell and coral debris. No significant oil impact or wildlife damage was observed.

Losiep Island Survey

The survey was concentrated on the side of the island that faces the wreck to the west. The ledge areas on Losiep, shown in Figure C-7, were not as extensive as the Pao Island's ledges. They did seem to be higher but the shapes did not allow as many tidal pools as found on Pao.

We did not find any turtle trails where the beach sand areas begin on the inboard side and wrap around the island tip towards the reef. There were some turtle trails further around the island tip, but they apparently became discouraged with all the coral/rock rubble that appeared to be storm originated and turned around without making any nests.

Most of the oil deposits were similar in size and distribution as found on Pao but there seemed to be even less impact on the ledges than what we found on Pao Island. Again, no large concentrations of oil were found.

The few tidal pools found were mostly clear and free of oil. Any oil found was in advanced stages of weathering. See Figure C-8 showing an oil patch approximately 4 inches across.

Figure C-7. Losiep Island Beach Ledges

Figure C-8. Losiep Island Weathered Oil Deposit

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix D

Oil Disposal

Transportation of Oil Drums from Yap to Guam

Shipping of oil from Yap to Guam will be accomplished by WAAB Shipping Agency. All oil drums will be properly marked for receipt by Unitek at Guam for disposal.

Recycling of Recovered Fuel

The proposed transportation and disposal of approximately 6,300 gallons of bunker (NSFO) fuel removed from *Mississinewa* will use Unitek Environmental Guam (UEG). UEG is registered with Guam EPA and the U.S. EPA as a used oil and hazardous waste transporter under EPA ID# GUD982430944. Their Cabras Island Hazardous Waste Transfer Facility is permitted by Guam EPA under permit number 99-1097. UEG maintains all necessary equipment and personnel to perform this task, and their vehicles and personnel have passes to allow access to U.S. Navy facilities as well as Port of Guam facilities. The company has worked with the Guam Power Authority for recycling of fuels since 1988.

The following options are available for all disposal and transportation on Guam.

OPTION 1. Recycling as Alternate Fuel at the Guam Power Authority Cabras Island Power Plant

Upon arrival of the transport vessel at the Port of Guam, UEG will mobilize to the vessel a 45-ft. tractor/trailer combination for transportation of the waste on Guam. The material is to be manifested on a straight bill of lading, as the material will be utilized for its intended purpose. The 117 drums will be transported to Unitek's Hazardous Waste Transfer Facility located at the Port of Guam. The subject drums will be staged at the facility and sampled for the following parameters:

Parameter	Method	Allowable Limit
Total Arsenic	AE/6010	5.0 ppm
Total Cadmium	AE/6010	2.0 ppm
Total Chromium	AE/6010	10.0 ppm
Total Lead	AE/6010	100.0 ppm
Total Halogens	SW846/9077	<1,000 ppm
PCBs	SW846/8080	<2.0 ppm
Flash Point	ASTM D-3828	140 F^{o}
Water, % volume	ASTM D-95	5.0% max
Sediments, % weight	ASTM-D-473	2.0%
Sulfur % weight	ASTM D-1552	Not specified

If the results of this analysis indicate the material is acceptable for recycling at the Guam Power Authority's (GPA) Cabras Island Power Plant, the material will be transferred to a tanker trailer and delivered to GPA for recycling as alternate fuel. Unitek will then transport the 55-gallon drums to DRMO Guam or the COMNAVMAR Fuels Division.

1.1 Fuel Processing for Water Removal

If laboratory analyses indicate elevated levels of water within the fuel, Unitek can process the subject fuel through UEG's oil/water separator.

1.2 Fuel Processing for Sediment Removal

If laboratory analyses indicate high sediment content within the fuel, Unitek can process the subject fuel through UEG's centrifuge system.

1.3 Drum Cleaning

Unitek can also clean all 55-gallon drums prior to delivery to DRMO Guam or COMNAVMAR Fuels division.

OPTION 2. Transportation to DRMO Guam or COMNAVMAR Guam

UEG can provide transportation of the full drums from the Port of Guam to either DRMO Guam or the Navy Fuel Facility in Guam.

Note: If the fuel cannot be recycled on Guam as alternative fuel at GPA Cabras Island Power Plant due to elevated halogen, total metals or sulfur content, it must be delivered to a U.S. EPA Permitted facility.

Appendix E

Personnel

USN Supervisor of Salvage (SEA 00C) Representative: Jim Ruth

GPC Personnel:

Program Manager	Lloyd L. Saner
Chief Engineer	Jeff Cane
Diving Coordinator	Paul Schadow

Pacific Foundation Company of Guam (Subcontractor):

Matt Kahler	Lead Diver/Owner
Salvadore Quichocho	Tender
Bradley Johnah	Diver
Larry Taylor	Diver
Jonathan Watson	Diver

GPC Consultant

Lewis “Chip” Lambert

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix F

Lessons Learned

Equipment

All ESSM equipment operated with no problems. The Inmarsat phone was very useful, since it was our only link to the outside world. This phone has the capability for sending data at a very slow rate of 9600 Bd. However, the computer that is to be used must be set up to the phone. There are instructions with the phone. However, each computer is set up differently, and we were not able to get this function working. We think the problem was the setup on the computer, not the phone.

Recommendation is to have a computer programmer work through the setting with the phone and provide a more comprehensive set of instructions.

Operations

When pumping oil from the overhead underwater, it was noted that the diver's exhausted air was being trapped above the oil. When the diver extended the suction wand into the trapped air packet, the air would create pressure in the suction hose.

If the pump was shut off and an attempt was made to remove the suction hose from the pump before all the trapped air was pumped through the pump, the hose would be under pressure. Any product remaining in the hose would be forced out by the trapped air, creating a spill of the product at the pump.

Corrective action would be to place the wand below the air pocket and to pump seawater through the pump until all air is pumped out of the hose.

The pump suction line needs a vent valve to relieve the pressure/vacuum. The suction gauge needs to be a duplex gauge, 30-in. vacuum to 100 psi.

Logistics

Hiring the consultant (Chip Lambert) proved to be very helpful, since he had recent knowledge of the wreck, the personnel within the Government, and the local personnel who could provide assistance.

Getting personnel and equipment into the island would have been a major problem had GPC not charted the Pacific Missionary Aviation Company on Yap, since there are only two flights a week to the atoll.

