SL740-AL-RPT-010

0910-LP-118-8393

U. S. NAVY SALVAGE REPORT

USS FITZGERALD (DDG 62) AND USS JOHN S MCCAIN (DDG 56) SALVAGE RESPONSE AND HEAVY LIFT OPERATIONS

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Published by Direction of Commander, Naval Sea Systems Command

1 MAY 2019

FOREWORD

The collision of USS Fitzgerald (DDG 62) on 17 June 2017 and subsequent collision of USS John S McCain (DDG 56) on 21 August 2017 came as a shock to the U.S. Navy and became a test of the Navy's combat salvage response capability. While the collisions did not occur during combat operations, they tested the Fleet's capacity to respond to such causalities. The causalities tested first, ship's force at sea, then various Naval activities at the pier, the greater 7^{th} Fleet salvage community, and ultimately, Supervisor of Salvage and Diving (NAVSEA 00C, SUPSALV) technically and our management of the heavy lifts.

Immediate salvage response to these tragedies was orchestrated locally by the CTF-73 Salvage Officer and Master Diver along with Ship Repair Facility and Japan Regional Maintenance Center, Yokosuka. Supporting their response were varied activities including Southwest Regional Maintenance Center (SWRMC), 15th Marine Expeditionary Unit (MEU) Force Recon Detachment on board USS America (LHA 6), USS Frank Cable (AS 40), USS Emory S Land (AS 39), and Mobile Diving and Salvage Unit ONE. From HQ, NAVSEA stood up their NAVSEA Ship Incident Response Center (NSIRC) which coordinated efforts of SEA 21, SEA 05, the Naval Shipyard community, and SUPSALV. Initial and joint response proved to be successful as both ships were stabilized, patched, dewatered, and prepared for lifting and transport to their permanent repair site.

Unlike the numerous planned heavy lift operations SUPSALV conducts, emergent U.S. Navy Heavy Lift operations are relatively rare and the need to conduct two heavy lift operations within a few weeks of each other fully taxed our capacity. SUPSALV mobilized our in-house team (HL SME and Naval Architect) and members of the Heavy Lift Reserve Detachment to Yokosuka, Singapore, Subic Bay, the Netherlands, and eventually, Pascagoula, MS. to support MSC contracted lift of Fitzgerald and SUPSALV contracted (through Western Pacific Salvage contractor, SMIT) lift of John S McCain.

The success of the heavy lift missions were a direct result of the experience and training of SUPSALV's heavy lift team. Based on conditions encountered during USS COLE's October 2000 emergent heavy lift, SUPSALV initiated the formation of the Heavy Lift detachment and worked to ensure that team received real-world experiences and training to support their mission. In the past 10 years alone, SUPSALV has conducted or participated in 25 heavy lift operations, some of them included multiple ships and multiple lifts. This hands-on approach to training greatly contributed to our team's ability to execute these missions.

The reality of operating with commercial carriers is that the Navy does not control the availability of commercial assets. Despite the challenges we may face, In the future, when and if emergent heavy lift becomes necessary again, the U.S. Navy and SUPSALV salvage and heavy lift team will be ready to execute the mission whenever and wherever it is required.

Well done to all activities who supported these operations and we thank the CTF 73 Salvage team and the Navy Reserve Heavy Lift detachment for their assistance in preparing this report.

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Chapter 1 - Introduction

During the summer and fall of 2017, Commander Seventh Fleet (C7F) and NAVSEA Supervisor of Salvage and Diving, 00C (and also known as SUPSALV), responded to two C7F casualties that required actions from Fleet salvors, SUPSALV, the 00C Heavy Lift Reserve Detachment, and activation of a number of SUPSALV contracts. The casualties; collision of USS Fitzgerald (DDG 62) near Yokosuka, JA on 17 June 2017 and of USS John S McCain (DDG 56) near Singapore on 21 August 2017 began a seven-month long effort which challenged SUPSALV both technically and logistically. This report highlights the challenges, actions taken, results, and lessons learned.

