Repatriation of the mine stricken U.S. Frigate "Samuel B. Roberts" by a self-propelled heavy lift vessel

By

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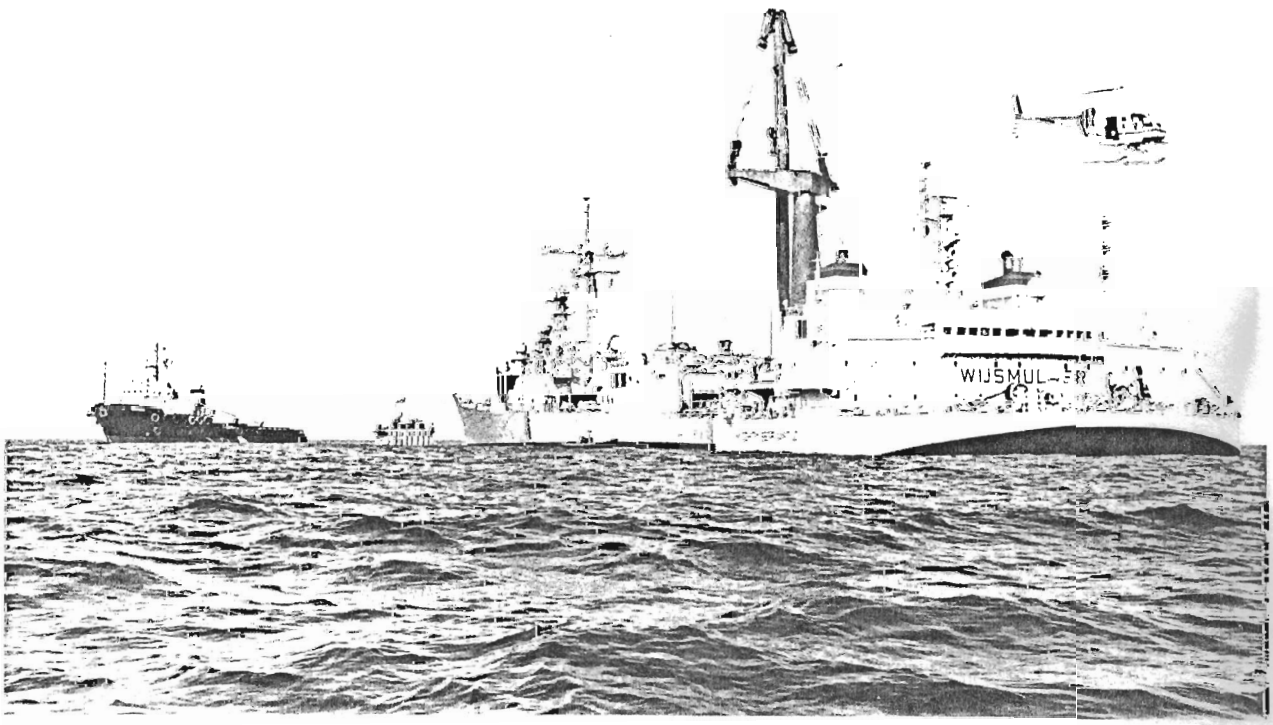

Acknowledgement

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- R. Ross Camardella - Contracting Officer MSC;
- Cdr. Paul X. Rinn - C.O. "Samuel B. Roberts";
- Cdr. John W. Townes III - C.O. "Samuel B. Roberts";
- Capt. Jerome A. Peschka - MSC Naples representative;
- Lcdr. James Hunn - Comnavsurflant representative.

1. Introduction

In April 1988, the U.S. Frigate "Samuel B. Roberts" was hit by a contact mine while navigating in the Persian Gulf. Instead of towing the frigate back to the United States, using traditional tugs, the U.S. Navy decided to have the mine stricken frigate "Samuel B. Roberts" repatriated onboard a commercial self-propelled heavy lift vessel.

The Dutch transport company "Wijsmuller Transport BV" operates 8 of these vessels and was awarded the contract.

Mobilization of the MIGHTY SERVANT 2 to Dubai and preparations of the cribbing and deck recesses where completed within one month and after some delays due to weather, the "Samuel B. Roberts" was docked firm on the deck of the heavy lift vessel. The transport from Dubai, via Suez, to the frigate's home base Newport, Rhode Island, went very smooth, arriving only 30 days after departure.

The frigate and its riding crew were delivered home safely and in time for the home coming ceremony. This unique transport confirmed the versatility of the semi-submersible heavy lift ships as well as their ability to perform demanding jobs.