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix G

Photos

Figure G-1. *Micro Spirit* over Wreck and Slick

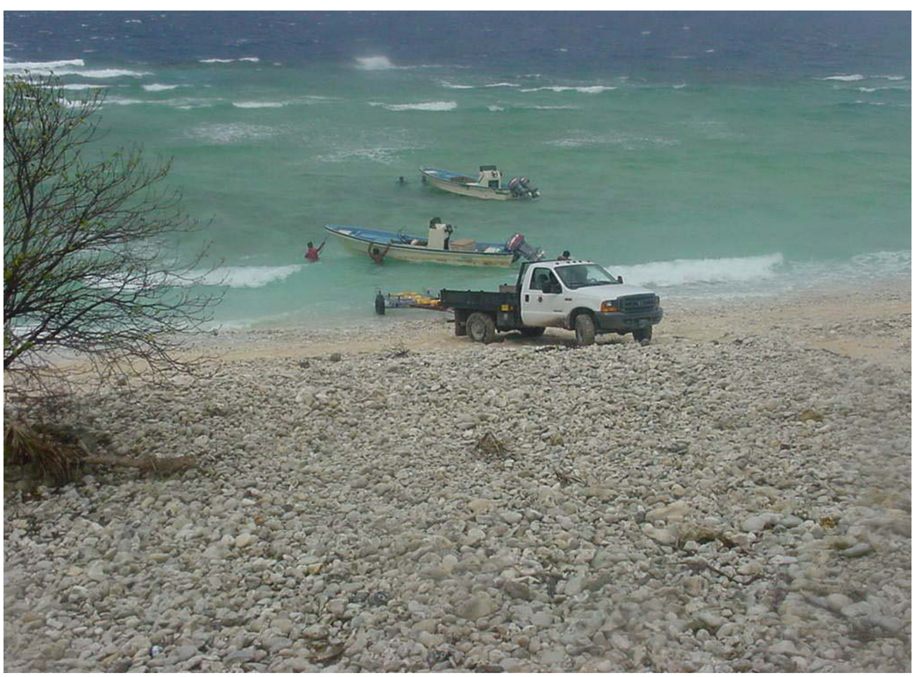


Figure G-2. Boat Launch from Falalop Island

Figure G-3. Hull Crack Patch

Figure G-4. Oil Pumping on *Micro Spirit*

SECTION III

UNDERWATER SURVEY REPORT II
USS *MISSISSINEWA* (AO 59)
ULITHI ATOLL

26 January – 18 February 2002

Prepared by:

U.S. NAVY
SUPERVISOR OF SALVAGE AND DIVING
NAVAL SEA SYSTEMS COMMAND

Naval Sea Systems Command
Code 00C, Supervisor of Salvage and Diving
1333 Isaac Hull Avenue, SE, Stop 1072
Washington Navy Yard, DC 20376-1072

THIS PAGE INTENTIONALLY LEFT BLANK

OIL SPILL RESPONSE OPERATION
USS *MISSISSINEWA* (AO 59)
ULITHI ATOLL

26 January 2002 – 18 February 2002

TABLE OF CONTENTS

APPENDICES

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION A – EXECUTIVE SUMMARY

USS *Mississinewa* (AO 59) is a World War II, U.S. Navy oiler that was sunk on 20 November 1944 in Ulithi Atoll, Yap State, Federated States of Micronesia (FSM), in the western Pacific Ocean. Oil was reported to be leaking from the wreck into the lagoon in August 2001. Following requests from FSM, via the U.S. State Department, the Chief of Naval Operations tasked the Naval Sea Systems Command (NAVSEA) Supervisor of Salvage (SUPSALV) to survey the vessel to determine the location of the leak(s) and to undertake at least temporary measures to secure the leak(s). Temporary patches were installed and some oil temporarily trapped outside *Mississinewa* tanks was recovered. A report of the condition of the vessel was provided.

In December 2001, a new oil leak was reported and a second U.S. Navy survey was initiated. The second survey of *Mississinewa*, from 26 January through 18 February 2002, was a more comprehensive, better-supported operation, based on information gained during the initial emergency survey. The second operation, the subject of this report, was a cooperative effort involving both Naval Sea Systems Command (NAVSEA) and Fleet assets. NAVSEA SUPSALV provided an Engineering Duty Salvage Officer; survey, patching, and pumping equipment from SUPSALV's Emergency Ship Salvage Material (ESSM) system, and a team of specialists from SUPSALV's ESSM contractor, GPC, A Joint Venture. GPC also provided the sub-contracted support vessel, *Smit-Lloyd* 74, a commercial anchor-handling tug mobilized from Singapore. Via the CINCPACFLT chain of command, a team of divers from Mobile Diving and Salvage Unit One (MDSU-1) in Pearl Harbor, supported by EOD Mobile Unit Five, in Guam, was tasked with providing all personnel and equipment for surface supplied air diving support. The mission of the joint team was to perform a comprehensive survey that would facilitate all potential future operations, including oil removal. The team was to again secure existing leaks, remove oil temporarily trapped outside *Mississinewa*'s tanks, and properly dispose of recovered oil. Section E of this report lists SUPSALV and MDSU equipment mobilized in support of this mission.

Tools and support equipment were mobilized from the ESSM base at Cheatham Annex, Williamsburg, Virginia, and arrived in Guam during the week of 22 – 25 January 2002. The support vessel *Smit-Lloyd* 74 was mobilized from Singapore and arrived in Apra Harbor on 31 January. The MDSU-1 team and equipment arrived early evening on 1 February at Anderson AFB, Guam, MI.

Load out took place in Guam on 2 – 3 February 2002. *Smit-Lloyd* 74 with embarked salvage forces departed Guam on 4 February at 0930 and arrived in Ulithi Atoll at 1500 on 5 February. Repair and oil recovery operations took place between 6 – 14 February and included the following significant events:

- Removal of a leaking 4" valve, plugging and capping the flange in #4 starboard wing tank.

- Plugging of a 12" pipe that was leaking in #3 starboard wing tank near the aft bulkhead.

- Patching of a hull crack approximately 24” long in the overhang at #3 starboard wing tank.

- Pumping of 3,400 gallons of Navy Special Fuel Oil (NSFO) and 7,400 gallons of associated contaminated water.

- Drilling, sampling and plugging of 7 tanks to verify contents.

Having completed the tasking, *Smit-Lloyd* 74, with all personnel onboard, departed Ulithi on the evening of 14 February, arriving back in Guam on the morning of 16 February. All equipment was offloaded using U.S. Navy Public Works cranes. A Guam waste oil company was subcontracted to remove the recovered oil and clean the two contaminated vessel tanks. *Smit-Lloyd* 74 departed for its homeport of Singapore on 18 February.

SECTION B – CHRONOLOGY OF EVENTS

30 January 2002:

NAVSEA Representative, LCDR Gregg Baumann and the ESSM contractor team arrived in Guam. *Smit-Lloyd* 74 was delayed offshore due to local port clearance problems.

31 January 2002:

NAVSEA representative and ESSM personnel started preparation of previously shipped support equipment at EOD Mobile Unit 5 at Naval Station Guam. Local supplies were purchased and coordination established among Navy Port Services, the tug's agent, and the USCG for entry of *Smit-Lloyd* 74. *Smit-Lloyd* 74 was cleared for entry mid-morning. The tug entered port and was berthed on Victor pier, Naval Station at 1400.

1 February 2002:

Continued preparation of equipment, and worked with Port Services and the USCG to facilitate loading of *Smit-Lloyd* 74. The tug passed safety re-inspections late in the afternoon. Installed and tested the ESSM satellite phone system. Mobile Diving and Salvage Unit-1 (MDSU-1) arrived at Anderson AFB early evening and all personnel and equipment were transported to Naval Station Guam, EOD Mobile Unit 5.

2 February 2002:

Vessel loading started at 0700. Equipment was positioned and verification of serviceability was conducted throughout the day. Electrical compatibility problems with the EOD Recompression Chamber Van and the vessel systems were resolved. Last-minute supplies were procured and loaded.

3 February2002:

Equipment operational condition verification continued. All equipment verified as operational and secured for sea. Arrangements made for OTS weather routing for duration of the operation. The tug developed the Fuel Transfer procedures based on a master plan sent in from Singapore.

4 February 2002:

At 0700, USCG was on board and approved the fuel transfer procedures. The vessel was not underway until 0930 due to other vessel movements in the harbor. Conducted training enroute, including hot tap, pipe stopping tools and techniques, and PM of available equipment.