1-1 Geography and Timeline

These operations presented unique challenges to the C7F and SUPSALV salvors and heavy lift engineers some of these challenges were complicated by geography and timing of the events. While the two incidents occurred almost 2,900 nautical miles apart, they both were C7F forward deployed ships operating in the western Pacific. The occurrence of such rare events just nine weeks apart compounded the response challenges.

The USS Fitzgerald casualty happened on 17 June 2017and she was able to reach Ship Repair Facility (SRF) Yokosuka. There, USS Fitzgerald was patched and drydocked at SRF where the diver-installed patch was removed and a second patch that would remain in place during the heavy lift was installed. USS Fitzgerald was then transported across the Pacific to Pascagoula, MS for offload and permanent repairs. USS John S McCain, the collision of which occurred 21 August 2017, was lifted at Changi Naval Station in Singapore, after a diver-installed patch was installed, and transported to Yokosuka, Japan. Due to this overlap, our teams in the western Pacific were immersed in these operations for almost six months. Figure 1-1 overlays the timeline of Fitzgerald and John S McCain events on a map showing the location of major events and activities that took place during the operations.

Two additional factors made this operation unique. First, both of these collisions occurred with guided missile destroyer class ships, provided a rapid learning curve between the first and second incident. Second, both incidents occurred within a very short distance of safe ports and both ships were able to control flooding and independently transit to safe harbor. Both ships’ propulsion systems, while degraded, were operational.