2. Background

On April 14, 1988, the U.S. frigate "Samuel B. Roberts" (FFG-58) entered a mine field in the Persian Gulf. The commanding officer Paul X. Rinn immediately took action but the ship got hit by a contact mine. This mine exploded below the ship's large engine compartment, which flooded. The explosion tore a large hole in the ship's bottom, apparently breaking her keel and throwing the ship up more than ten feet. The main engines were thrown from their mountings, and elements of the superstructure cracked as the ship flexed. However, the crew was able to handle this damage, partly by wiring together portions of the superstructure [1]. The damage-control performance by the crew was outstanding. Using her retractable auxiliary propellers, the "Samuel B. Roberts" was able to reach Bahrain. Consequently, she was towed to Dubai.

After assessment of the damage by personnel from the Commander Naval Surface Forces Atlantic and the Bath Iron Works shipyard, it was decided to restore the hull integrity in Dubai and repatriate her to the United States for final repairs, rather than perform the complete repairs in Dubai [2].
In first instance, a wet tow, using a conventional U.S. Navy tug was considered for bringing the "Samuel B. Roberts" back to the States. Meanwhile, the author's company contacted the U.S. Navy with a proposal to transport the "Samuel B. Roberts" using one of their self-propelled semi-submersible heavy lift vessels of the MIGHTY SERVANT class (for details, see appendix 1).

May 19, 1988, Wijsmuller Transport BV gave a technical presentation in Washington, D.C. upon request of MSC. The proposed dry transport option, using the MIGHTY SERVANT 2 was discussed with a forum of approximately 25 experts, representing various U.S. Navy departments.
On May 20, 1988, the transport contract was awarded and the detailed engineering started, while the MIGHTY SERVANT 2 started to mobilize to Dubai.

2. Preparations

The preparations for the dry transport of the "Samuel B. Roberts" consisted of:
- detailed engineering, resulting in a Transport Manual, containing the details of deck preparations, loading procedures, stability, motion responses, seafastening, etc.;
- inspection of the "Samuel B. Roberts" while in drydock in Dubai;
- co-ordination of activities with the U.S. Navy representatives in Dubai;
- mobilization of the MIGHTY SERVANT 2 from India;
- installation of deck recesses, guide posts and cribbing.

June 16, immediately after arrival of the MIGHTY SERVANT 2 in Dubai, the deck preparations, subcontracted to "Dubai Drydocks", started i.e.:
- marking of the deck;
- cutting of the stabilizer fin recesses;
- cutting of the sonar dome recess;
- restoring water tightness of tanks around dome recess;
- opening up of two hatch covers in order to create a recess for the protruding propeller strut and rudder;
- installation of 10 docking cradles (see fig. 2.1);
- installation of the keel cribbing;
- modification and installation of the guide posts;
- welding of pipeline for supply of cooling water.

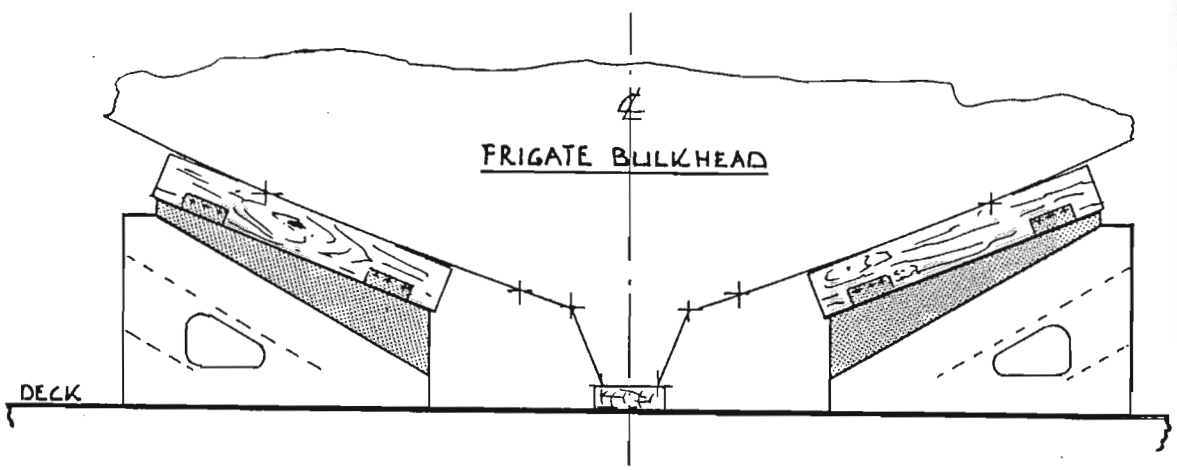


Figure 2.1. Typical docking cradle.