5 February 2002:

Continued training while underway. Conducted four-point mooring meeting to lay out position of anchors, step-by-step procedures and mooring assignments. Continued equipment set up, as the weather was very good. At 1300, the Ulithi Atoll was in sight. Prepared small boats for launching and rigged marker buoys for marking *Mississinewa*. Entered the atoll at 1500 and headed for the oil sheen. *Mississinewa* position was verified using GPS and corresponded almost exactly to that shown on the chart. Small boats were launched and scuba divers began marking the site at 1630. Marking completed at 1650. Port stern anchor dropped at 1717 and completed at 1725. Starboard stern anchor moor completed at 1750. Dropped the port bow anchor at 1800 followed by the starboard bow anchor. Secure in the four-point moor at 1845 and scuba divers verified the anchor systems.

6 February 2002:

At 0600, started setting up dive, pumping, and monitoring equipment that had been secured for sea. Then at 0700, shifted the vessel within the moor to place dive station over the # 4 cargo hold forward bulkhead, approximately 50' north of the wreck. This position provided an operational lee from the predominantly NNE winds and seas. *Mississinewa* and *Smit-Lloyd* 74 lay in an almost east/west direction, bows to the east with *Smit-Lloyd* 74 upwind (north) of the wreck.

The peristaltic pump and monitoring station was set up on the aft deck of the vessel behind the diver operations complex. Hoses consisted of 300' of 2" suction to the pump, 25' of discharge hose to the monitoring station and another 50' to the port ship deck fitting.

Descent line was installed on the first scuba dive and support vessel position was deemed suitable. Prepared for first supplied air dive. Only one diver camera system was working. This would be a continuing problem throughout the mission and for most of the operation. For the most part, during the entire operation, only one camera system of the three aboard would be operational. At times no camera systems were working.

First dive conducted survey operations and found a leaking 12" pipe just forward of the bulkhead at frame 76. Pipe was not readily accessible as a 4" pipe was bent in front of it. Inserted the oil recovery wand into #4 starboard wing tank (aft of frame 76). Pumping operations started at 1330 in #4 starboard wing tank overhead. Output of the pump was approximately 8 gpm when pumping the heavy oil, or 30 gpm when in the oil/water mix and approximately 50 gpm in water. Approximately 1,100 gallons of oil and oil water were pumped.

Next two dives worked on the leaking 12" pipe, clearing away debris, moving the bent 4" pipe that hindered access, and preparing to clear the remains of the Victaulic joint so a plug could be installed.

Note: See Appendix D for clarification of work done at the job site.

7 February 2002:

Used the peristaltic pump suction wand in #4 starboard wing tank again with mostly water being recovered. Shut down the pump. During the first dive inserted an inflatable nitrile balloon into the 12" pipe to stem seepage. Inflated with the scuba bottle. Continued cleaning the pipe, as it was encrusted with growth. The second dive knocked off the Victaulic band and cleaned the internal pipe diameter as it was decided to mechanically plug the pipe with the 12" expandable plug, (see picture on page 6), coated with epoxy. The third dive coated the plug with the already mixed epoxy and inserted it into the pipe. The pipe was not perfectly round and the plug had to be hammered into place before being expanded. Epoxy was smeared around the outer edge of the plug and on the wing nut.

Conducted a run to Mangejang Island with a 15' Zodiac boat for sand so the repair crew could mix cement. The intent was to cap over the12" plug assembly with cement as a final closeout, but time did not permit this over the remainder of the operation.

8 February 2002:

Pumped from #4 starboard wing tank again for a short time, retrieving approximately 500 gallons of oil/water. The first dive entered #4 starboard wing tank and found leakage from the 4" valve and its concrete repair from the August repair effort. On the second dive, divers started chipping away the previous concrete repair and, while using the hydraulic chisel, completely broke the old repair away from the valve assembly.

Jessie Raglmar, director of the Yap Government, Department of Emergency Planning, came aboard and was briefed on the operational concepts and progress to date by LCDR Baumann. The briefing also emphasized the intent of the U.S. to take further action on the vessel in the near future.

The third and fourth dives removed the valve. After attempting to chisel the nuts off, it was decided to see if they could be unscrewed. The nuts were removed by ratchet and socket by hand and the valve was hammered until it and the suction piping fell away. An expandable pig plug was immediately inserted as oil streamed out of the open 4" pipe. Approximately 20 gallons of oil was released, but contained within the overhead of the wing tank where it was subsequently pumped out. To date, approximately 2,000 gallons of oil and 450 gallons of oily water were collected.

9 February 2002:

Recovered mostly water from a short pumping of #4 starboard wing tank. The first dive of the day installed a blanking plate over the flange where the valve had been bolted. The pig plug was driven further into the pipe so the plate would fit snug against the flange. The plug, however, still has a 3/8" center rod in it so it could be readily extracted if access were needed in subsequent operations. Pumping operations worked the remainder of the day to extract numerous pockets of oil in the overhead. This diver operation, however, also put a lot of expelled diver air into the overhead, which would become a problem when the divers attempted to patch the hull crack in #3 starboard wing. Approximately 4,000 gallons of oil/water were recovered to date.

Figure 2. Typical Pipe Plug Used

10 February 2002:

Early morning pumping revealed high water to oil concentration.   The wand was moved into the #4 port wing tank as oil was found. Pumping revealed a high concentration of water. The diver survey could not locate a leak.

Using the DL 9 hydraulic drill and working from the #4 port wing tank, the divers drilled two 9/32" holes (one high and one low) through the longitudinal oil-tight bulkhead into #4 center tank. No oil was found. The divers also drilled into #5 port wing tank from #4 wing. They drilled both tanks half way up and within 5' of the bottom (now top) of the tank. Again, no oil was found. All sampling holes were plugged with 5/16" self-taping bolts with Teflon wrapped threads and nitrile washers from the Hot Tap System that were inserted with a ratchet wrench. It could now be concluded that all of the #4 tanks were empty and that # 5 port wing tank was empty. However, some residual oil might be in the internal pipes in these tanks.

Next, from #4 starboard, the divers drilled two holes into the #5 starboard wing tank forward bulkhead. One hole was down 15' from the vessel bottom (now top) and one was down 5'. Water was found at the 15' hole while oil was found at the 5' hole, leading to the conclusion that the tank was between 1/2 and 1/3 full of oil. A total of 7,800 gallons of oil/water had been recovered.

11 February 2002:

The divers re-inspected #4 port and concluded that nothing was leaking and that the oil that had been pumped from that space had been there a long time as there was a distinct non-growth line at and above the oil level.

Moved on to the external hull bottom in the vicinity of the crack in the shell plating, just forward of #4 starboard bulkhead at frame 76 in #3 wing, which is at the turn of the bilge. The divers removed the previously applied patch that was leaking and applied a new patch. They had difficulty getting the new patch to hold, as a small amount of oil and air was still escaping through the crack. Subsequent dives attempted to correct these leaks with wedges and damage control putty and more cement in sand bags but small leaks persisted.

12 February 2002:

We pumped #4 starboard with mostly water recovered. First dive found the concrete patch in the crack still leaking a few drops of oil and air. Inspection below revealed no apparent source other than some residual oil and air trapped high in the hull. Scuba dive sets out the magnets as locators for drilling 9/32" sample holes in selected wing tanks to grossly determine select tank contents. Tank #6 starboard was selected as the first tank to be sampled. A divers' stage made from an ESSM basket top was positioned and the tank drilled using the drill press at approximately the 2/3-full mark. Inserted sampling tools (see Appendix D) and no oil was found. Concluded that the tank was empty; this agreed with the original Captain's Report of Sinking. The hole was secured with a self-tapping bolt driven in with a ratchet wrench.