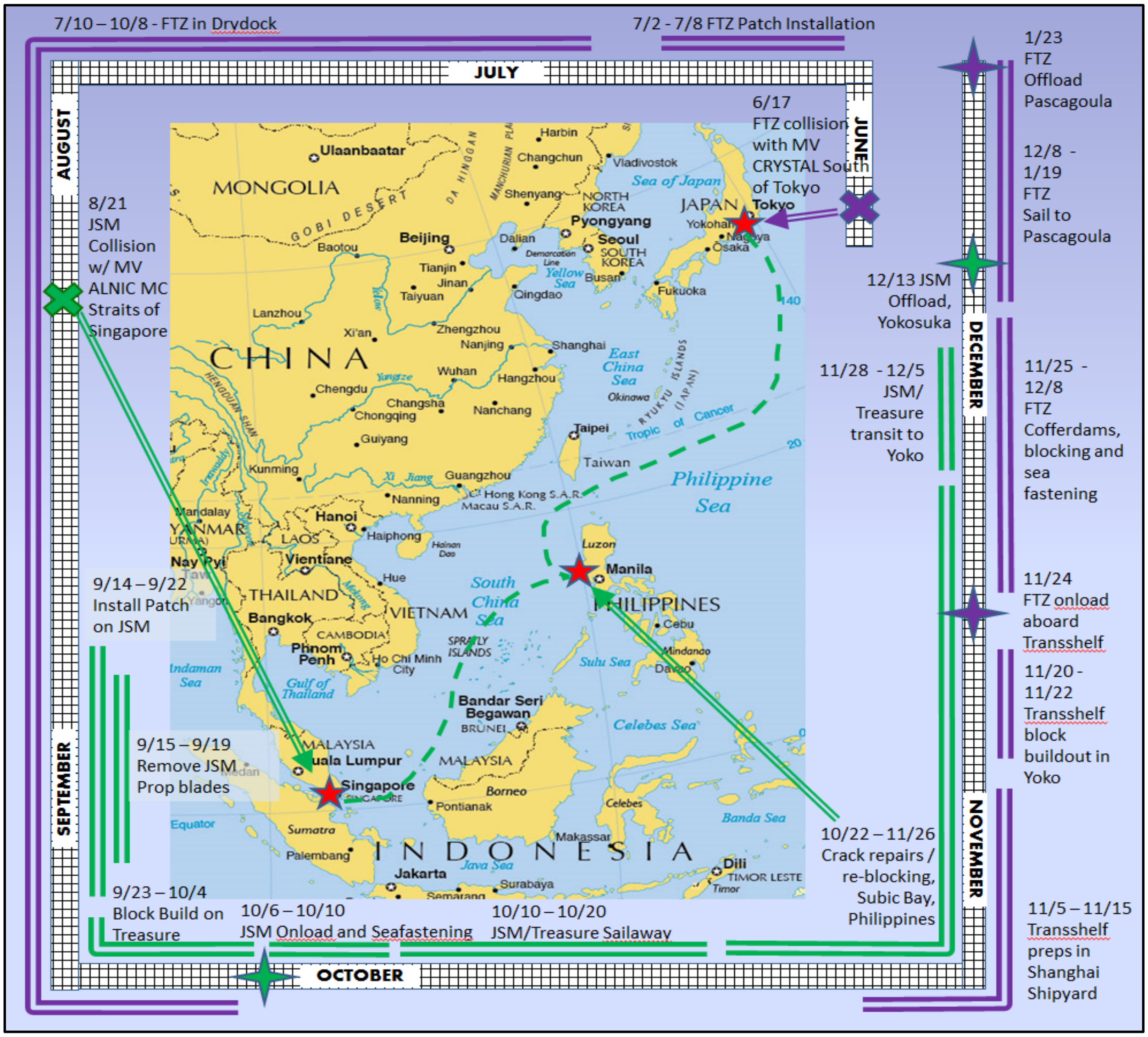


Figure 1-1. Timeline and locator map of major events in C7F AOR.

1-2 Fitzgerald Collision and Immediate Responses

1-2.1 Description of Event

At approximately 0220 JST on 17 June 2017, USS Fitzgerald collided with M/V ACX CRYSTAL (ACX) 56 nautical miles southwest of Yokosuka, Japan. ACX's bow impacted the starboard bow of USS Fitzgerald around frame 120. Extensive topside damage occurred to the Commanding Officer's stateroom, Radar 1, refueling station 3, the starboard windbreak, and various fan and cooling equipment rooms. The bulbous bow of ACX penetrated the hull 15 ft below the waterline, creating a 17x12 ft hole into the starboard access trunk outside Berthing 2, with a 4 ft gash extending into Auxiliary Machinery Room Number 1 (AMR 1) and the forward starboard potable water tank. As the two ships separated, the port side of ACX struck the starboard side of USS Fitzgerald, damaging numerous locations topside aft of the initial impact.

1-2.2 Damage Description

USS Fitzgerald set general quarters immediately. After muster, seven personnel were missing, all of whom had been assigned to Berthing 2. As Japan Coast Guard and U.S. Navy search and rescue helicopters began a search of the area for the missing crew members, USS Fitzgerald returned to Yokosuka under her own power with a transit speed of three to seven knots. The ship locked the starboard shaft after the shaft control unit (SCU) lost indications, most likely due to damage to number one switchboard in AMR 1.

Upon mooring at Berth 12, the status of the ship's engineering plant was as follows:

- Gas turbine main engines: 1A & 1B – automatic shutdown, did not attempt to restart, 2A & 2B – operational
- Gas turbine generators: NR1 – inaccessible (underwater), NR2 – tripped offline, NR3 – operational
- Switchboards: NR1 – inaccessible, NR2 – ground, NR3 - operational
- Shafts: Port – operational, Starboard – locked
- Fire Pumps – 3 of 6 available
- Sea Water Service Pumps – 4 of 5 available
- Fuel Oil Purifier and transfer pumps – 0 of 2 available
- Fuel Oil service pumps – 2 of 4 available
- L/O service pumps – 4 of 4 available
- CPP pumps – 2 of 2 available
- HPACs – 0 of 2 available
- LPACs – 1 of 3 available
- ACs – 3 of 4 available, chill water system inoperable

The spaces in the list that follows were damaged by the collision impact damage. Figures 1-2 and 1-3 show the profile and plan views of the damage and the spaces in which they occurred.