Due to the explosion, the hull of the "Samuel B. Roberts" was deformed. Measurements taken after the temporary repairs showed a permanent hogging of .9 m and large distortions of the bulkheads adjacent to the engine room. The keel shape was superimposed on the anticipated hogging of the MIGHTY SERVANT 2 and the cribbing wood in between was adapted to avoid overloading of the hull girder of the "Samuel B. Roberts".

The deck preparations continued around the clock and the MIGHTY SERVANT 2 departed for the loading site on June 23, after a final inspection by the Wijsmuller superintendent, the U.S. Navy representatives and the Marine Warranty Surveyor.

The "Samuel B. Roberts", now under command of Cdr. John W. Townes III who relieved Cdr. Paul X. Rinn, followed the next day with her two assisting tugs.

3. Loading

The original proposed loading location (25-21 N, 55-10 E) was approx. 6 miles offshore Dubai. Upon arrival the weather conditions were not favorable and the loading operation was postponed for 24 hours. Next day, swell increased to 1.5 - 2 m with winds over 25 knots. Again loading was postponed for 24 hours. Early next morning, because of no improvements of the weather conditions, it was decided to seek a more sheltered area and the MIGHTY SERVANT 2 raised anchor and sailed to a small island named "Iazirat Sir Abu Nu'Ayr" (25-13 N, 54-16 E), followed by the "Samuel B. Roberts" towed by two assisting tugs. Although the island did provide some shelter, the weather conditions did not allow for the loading operation until June 27, 4 days after leaving Dubai.

The loading operation was critical because of the protruding sonar dome and stabilizing fins. These needed to be exactly positioned in their recesses and divers with underwater video cameras were used to monitor the docking.

The MIGHTY SERVANT 2 reached its required submerged draft at 13:45. At 15:40, the "Samuel B. Roberts" was slowly manoeuvred over deck and the tugger lines were connected. Once the frigate came close to the MIGHTY SERVANT's forecastle, fire hoses were passed over and connected in order to provide cooling water for one of the frigate's auxiliary engines, from the time that the sea chest was lifted out of the water until the time that the cooling water pipe was connected.

At 16:50, after final positioning, deballasting started while the sinking of the sonar dome into its recess was continuously monitored. At 19:00, the sonar dome was safely in the recess and the keel of the "Samuel B. Roberts" was resting on the cribbing. The divers inspected all the docking cradles as well as the stabilizing fins and at 20:45, deballasting continued.

During deballasting, a critical phase of minimum stability occurred when the waterplane area of the frigate became very small while the main deck of the MIGHTY SERVANT 2 was still submerged.
With a 4 m trim by stern and a 1 deg list over port, sufficient stability was guaranteed during this phase. The minimum GM(fluid) was in the order of .8 m, see fig. 3.1.