Drilled #7 Starboard wing tank, again at the $^{2}/_{3}$-full mark, and observed a steady stream of black oil coming out. Again, the hole was plugged with a self- tapping bolt. The divers concluded that the tank was most likely 90% full, as noted in the Captain's Report.

13 February 2002:

We pumped residual oil around the #3 and #4 port wing tank areas. Again, very high water content was recovered, indicating only residual oils remaining. A crack in the hull plating at #3 starboard just forward of frame 76 was still releasing a very small amount of oil. The decision was made to drill two holes: one in #4 aft starboard wing and one just behind the crack to relieve the trapped divers air that was causing the oil release and interfering with the patching of the crack. Holes were drilled and allowed to vent all night. We made a run to Mangejang Island for more sand, as the divers would re-patch the crack in the morning. A total of approximately 10,000 gallons of recovered oil/water had been recovered with the water-to-oil ratio increasing rapidly.

14 February 2002:

All air had been vented from tank #4 starboard wing and the area aft of the hull crack in #3. An old patch was removed and wedges and caulking materials reapplied, followed by sand bags full of concrete. No signs of leaking and the surface sheen had completely disappeared.

Moved to #9 starboard wing tank and drilled at the 2/3-full mark to determine contents. Inserted sampling rod and no oil was found. The divers secured the access hole with the self-tapping bolt. Moved to #8 starboard wing tank and drilled at the same height as #9. Black oil streamed from the hole, indicating oil in the tank. The divers plugged the hole with a self-tapping bolt.

Recovered tools, hoses, and equipment from the bottom and prepared to release the moorings. Divers conducted a final inspection of the exterior of the vessel and of the ocean surface. They saw no leakage from the ship or any evidence of sheening on the surface.

We stored and secured all equipment for sea. Lashed and secured all deck stored items and informed the Vessel Master that the repair crew was ready to depart the atoll.

Released the stern moorings and recovered the starboard bow anchor, followed by the port bow anchor. Recovered the stern anchors and winched them onto the aft deck.

Underway out of the atoll at 2130 hours, enroute to Guam.

15 February 2002:

We spent the day enroute to Guam in 12' – 15' seas from dead ahead. Very rough and uncomfortable ride on this now very "green ship."

16 February 2002:

Arrived in Guam early morning and berthed at the Naval Base. Started equipment offload at 0800 hours and completed before noon. The Guam subcontractor Unitec arrived and started offloading recovered oil/water from the two mud tanks. A total of 11,000 gallons were removed. Navy Public Works disposed of the accumulated soiled sorbents.

17 February 2002:

Tank cleaning proceeded throughout the day. Vessel was to move to a commercial fueling berth Monday morning. We reconfigured the ESSM equipment for return shipments and equipment to be staged in Guam for possible future use in *Mississinewa* operations.

18 February 2002:

We spent the day enroute to Cheatham Annex. *Smit-Lloyd* 74 shifted berths to load fuel, and departed Guam for Singapore.

27 February 2002:

Smit-Lloyd 74 arrived in Singapore and went off charter.

8 March 2002:

Partial equipment shipment arrived at Cheatham Annex.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION C – PROBLEMS ENCOUNTERED

Problem: The chartered tug, *Smit-Lloyd* 74, was not fully prepared to enter U.S. waters. This delayed entry for three days while papers were approved. Some of these problems may have been caused by the last minute tasking to obtain a chartered tug and because few foreign tug operators realize entering Guam subjects them to all U.S. port entry laws.

Recommendation: Future vessel charters need to be verified for suitability prior to charter and the terms of the charter verified as regards these requirements.

Problem: Diver underwater cameras were less than reliable. For the most part, only one of the three systems worked on a daily basis. Three dives had no operational cameras. The equipment was a combination of MDSU equipment and ESSM equipment. Initial problems appear to involve cable connectors on the divers' helmets.

Recommendation: Investigate the cause of what seems to be an unacceptable operational availability rate on the camera systems.

Problem: The Maritime Mini-M Satellite phone system worked fine, even underway, for phone calls. E-mail, however, was excessively time consuming because such communication must work online thru the Navy Web site to access the Microsoft Outlook program. The firewall protection on Navy servers at Yorktown Naval Weapons Station prevented timely access to the ESSMMIS program at Cheatham Annex.

Recommendation: Look into a separate, simple commercial e-mail account that will work well within the 9600-baud rate of the Mini-M phone system.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION D – LESSONS LEARNED/RECOMMENDATIONS

Lesson Learned: The temporary pipe flange blanking system and Hot Tap Saddle System were functional, but too heavy. The 10” and 12” sizes were too heavy and cumbersome for diver operation in restricted spaces.

Recommendation: Develop lighter versions of these systems using 3/8” plate for the flanges and blanking plates.

Lesson Learned Drilling and sampling the tank contents with the Hot Tap 9/32” drill and 5/16” self-tapping bolts as a plug worked well as a simple sampling technique. Using a syringe/tube combination and a rod enabled probing through the hole into the tank.

Recommendation: Incorporate this technique and further develop the components beyond the medical syringe/surgical tubing used as an onsite developed tool in *Mississinewa* operation.

Lesson Learned: Shop Van was essential for enclosed workspace on an open deck platform. Tools were stored outside, in baskets on top of other baskets and in boxes. While underway, the deck was awash, and at the worksite, daily rains drenched tools and equipment. The Shop Van would offer both an organized storage space and a protected workspace.

Recommendation: Incorporate a Shop Van into future similar operations.

Lesson Learned: Garbage accumulation onboard the vessel became a problem. There was no disposal alternative and a reluctance to burn on the aft deck in the oily environment; the vessel took on an unacceptable odor after the third day.

Recommendation: Garbage disposal or storage must be considered in future operations of this nature.

Lesson Learned: Decontamination of the divers from working in oil needs to be better developed. Suits and equipment were saturated with heavy oil and the on-deck wash down station could not remove the oil from the saturated gear. Much of the gear had to be discarded.

Recommendation: Consider an onboard commercial duty washing machine to launder heavily soiled clothing. Also establish a better decontamination station for the divers and equipment when they exit the water.

Lesson Learned: Inflating the nitrile balloon with the scuba bottle inside of the piping system worked well. The air pressure gauge also worked in the 100’ of water.

Recommendation: Incorporate these systems into the inventory of equipment for temporary repairs.

Lesson Learned: The ESSM-made Pig Plug and the mechanical expandable plug worked well to secure leaking pipes.

Recommendation: Incorporate these tools into the appropriate system.

Lesson Learned: The heavy-duty Trident fixed magnet system worked well as it did on the *Ehime Maru*. It provides high holding power in a quick and easy application. Also, the magnets worked well with the drill press.

Recommendation: Incorporate into appropriate systems.

Lesson Learned: A simple grid system installed on the hull will facilitate locating operational points for penetration.

Recommendation: Develop a simple wire grid system, attached with magnets and C clamps, to facilitate operations.

Lesson Learned: Heavy duty C-clamps worked well as hard points on the hull. They were attached to open shell plating, frames and the bilge keel. The C-clamps were also used with the descent line and the stages.

Recommendation: Include heavy duty C-clamps in future operations.