Berthing 3	2-300-2-L
Berthing 5	3-310-2-L
Fuel Oil Service Tank	5-300-4-F
Aft Officers Country	1-300-1-L
Crew Library	2-344-2-L
Berthing 7	3-338-2-L
Fuel Oil Storage Tank	5-338-2-F
Air Conditioning Machinery and Pump Room (Shaft Alley)	5-300-1-E

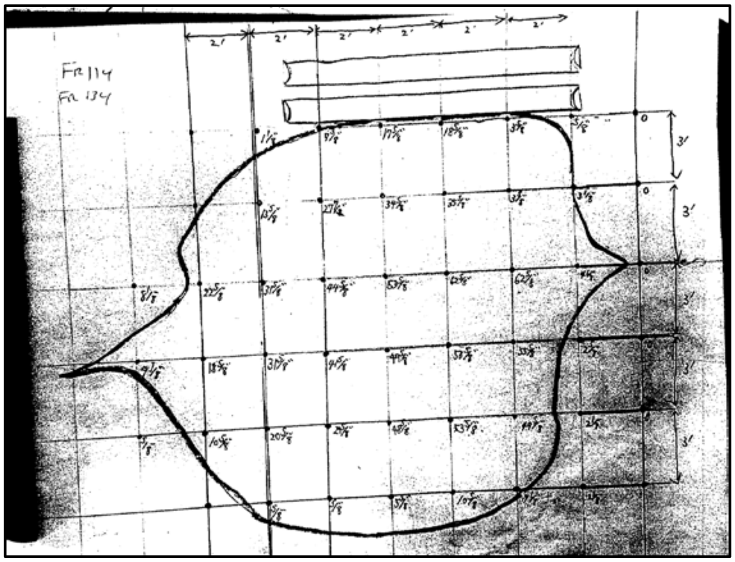


Figure 1-2. Sketch of Fitzgerald's damaged underwater shell giving shell plate indentation depths at various locations.

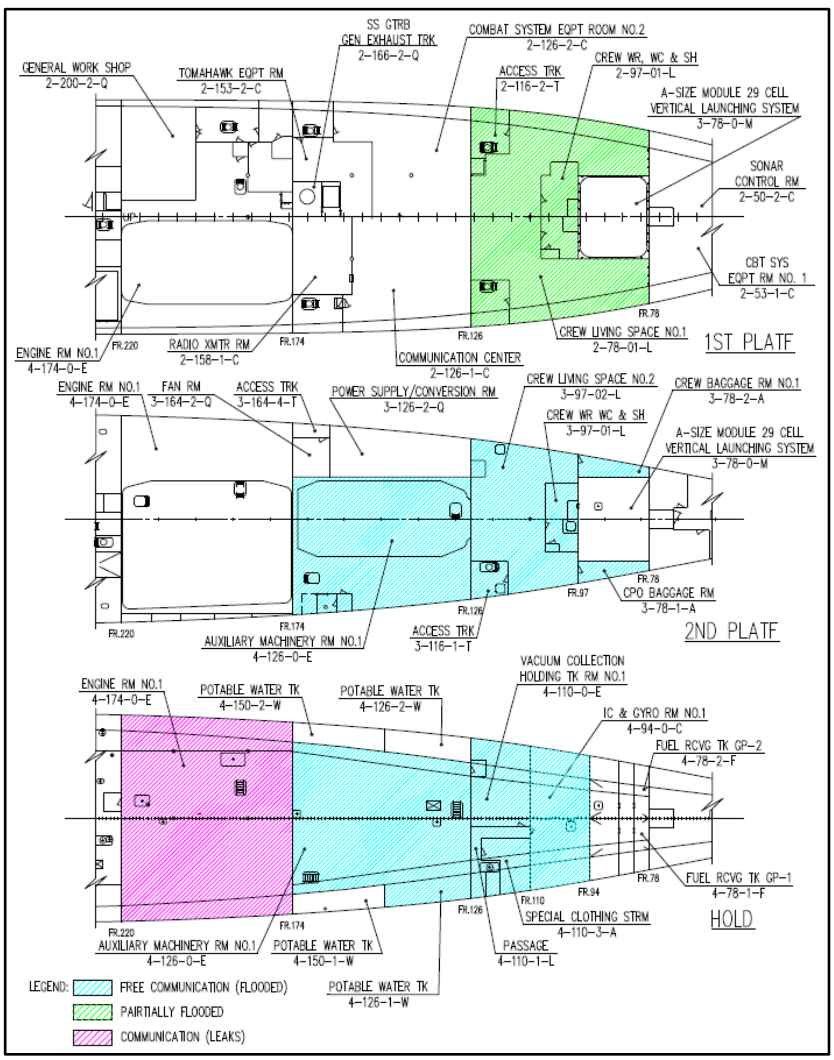


Figure 1-3. Damage and Flooding Status at 1400 JST on 21 June 2017.