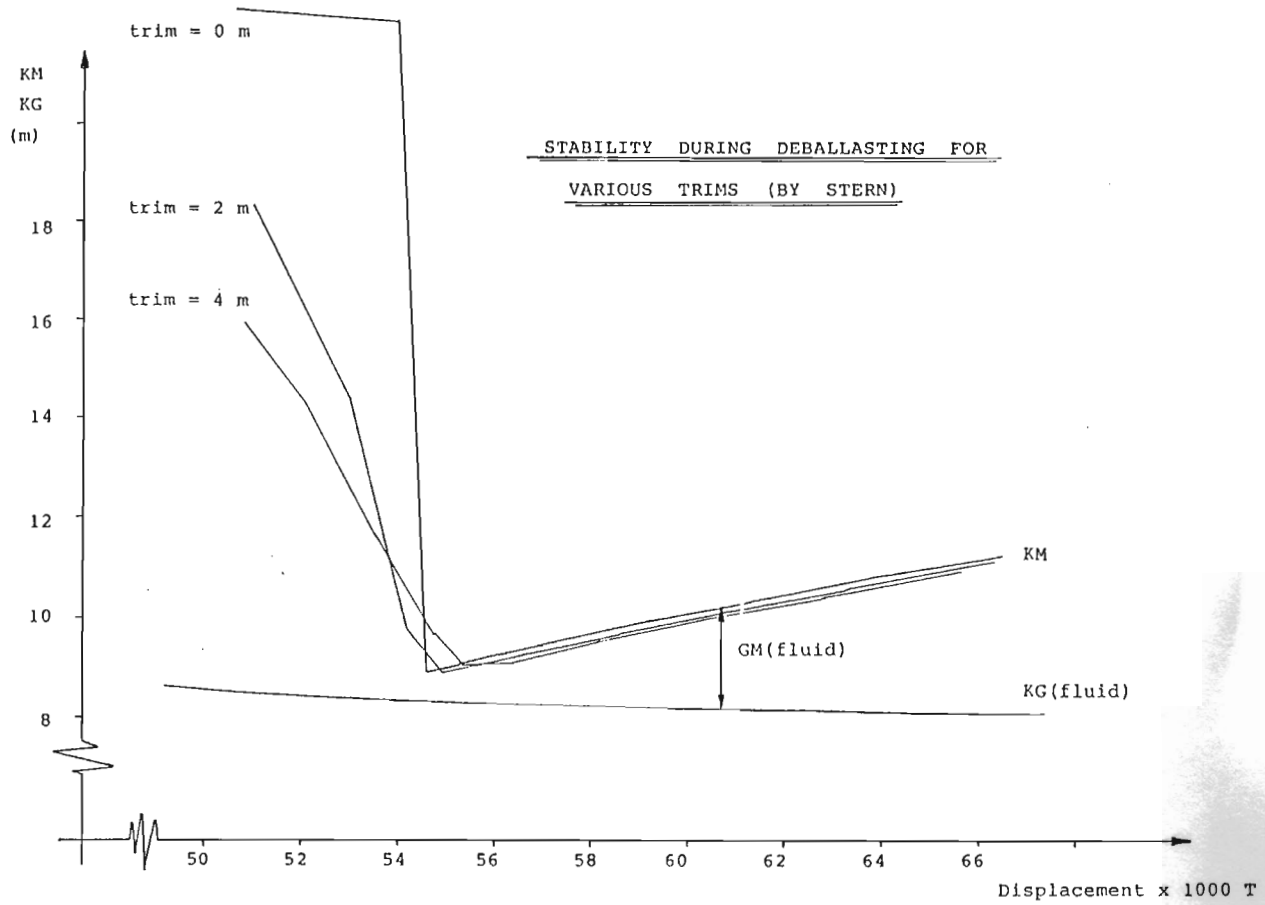


Figure 3.1. Stability during deballasting.

Immediately after part of the main deck of the MIGHTY SERVANT 2 became accessible, the pipe connection to the frigate's seawater inlet was made and water was supplied in order to have its auxiliary engines running again.

At 22:30 the main deck was completely dry and the docking of the "Samuel B. Roberts" could be inspected. As, due to the explosion, the hull shape was no longer conform the original lines drawing, the frigate was resting on the port side docking blocks only. The small gaps (25-100 mm) on the starboard blocks were wedged with wooden shims.
Next day, on June 28, the MIGHTY SERVANT 2 returned to Dubai for seafastening of the "Samuel B. Roberts".

Seafastening.

Upon returning in Dubai, seafastening of the "Samuel B Roberts" started. The seafastenings consisted of:
- 14 standard Wijsmuller Transport BV seafastenings for restraining the transverse and longitudinal displacements;
- 10 special designed/constructed bars for restraining the transverse and roll displacement, see fig. 3.2.

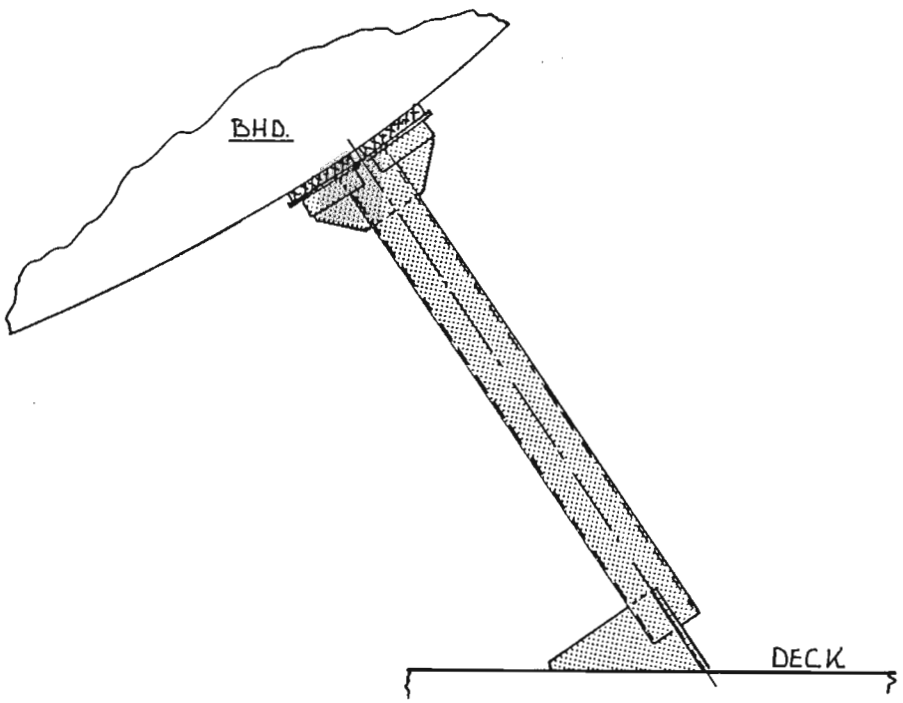


Figure 3.3. Roll bar.