SECTION E – EQUIPMENT UTILIZED

SUPSALV Equipment Deployed:

Containment Systems				
	Commercial Supply Vessel 198.4’		Vessel name *Smit-Lloyd* 74	1
POL Offloading System				
P10100	Hot Tap System, Lightweight			1
P17200	Submersible Hydraulic Pump System, 2” to 6”	PU0831	Control Block for 2” Hydraulic Pumps PU0830/PU0835	1
P17200	Submersible Hydraulic Pump System, 2” to 6”	PU0830	Pump, Trash and Slurry, 2” Hydraulic	1
P17200	Submersible Hydraulic Pump System, 2” to 6”	PU0835	Pump, 2”	1
P17200	Submersible Hydraulic Pump System, 2” to 6”	TL0017	Tool Box, POL Pump System	1
EHIME	*Ehime Maru* Support System	TE1031	Flow meter, 3”, 20-650 gpm	1
Field Support Equipment				
		PU0300	Pump, Peristaltic, 2” Diesel	2
		PW0020	Power Unit, Hydraulic, Mod 9, Diesel, 10 gpm @ 2000 psi	1
		DR0010	Drill, Hydraulic, ½”	2
		HT0005	Hot Tap Kit, Lightweight	2
			Hose, Layflat, 2” (Angus)	100’
			Hose, Hydraulic, Synflex, ¾” (Black)	400’
			Hose, Suction Red, 2”	400’
			Hose, Hydraulic, – 12 (Blue)	150’
			Piping & Fittings, Miscellaneous	
			Flanges & Gaskets, Miscellaneous	
			Probe	
			Sonic Thickness Gauge	
			Satellite Phone System	2
			Hand-held Radios	2

MDSU Equipment Deployed:

Diving Equipment		**Hydraulic Tools**
SSDS CONEX		HPU MOD 9
ASRA		Tool Package
MK3 Console		Hydraulic Hose Reel
MK3 VOL. Tank		Hydraulic Hose Reel
Highstar Compressor		
Ladder/Benches		Cut/Weld
Descent Line & Clump		
		POWCON Welder
Support		U/W Cut & Weld Equipment
F470 Zodiac		**Additional Supplies**
Honda 40-hp		
Honda 3K-Gen		Medical Kit Equipment
Onan 5K-Gen		Umbilical & Camera Cables
Metal Basket		Cutting/Welding Equipment, Etc
White Shipping Box #1		Chaffing Gear, Miscellaneous
White Shipping Box #2		Cameras & Monitors
White Shipping Box #3		Peck & Hails, Cargo Straps, Etc
White Shipping Box #4		2 Awnings, Poles, Clumps
White Shipping Box #5		
Awnings		

SECTION F – EQUIPMENT EVALUATION

Diver Camera System (MDSU Equipment)

Problem: Divers Camera Systems were less than reliable. Out of the three systems, only one was operational for most of the operation.

Recommendation: Explore the reasons for unreliability of the cameras and develop a fix.

Power Unit, Hydraulic, Mod 9, Diesel, 10 gpm, @ 2000 psi (PW0020):

Problem: Water entered the hydraulic system and had to be flushed.

Recommendation: Consider using a single length of hydraulic hose to minimize the possibility of leaks. Also, consider using a water-removing filter system that can be inserted onto the hydraulic return lines.

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX A: GPC PERSONNEL

SUPSALV contractor personnel from ESSM Base, Williamsburg, (757) 887-7402, participated in the on-site operations.

Project Manager: Ronald Worthington

Equipment Engineer: Craig Moffatt

Diving Coordinator: Paul Schadow

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX B: *MISSISSINEWA* (AO 59) TANK SCHEMATIC AND CAPACITIES

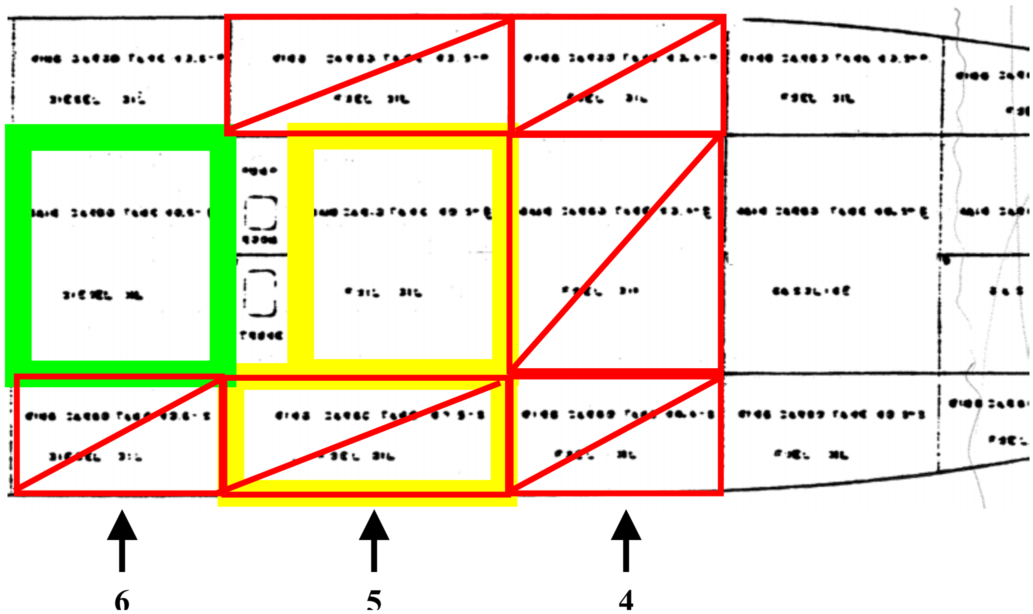


Figure 3. Forward Sections of *Mississinewa*

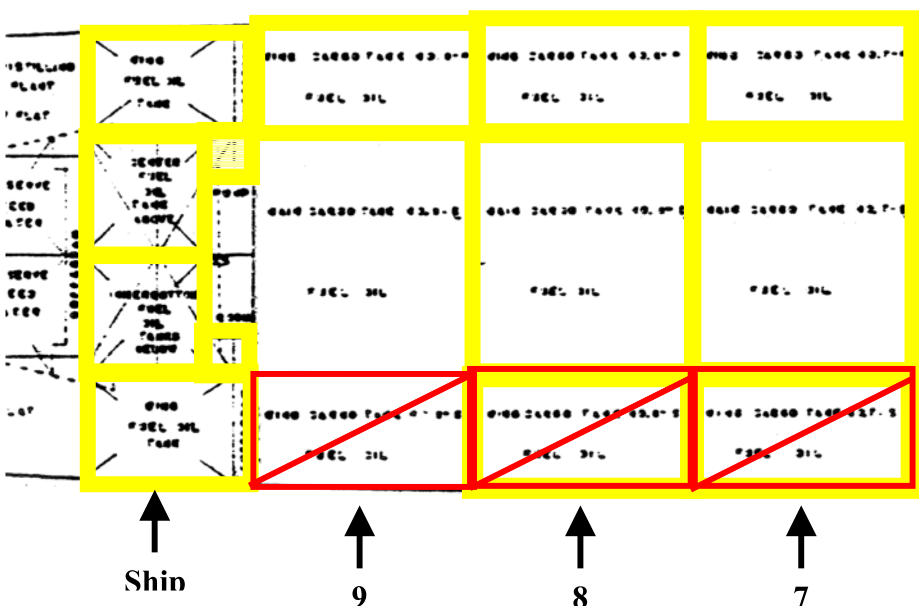


Figure 4. After Sections of *Mississinewa*

Diesel Fuel – Full (Assumption)

NSFO (Tanks that were inspected and proven to have oil or are assumed to have oil.)