1-3 John S McCain Collision and Immediate Response

1-3.1 Description of Event

At approximately 0524 on 21 August 2017, USS John S McCain collided with a Liberian merchant oil/chemical tanker, ALNIC MC, impacting the port quarter with the merchant tanker's bulbous bow. The event took place approximately 10 nautical miles off of the Singapore shoreline and resulted in the deaths of 10 U.S. Navy sailors.

USS John S McCain reported flooding in the following spaces. Berthing spaces 3, 4, 5, 6, 7, aft IC Gyro, related power conversion spaces, and shaft alley. Reports indicated that there was no progressive flooding and that active dewatering was in progress. The ship reported that the second deck berthing areas in the vicinity of frame 300 and shaft alley were completely flooded. Chilled water cooling to communications equipment was compromised. The ship secured all non-essential equipment to maintain power for vital communications. NAVSEA Ship Incident Response Center (NSIRC) calculations projected 1-2 degrees of list and that the ship would be stable, both of which were confirmed by ship’s force.

USS John S McCain remained stable, trimmed by the stern and listing to port. She proceeded to Changi Naval Station on her own power, running the starboard shaft with the port shaft locked. Once in port, NAVSEA and on-site response personnel created weight and stability models and confirmed the ship was stable. Unlike USS Fitzgerald, USS John S McCain’s post casualty list and trim would have supported dry docking the ship.

1-3.2 Damage Description

The bulbous bow of ALNIC MC struck USS John S McCain’ port quarter creating a large indentation on the hull spanning approximately from frames 308 to 340 from approximately 7 feet above the keel to 31 feet above the keel. At the center of this indentation was a 4 – 7 ft wide split in the hull plating. The immediately affected compartments were Berthings 3 and 5, and Fuel Oil (FO) Service Tank 5-300-4-F. The indentation from the collision extended approximately 10 ft into all three of these spaces. Figure 1-4 show an image of the damaged hull and figure 1-5 shows a plan view of the damaged decks and spaces.

In addition to the side hull, the bilge keel suffered deformation from frame 330, where the bilge keel ends, to approximately 15 feet forward of the impact site. At the impact site, 95% of the bilge keel had peeled away, and the aft weld seam on the bilge keel had sheared off approximately 6 inches on top, and 1 foot on the bottom.

Figure 1-4. Photograph of the damage to the port side of John S McCain extending from frame 308 to frame 342.