These seafastenings were only welded to the deck of the MIGHTY SERVANT 2 after pressed hard against the hull of the "Samuel B. Roberts", thus allowing for some relative motion between the two vessels in seaway. Rubber pads equalised small irregularities and ensured load spreading.

Installation of the seafastenings took 3 days. During this time, provisions were made to supply the frigate with electricity and hoses were connected to the water/sewage outlets.

4. Transport

The MIGHTY SERVANT 2, carrying the "Samuel B. Roberts", left Dubai on July 1, 1988 and was escorted out through the Strait of Hormuz by a variety of Navy vessels. The route via the Suez Canal was selected.

The behaviour of the vessel was closely monitored in order to stay within the design limits of the seafastenings. The observed environmental conditions and resulting roll and pitch motions are given in the following table.

Table. Observations during transport.

date	course	wind		swell		sea	roll		pitch	
		speed	dir	height	dir	height	ampl	per	ampl	per
	deg	kn	deg	m	deg	m	deg	s	deg	s
01/07		departure Dubai								
02/07	var	14	200	2.0	220	1.0	3	8.5	.5	8
03/07	215	26	220	5.0	220	3.0	10	8.5	.8	8
04/07	240	35	200	6.0	var	3.5	8	8	.8	9
05/07	230	28	210	4.0	180	3.5	8	8	.5	9
06/07	258	12	270	1.0	210	1.0	2	8.5	-	-
07/07	261	14	270	-	-	.5	-	-	-	-
08/07	330	4	330	-	-	-	-	-	-	-
09/07	330	-	-	-	-	-	-	-	-	-
10/07	330	-	-	-	-	-	-	-	-	-
11/07	310	9	330	-	-	1.0	-	-	-	-
12/07		passage Suez Canal					-	-	-	-
13/07	287	30	310	-	-	1.0	-	-	-	-
14/07	287	20	310	-	-	1.0	-	-	-	-
15/07	290	25	270	-	-	1.5	-	-	-	-
16/07	280	23	300	3.0	325	2.0	12	8 *	.5	10
17/07	256	15	315	2.0	355	1.0	5	8	-	-
18/07	259	10	310	-	-	.5	-	-	-	-
19/07	275	10	310	.5	330	1.0	5	9	-	-
20/07	275	6	360	1.0	350	1.0	2	9	.5	10
21/07	275	-	-	1.0	350	.5	2	9	.2	10
22/07	270	20	240	2.0	310	2.5	2	9	.5	10
23/07	275	14	5	2.5	290	1.5	2	9	.5	10
24/07	284	15	300	2.0	320	2.0	1	9	.5	10
25/07	280	10	270	1.5	330	1.5	1	8	-	-
26/07	278	24	230	2.5	270	2.5	1	8	.5	9
27/07	272	12	180	1.5	230	1.0	1	8	-	-
28/07	268	14	230	1.0	210	1.5	1	8	-	-
29/07	260	-	-	1.0	190	-	-	-	-	-
30/07		arrival Newport, R.I.								

* Extreme roll made master decide to change course

The experienced environmental conditions were well within the predicted extremes:

- design extreme wave height = 15.3 m
- design extreme wind speed = 84 kn

The experienced motions were also well within the predicted extremes, see fig. 4.1 and fig. 4.2.

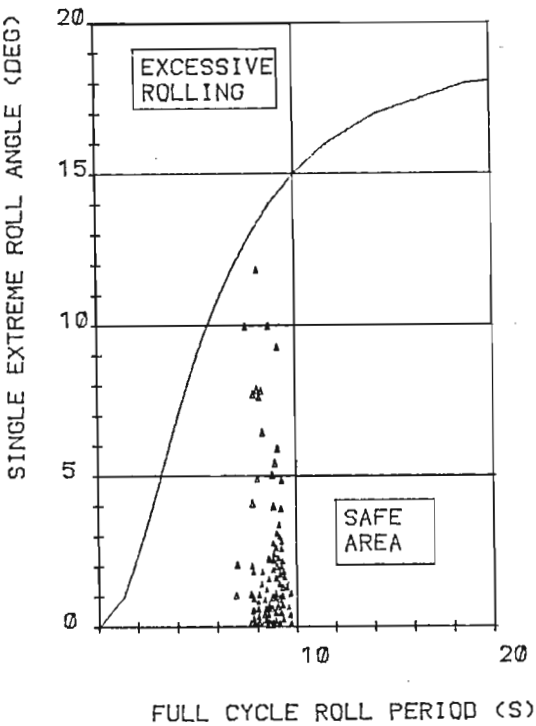


Figure 4.1. Comparison design and experienced roll motions.