Tanks that were drilled and checked for oil content.

Revised Analysis of *Mississinewa* (AO 59) Remaining Oil

Rev A **Date: 02/15/02**

Tank/Compt. Fwd to Aft	Cargo Type	20 Nov 1944 Cargo Loaded	Gallons Quantity	Tank Drilling Feb 2002	Estimated Remaining Fuel
RSFO-S-94	FO/SWB	None (note 3)	0		0
RSFO-P-94	FO/SWB	None (note 3)	0		0
RSFO-S-102	FO/SWB	None (note 3)	0		0
RSFO-P-102	FO/SWB	None (note 3)	0		0
1S	NSFO	None	0		0
1P	NSFO	None	0		0
2S	NSFO	NSFO	101,295		0
2P	NSFO	NSFO	101,295		0
2C	AVGAS	AVGAS	404,000		0
3S	NSFO	NSFO	150,280		0
3P	NSFO	NSFO	150,280		0
3C	AVGAS	None	0		0
4S	NSFO	NSFO	172,144		0
4P	NSFO	NSFO	172,144		0
4C	NSFO	NSFO	370,724	no oil	0
5S	NSFO	NSFO	234,969	1/2 full	117,485
5P	NSFO	NSFO	234,969	no oil	0
5C	NSFO	NSFO	370,724		370,724
6S	DO/SWB	SW Ballast	SWB	no oil	0
6P	DO/SWB	SW Ballast	SWB		0
6C	Diesel Oil	Diesel Oil	378,084		378,084
7S	NSFO	NSFO	175,742	has oil	175,742
7P	NSFO	NSFO	175,742		175,742
7C	NSFO	NSFO	370,581		370,581
8S	NSFO	NSFO	166,886	has oil	166,886
8P	NSFO	NSFO	166,886		166,866
8C	NSFO	NSFO	374,456		374,456
9S	NSFO	NSFO	143,630	no oil	0
9P	NSFO	NSFO	143,630		143,630
9C	NSFO	None	0		0
ER-FO Tk-S	FO (NSFO-?)	NSFO	73,341		73,341
ER-FO Tk-P	FO (NSFO-?)	NSFO	73,341		73,341
ER-FO Tk-C	FO (NSFO-?)	NSFO	163,011		163,011
ER-DB Tk-S	FO (NSFO-?)	NSFO	11,623		11,623
ER-DB Tk-P	FO (NSFO-?)	NSFO	11,623		11,623
LO-Tk - P	LO	LO	2,604		2,604
LO-Tk- Sump	Slops	Unkn	0		0
			4,894,004		**2,775,739**

APPENDIX C: SITREPS

The SITREPs that were generated during the second underwater survey of the *Mississinewa* site have been removed from this version of the report for the sake of brevity. The SITREPs are available in the original version of Underwater Survey Report II, which is available from NAVSEA.

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX D: PIPE STOPPING TECHNIQUES USED