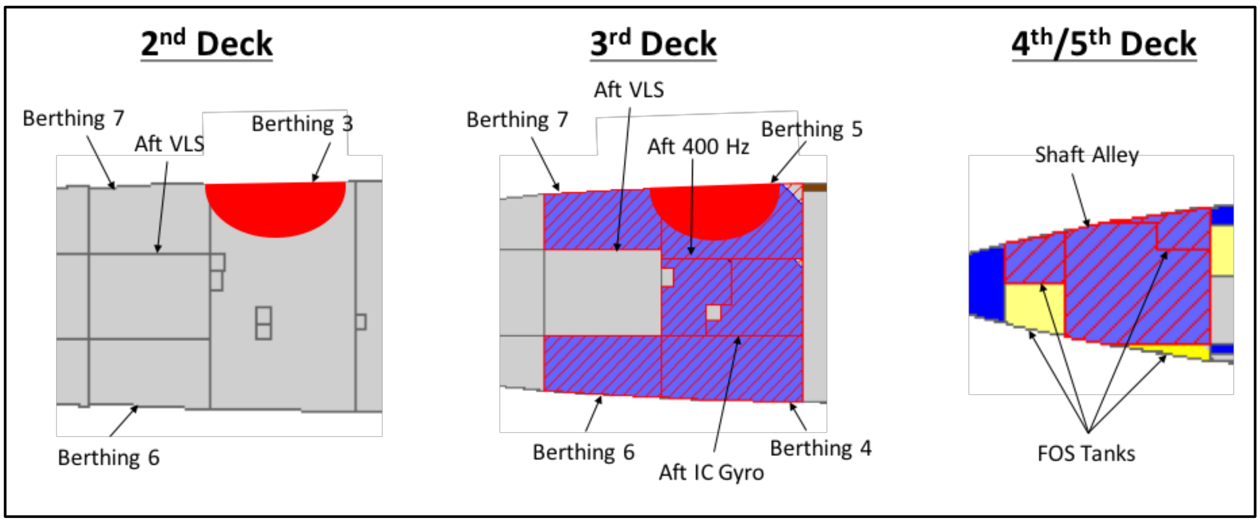


Figure 1-5. A plan view of damage to John S McCain. The red indentation represents collision damage. Red hashed spaces represent areas affected by flooding. Yellow spaces indicate the presence of fuel.

The following spaces were affected by the collision impact damage.

Berthing 3	2-300-2-L
Berthing 5	3-310-2-L
Fuel Oil Service Tank	5-300-4-F
Aft Officers Country	1-300-1-L
Crew Library	2-344-2-L
Berthing 7	3-338-2-L
Fuel Oil Storage Tank	5-338-2-F
Air Conditioning Machinery and Pump Room (Shaft Alley)	5-300-1-E

The opening in the hull varied in width between 4 and 7 feet. In Figure 1-5, the red circle indicates the location of the indentation, while the hatched red spaces show the areas affected by flooding. The majority of the flooding originated from the hole in Berthing 5. From there, the flooding progressed through the down-flood trunks to shaft alley, and back up the down-flood trunks to Berthing 4. Berthing 7 was flooded through the compromised aft bulkhead in Berthing 5, and from there the flooding progressed through cross-flood trunks to Berthing 6. The following is a list of spaces affected by the flooding:

Uncontrolled (open to sea):	
Fuel Oil Service Tank	5-300-4-F
Berthing 5	3-310-2-L
Shaft Alley	5-300-1-E
Berthing 4	3-300-1-L
Controlled (after patching and shoring):	
Berthing 7	3-338-2-L
Aft IC/Gyro	3-300-0-C
Aft 400 Hz	3-319-0-Q
Berthing 6	3-338-2-L
Possible Flooding:	
Fuel Oil Storage Tank	5-338-2-F

Chapter 2 - USS Fitzgerald Salvage Response and Emergent Repair

2-1 Initial Response

Commander, 7th Fleet issued an order for Commander, Task Force 73 (CTF 73) to mobilize the deployed MDSU One Company to Yokosuka to support the salvage operation. Ship Repair Facility (SRF) Yokosuka and CTF 73 requested NAVSEA 00C support to contract underwater welders from Phoenix International. Upon USS Fitzgerald mooring pierside at approximately 2000 on 17 June 2017, SRF divers conducted an initial site survey of the underwater damage. They drew a sketch of the damaged areas to help leadership better assess available options.