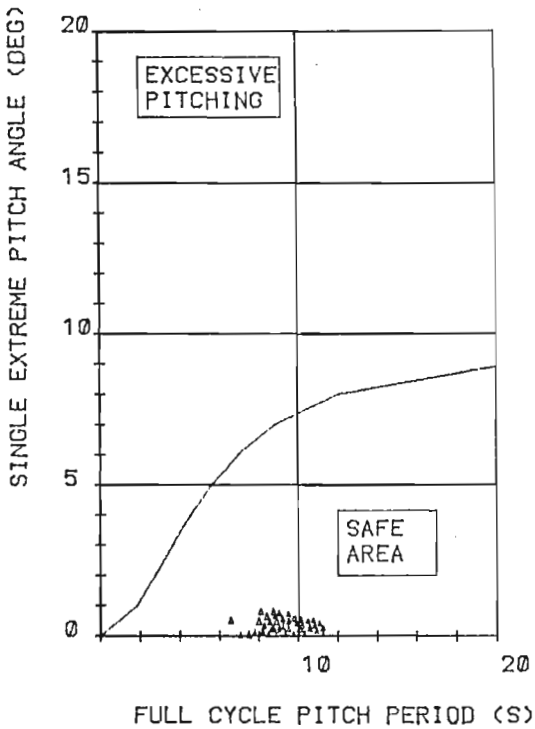


Figure 4.2. Comparison design and experienced pitch motions.

The total distance of 8100 miles was travelled with an average speed of approximately 12.5 kn. The maximum recorded speed was 16.0 kn. Sometimes, bunker procedures of escorting vessels demanded a reduction of speed.

During the voyage, 30 riders lived onboard the "Samuel B. Roberts" to take care of the maintenance of the frigate. Because of fire hazards, it was decided not to use the frigates galley and the riders were fed onboard the MIGHTY SERVANT 2. The vessel's recreation room provided a meeting point for both crews to socialize.