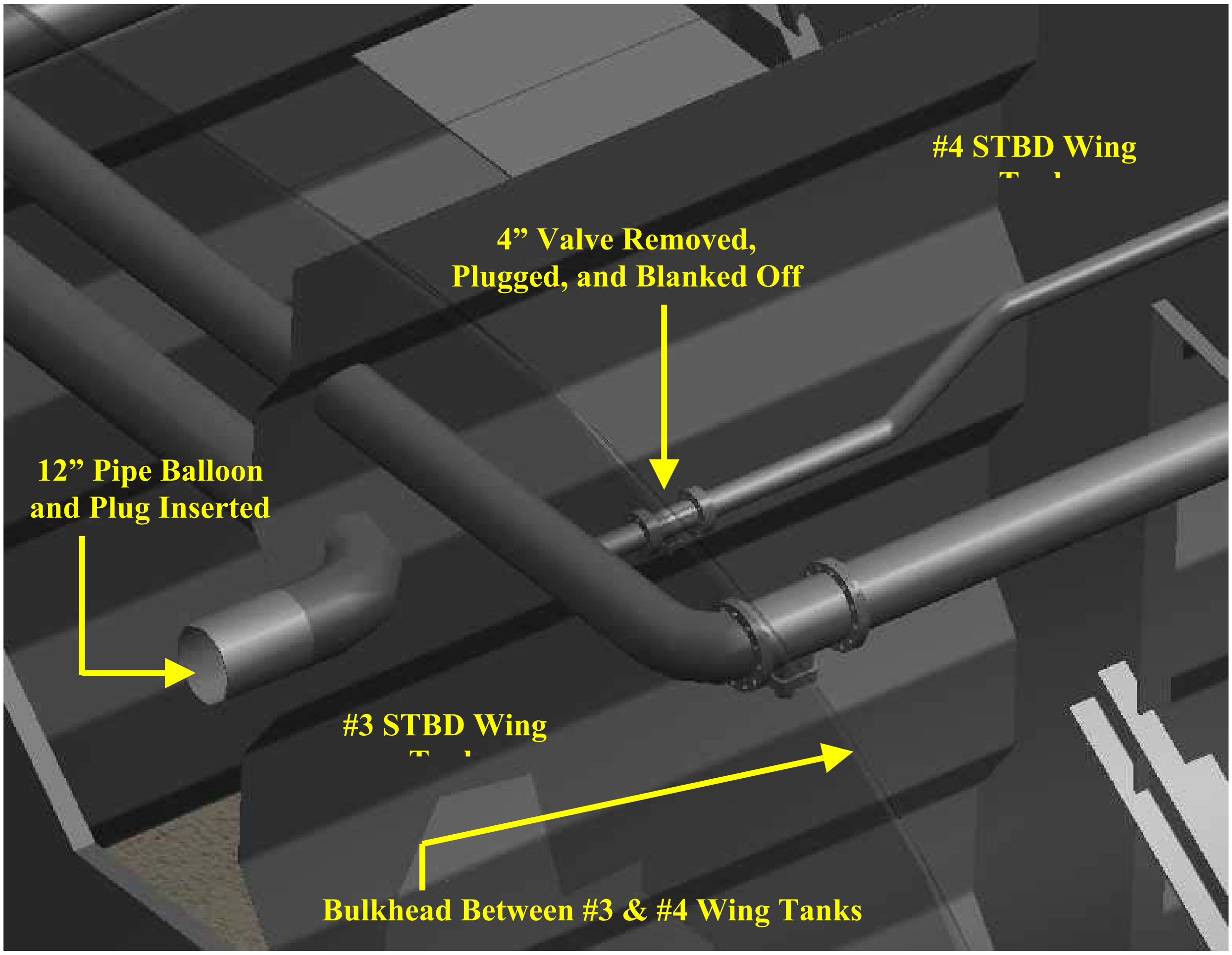


Figure 5. Piping in Number 4 Forward Wing Tank

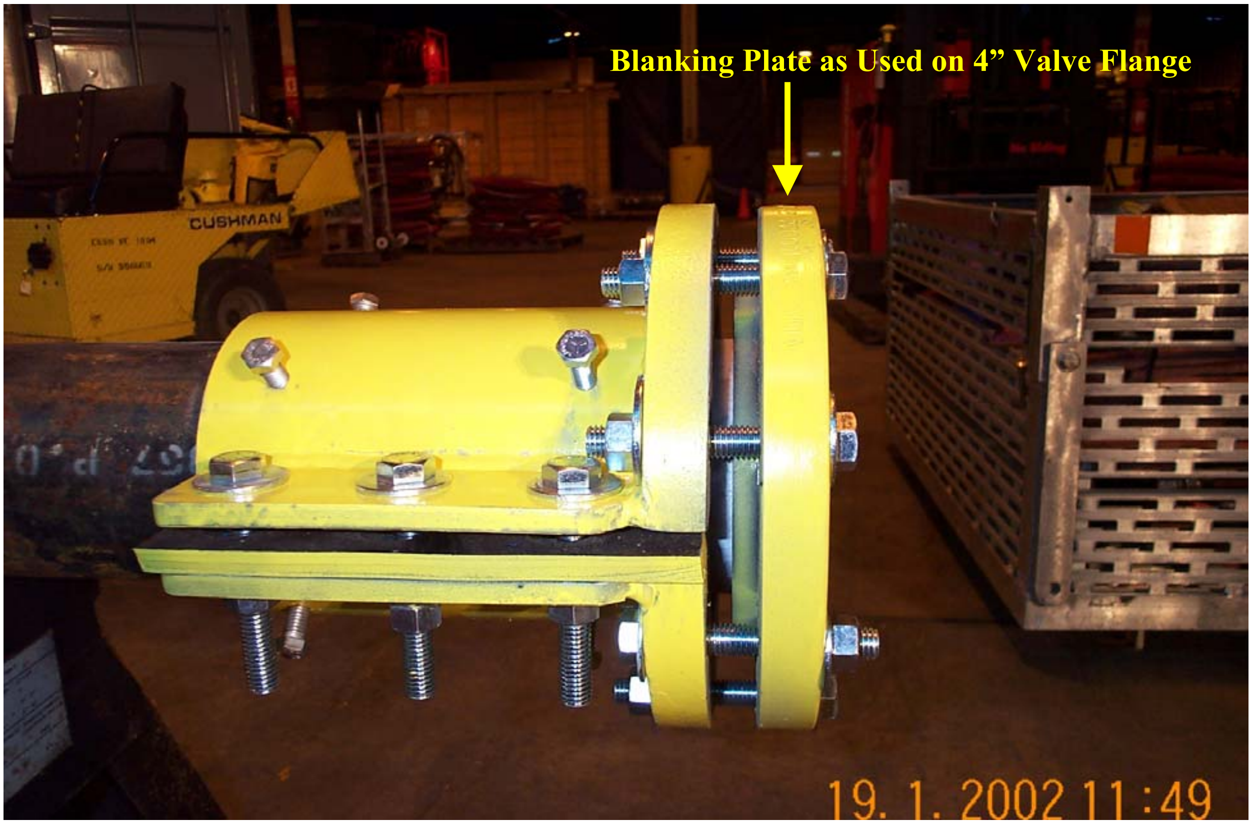


Figure 6. Blanking Plate Completed

Figure 7. Hull Sampling Equipment

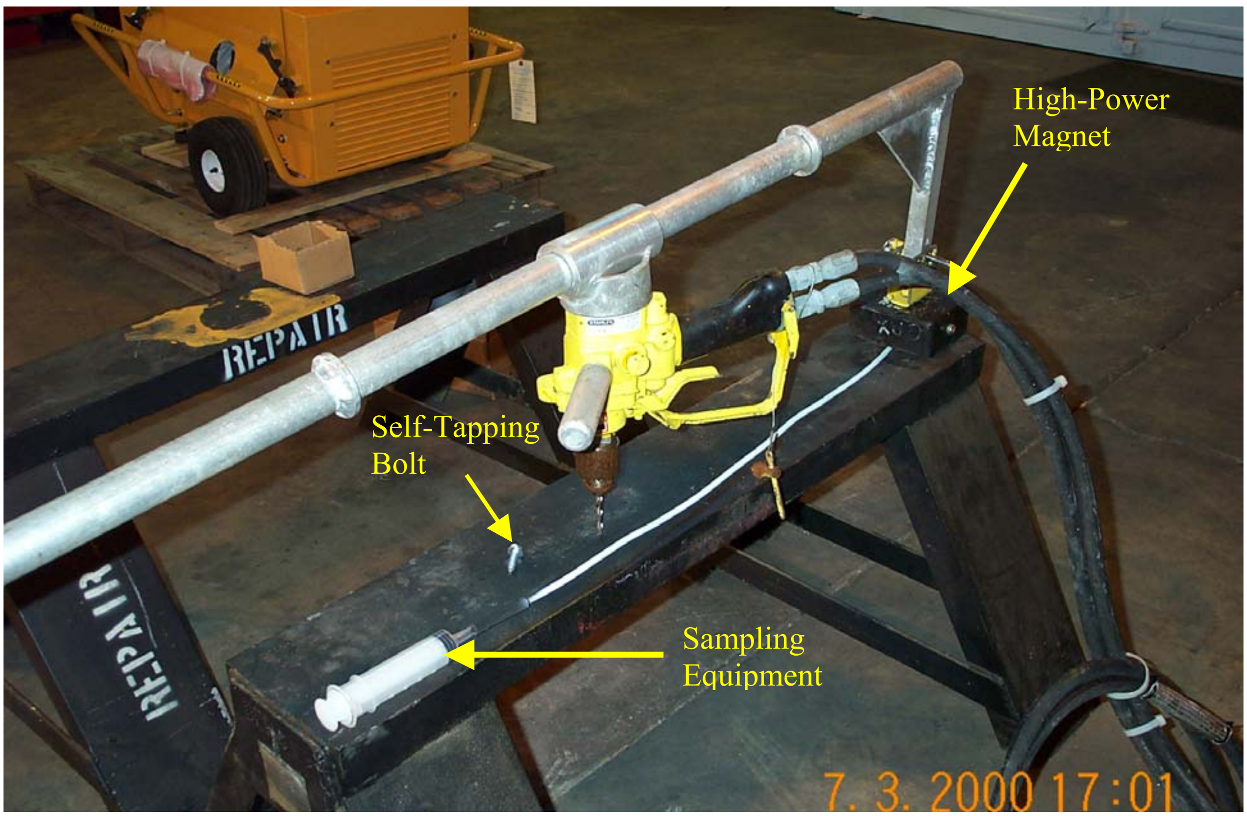


Figure 8. Bubba Drill Press, High Power Magnet, Sampling Tube, and Self-Tapping Bolt