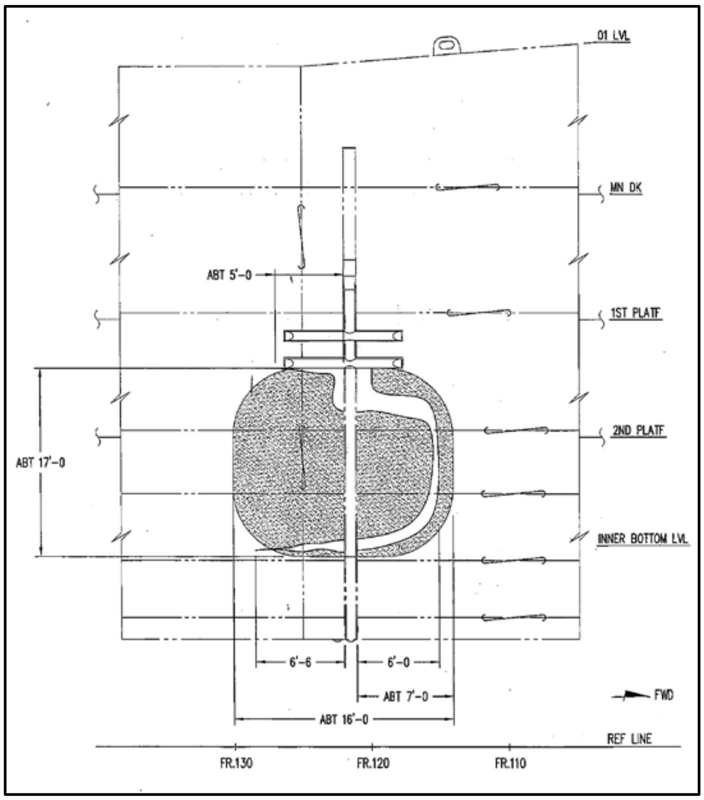


Figure 2-1. Early drawing of the damage based off the diver's description and sketch. The horizontal and vertical "tubes" that run down the middle of the hole are masker air belts.

The next morning, 18 June 2017, SRF divers recovered the remains of the seven missing sailors. Mobile Diving and Salvage Unit 1 (MDSU 1) divers arrived on scene later on 18 June 2017. The divers, utilizing surface supplied diving, immediately began mechanically isolating the flooded spaces by closing water tight doors and hatches and closing deck drains and plugs. They installed temporary lighting from frame 130 forward and arranged transportation for high capacity pumps, welding and cutting gear, and lift bags from the Emergency Ship Salvage Material warehouse in Sasebo, Japan. A full list of flooded spaces was compiled before any dewatering was attempted and is displayed in Table 2-1.

Table 2-1. USS Fitzgerald Initial Compartment Flooding Status

Partially Flooded	Fully Flooded	Open Communication
Radio	AMR 1	FWD starboard Potable Water Tank
FWD Power Supply Conversion Room	Berthing 2	Berthing 2 Access Trunk
Fan Room	FWD VCHT Pump Room	
FWD I/C Gyro Room	Special Clothing Storeroom	
Berthing 1		

On Monday 19 June 2017, divers began external patching efforts to isolate Auxiliary Machinery Room (AMR) 1 from sea. Wooden wedges and other materials found around the ship were used to close the opening and minimize free communication to the sea. Some of the partially flooded spaces were dewatered including forward 400Hz and fan rooms. Metal shoring was gathered from other ships on the waterfront and installed on the main deck starboard side where bulkheads began to show signs of buckling. Initially, dewatering of port side spaces increased the list to starboard and further buckling of the starboard side passageway where the superstructure was unsupported. The salvage team began dewatering with a more structured plan once this problem was recognized to take into account second order effects. Appendix B lists the steps taken during dewatering efforts. On Tuesday 20 June 2017, divers went down the flooded access trunk to secure the AMR 1 watertight door and close the pressure equalization valve. The team then used peri-jet eductors to pump down the water in the access trunk.

Analysis of flooded spaces determined that dewatering AMR 1 would improve the ship's damaged stability as it contained over 750 LT of seawater and was also contributing significantly to the 5-degree list of the ship. The salvage team tried multiple pumping configurations but were unable to outpace the leak rate beyond pumping a few feet below the ship's waterline. Ultimately they configured two 6-in hydraulic pumps rated at 2200 gallons per minute (GPM) in the AMR 1 escape trunk to dewater the space. By the end of the day, the space went from fully flooded to 5 feet of water on the upper level (the pumps had removed approximately 230 LT of seawater at that point). At this point, MDSU and SRF divers were able to access the space and identify a leak coming from the frame 126 transverse bulkhead between AMR 1 and Berthing 2. After divers patched the leak, the water level decreased to just below the lower level deck plates. MDSU and SRF divers were able to plug the hole with wooden wedges, mattresses, and other items all held in place with flight deck nets and chain hoists.