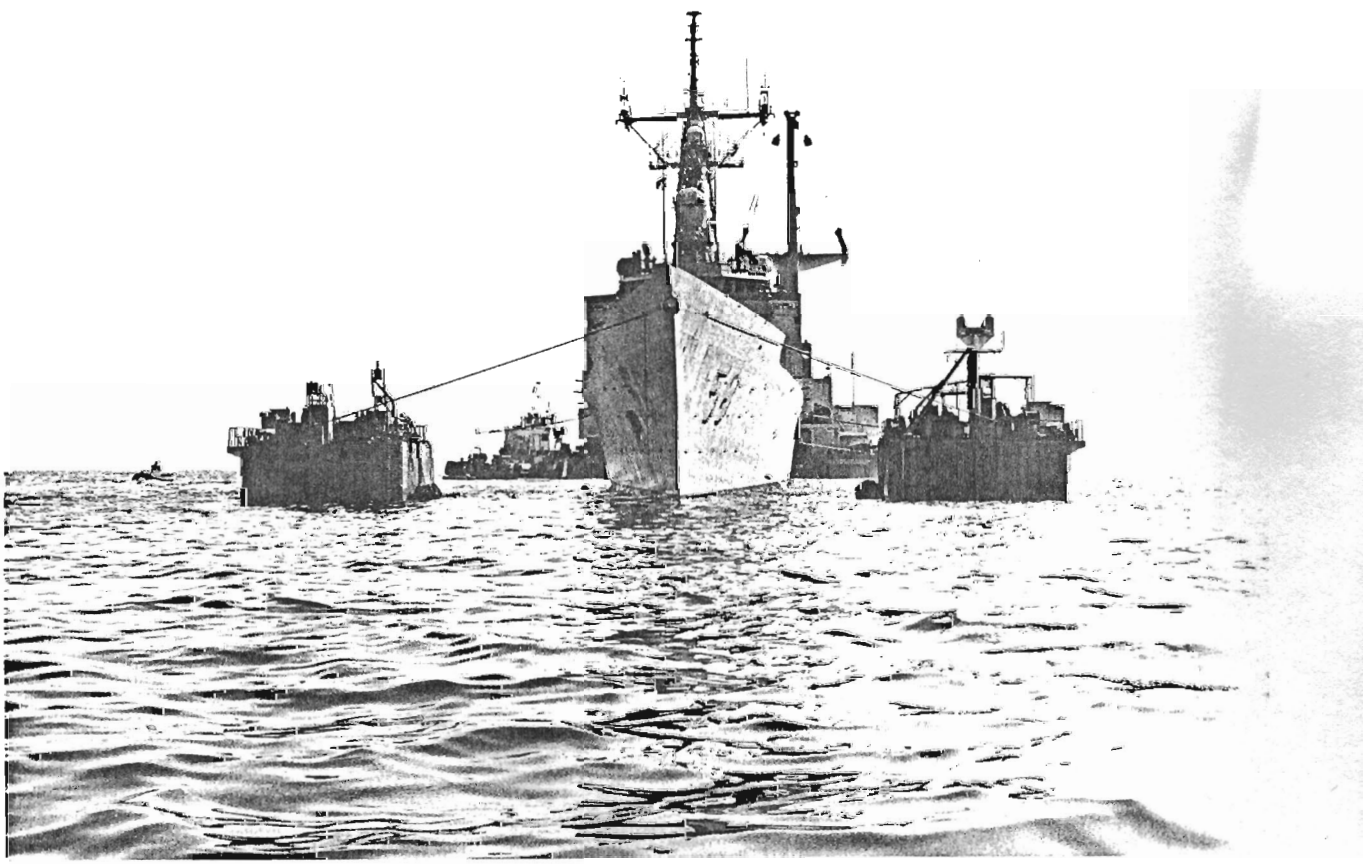
5. Offloading

Saturday July 30, 1989, the transport arrived in Newport, Rhode Island in the early morning fog and the MIGHTY SERVANT 2 dropped anchor past the Narrangett Bay bridge. Immediately, the preparations for offloading started. While inspection by U.S. Navy officials took place, preballasting to a minimum freeboard of .75 m started. A local subcontractor removed the seafastenings in less then 5 hours. In the late afternoon, after receipt of a favorable weather forecast, everything was ready for the offloading operation, which was more or less the reverse of the loading operation.

Next day, at 05:45, ballasting continued and at 06:00 the main deck started to submerge. The cooling water supply pipeline was disconnected and temporarily replaced by fire hoses. Ballasting continued and stability was maintained by having a large trim by the stern and a 1 degree list to port. Once past the critical phase, the trim and list were reduced.
As soon as the "Samuel B. Roberts" started floating, divers started monitoring the position of the sonar dome with respect to its recess while ballasting continued.

Once sufficient clearance was reached, two assisting tugs were connected and the frigate was carefully manoeuvred away from the submerged MIGHTY SERVANT 2. At 11:45, the last tugger line was cast off and the "Samuel B. Roberts" started its home coming ceremony, sailing to the U.S. Navy base on its own power, using its two auxiliary propellers units.

Deballasting was completed at 20:30 and on August 1, the MIGHTY SERVANT 2 sailed to Providence for removal the cribbing and restoring of the deck recesses.



6. Conclusions

Repatriating the frigate "Samuel B. Roberts" by means of a semi-submersible heavy lift vessel showed the potential of these type of vessels. Using a semi-submersible heavy lift vessel as a floating drydock can be very efficient, resulting in cost savings.

The transport can be effected fast and reliable. The track record of these vessels is extremely well. Due to their high transit speed, they are able to avoid stormy areas thus minimizing the risks for the cargo.