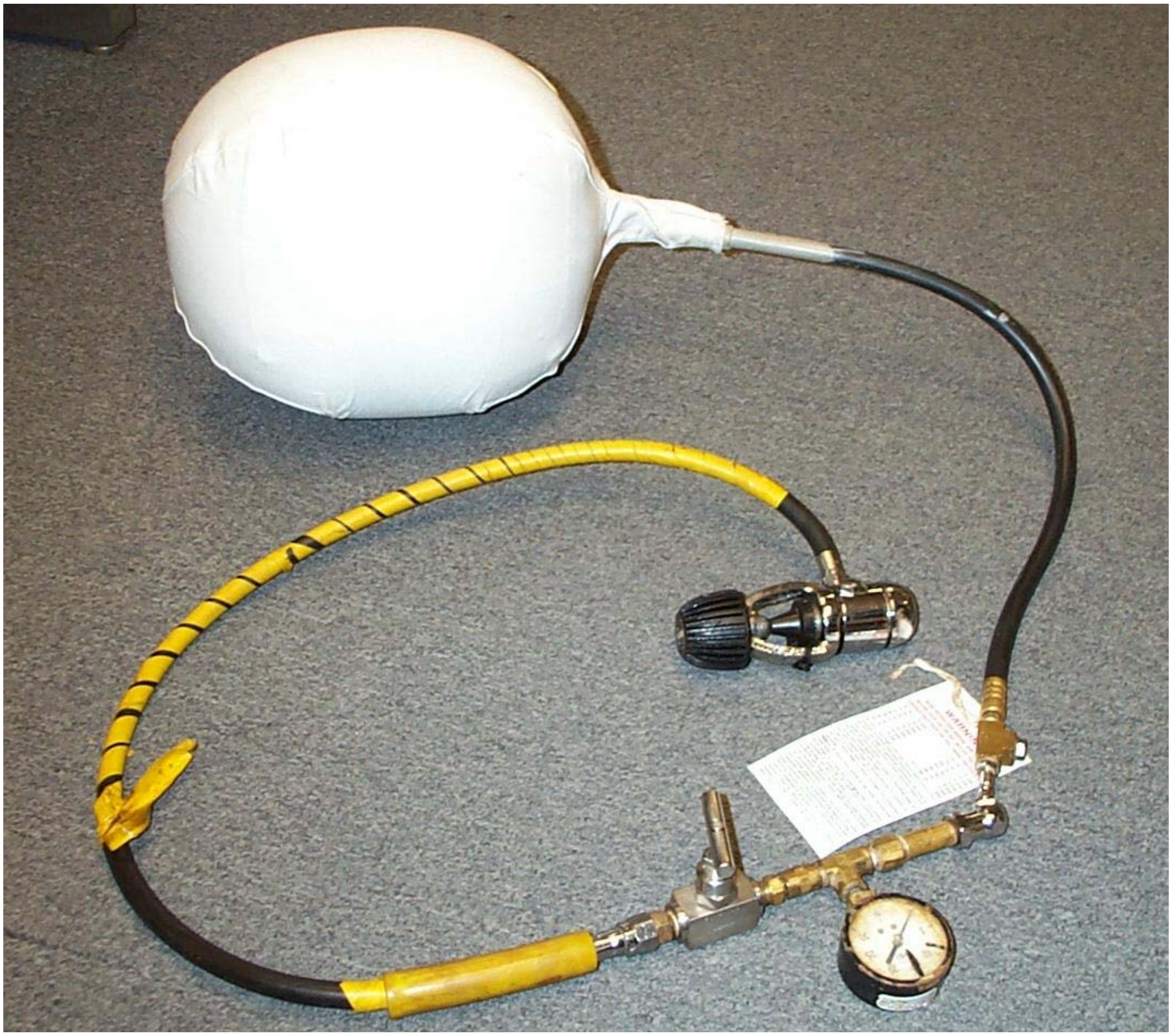


Figure 9. Nitrile Balloon Inflated by Scuba Bottle as Inserted in 12” Pipe

Figure 10. Another View of the Nitrile Balloon Inflated by Scuba Bottle as Inserted in 12” Pipe

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX E: PHOTOGRAPHS

Figure 11. *Smit-Lloyd* 74 Pierside in Guam

Figure 12. *Smit-Lloyd* 74 Aft Work Deck Area

Figure 13. MDSU and ESSM Equipment Arriving Pierside in Guam

Figure 14. Equipment Loading, Stern Mooring Hawser Down Center of Deck

Figure 15. *Smit-Lloyd* 74, MDSU and ESSM Equipment Loaded, Stern Mooring Line Down Center of Deck, Anchors, Port and Starboard, Aft

Figure 16. Enroute Training: Hot Tap / Pipe Saddle

Figure 17. Enroute Training: Balloon Pipe Stopper Through Hot Tap Hole

Figure 18. Preparing Wreck Markers Enroute

Figure 19. Pre-Arrival Mooring Meeting

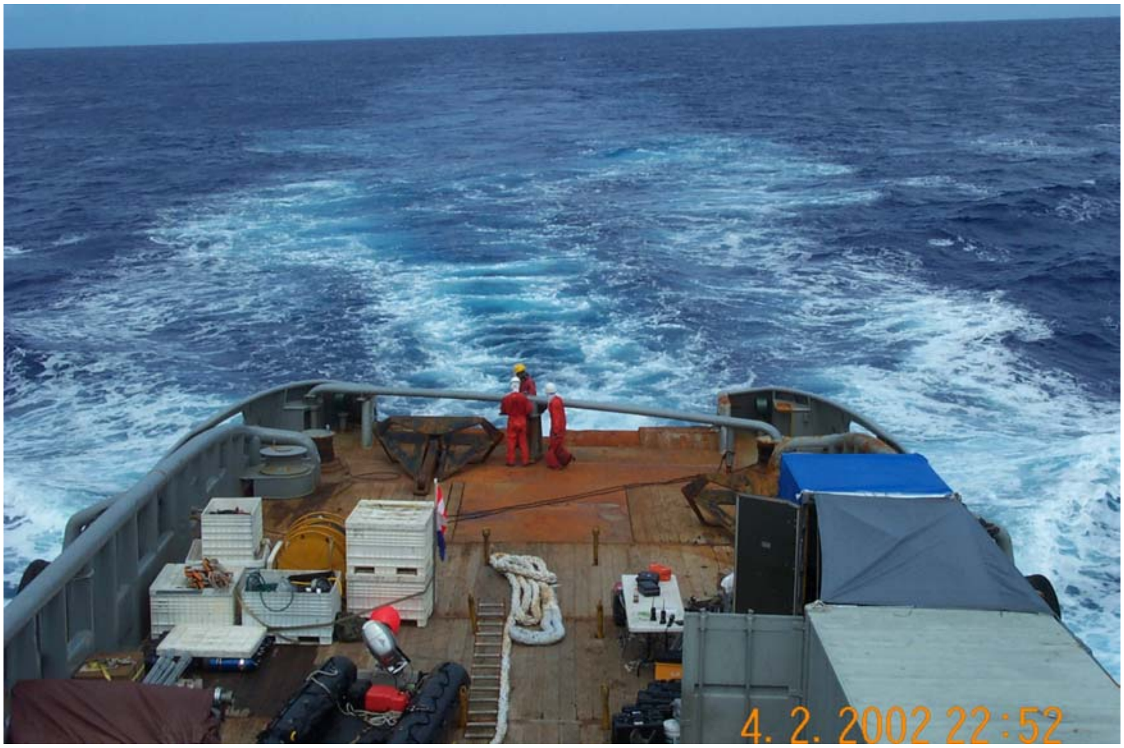


Figure 20. Starboard Stern Anchor Being Prepared for Launching

Figure 21. Arriving Ulithi Atoll

Figure 22. Sheen as Seen on Arrival

Figure 23. Preparing to Mark *Mississinewa*

Figure 24. Setting Up Peristaltic Pump

Figure 25. Setting Up Flowmeter

Figure 26. Preparing for First Dive

Figure 27. Scuba Survey

Figure 28. Homemade Radar Reflector for Setting Moorings

Figure 29. Dive Operations

Figure 30. Center and Stern Marker Buoys Along Axis of Wreck and Sheen

Figure 31. Dive Operations

Figure 32. Flow Monitoring and Sampling Station

Figure 33. Sheen

Figure 34. 12" Plug Ready to be Sent Below

Figure 35. Sand Detail for Concrete Preparation

Figure 36. Yap Government Officials Arriving

Figure 37. Meeting with Yap Officials

THIS PAGE INTENTIONALLY LEFT BLANK