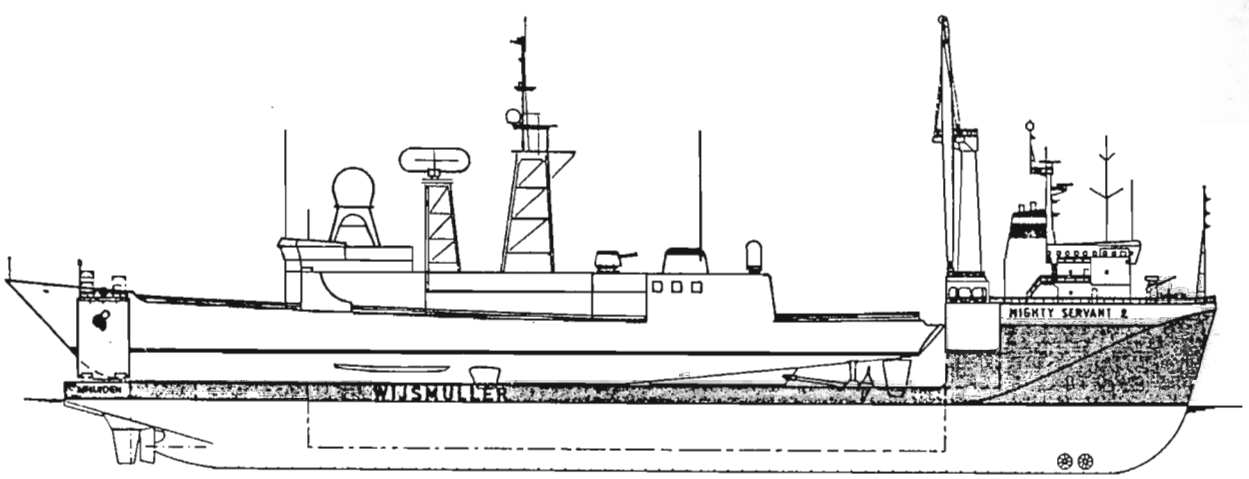
Apart from transporting disabled crafts, the semi-submersible heavy lift vessels can be deployed for a variety of alternative applications:
- during the Falkland war, various floating accommodation units were mobilized for the British Army, using semi-submersible self-propelled heavy lift vessels;
- the French Navy has used such vessel to transport nuclear testing equipment to one of their atolls in the Pacific;
- MSC has chartered such vessel, which is stationed in Diego Garcia stowed with landing crafts, floating cranes, tugs, etc.

Without a doubt, the future will bring more applications for these versatile vessels.

References

1. Norman Friedman - "World Naval Developments", the Naval Proceedings, June 1988.

2. Capt. Paul D. Rogers - "Fixing Battle Damage", the Naval Proceedings, June 1988.



APPENDIX 1

General information semi-submersible heavy lift vessels

Following table gives the main dimensions of the SUPER SERVANT.

Principal characteristics

	SUPER SERVANT	
Length o.a.	139	m
Length b.p.	130	m
Breadth	32	m
Depth	8.5	m
Draft summer	6.3	m
Draft max	14.5	m
Gross tonnage	10,184	T
Deadweight	14,449	T
Deck space	3,500	m^2
Deck load	15	T/m^2

Propulsion

SUPER SERVANT 1,3 and 4:
2 x 4,675 bhp Stork-Werkspoor diesel engines

SUPER SERVANT 5 and 6:
2 x 4,500 bhp M.A.N. diesel engines

Auxiliary engines

SUPER SERVANT 1,3 and 4:
3x190 KW diesel generators
3x350 KW shaft generators
1x190 KW emergency generator
1x360/440 KW cargo generator (SS 1)
1x395 KW cargo generator (SS3 /SS4)

SUPER SERVANT 5 and 6:
3x250 KW diesel generators
2x350 KW shaft generators
1x250 KW emergency generator

Communication equipment

-ssb radio telephony/telegraphy
-telex over radio
-vhf radio telephony
-weather facsimile

Navigation equipment

-two radars
-satellite navigator
-direction finder
-2 echo sounders
-autopilot
-magnetic log

Following table gives the main dimensions of the MIGHTY SERVANTS

Principal characteristics

	MIGHTY SERVANT 1	MIGHTY SERVANT 2	MIGHTY SERVANT 3	
Length o.a.	160	170	180	m
Breadth	40	40	40	m
Depth	12	12	12	m
Draft submerged max.	22	22	22	m
Gross tonnage	21,200	22,400	23,600	T
Deck space	40 x 120	40 x 130	40 x 140	m
Deck load	25	25	25	T/m^2
Deadweight	21,500	23,300	24,800	T
Cargo hold	80x16x7,5	90x16x7.5	100x16x7.5	m
Hatch	31x14.6	31x14.6	31x14.6	m
Heavy derrick	250	250	250	T

Propulsion

Two Stork-Werkspoor 12 TM 410 diesel generator sets, driving two c.p. propellers by four electra motors of 3,100 KW each. As two propellers can be driven by one main engine, maximum flexibility is ensured.

Auxiliary engines

Two diesel generators 380/440 V, 50/60 Hz, each 150/190 KW.
One emergency diesel generator of 190 KW.
One waste heat recovery turbo-generator of 820 KW.

Communication equipment

-ssb radio telephony/telegraphy
-telex over radio
-vhf radio telephony
-weather facsimile

Navigation equipment

-two radars (1 arpa coupled)
-satellite navigator
-direction finder
-echo sounders (for and aft)
-2 gyrocompasses
-doppler log + magnetic log