Figure 2-2. Auxiliary Machinery Room 1 salvage patch

This salvage patch slowed the rate of leaking into AMR 1 and greatly aided the ship's draft and trim. Over the next few days, the patch was improved and the wooden wedges swelled, further decreasing the leak rate. After 5 days, the leak rate was minor enough to be handled by the ship's installed main drainage system. Cement was later added around the patch, further strengthening it and filling gaps.

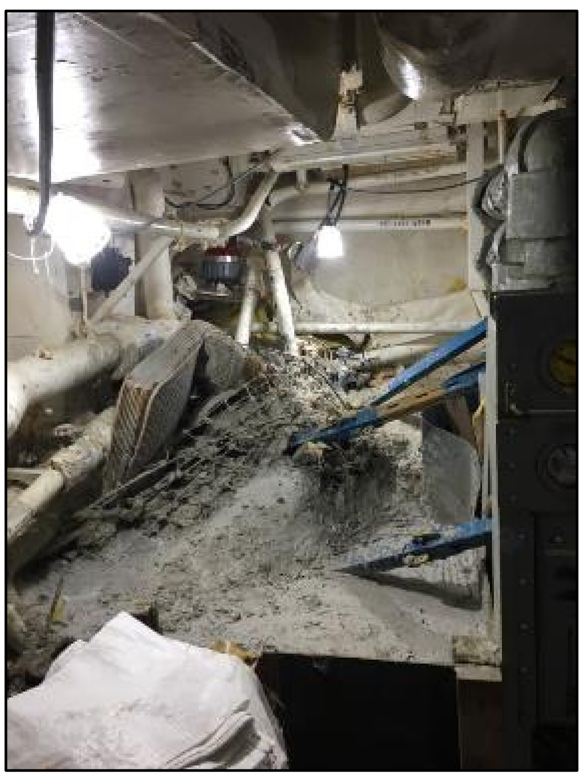


Figure 2-3. Auxiliary Machinery Room 1 salvage patch after application of cement

The salvage team then set up to dewater Berthing 1, now well above the waterline. MDSU and SRF divers also placed a wooden patch over the non-water tight access on the starboard side between Berthing 1 and Berthing 2. During this time, the divers worked outside of the shell penetration grinding and cutting. Due to the hull breach in that location, the divers' bubbles were not going straight up to the surface, but into Berthing 2. The bubbles collected at the highest point, the port side hatch to berthing 2. However, because the hatch was sealed, an air pocket formed under the hatch, making the port side more buoyant and increasing the ship's starboard list. The seal was broken allowing air to escape thereby eliminating the listing source.

2-1.1 Technical Assistance

Since USS Fitzgerald pulled into her homeport of Yokosuka, the local waterfront engineering technical authority, the SRF Chief Engineer, assumed responsibility for the technical aspects of the operation. The NAVSEA incident response center set up a dedicated bridge line to assist with any technical communications required between SRF and technical warrant holders at NAVSEA. Pearl Harbor Naval Shipyard provided five structural and electrical engineers to support salvage efforts at SRF's request.

SRF Fleet Technical Assistance (FTA) C283 Electrical division worked to discover and clear the ground in NR2 Switchboard in order to allow the ship to connect to shore power (only available through NR2 switchboard). The ship was then able to transfer from ships power to shore power at approximately 1900 on 17 June 2017 and secure NR 3 GTG and associated fuel systems.

SRF also stood up a project team which helped coordinate between the ship, SRF production shops, services, and the salvage team. The ship's Port Engineers, with extensive history and knowledge of the ship and its systems, were also on hand to assist with the salvage and repair process.

Computers, conference rooms, technical reference material and numerous subject matter experts (SMEs) were available to the salvage team. USS Ronald Reagan (CVN 76) was underway allowing USS Fitzgerald to moor at Berth 12, which had a large laydown area and high capacity portal cranes. The carrier's deployment also meant that there were plenty of available hotel rooms nearby as most of the temporarily assigned Puget Sound Naval Shipyard personnel had left after the carrier's maintenance availability.

2-2 Course of Action Development and Selection

By 19 June, there was sufficient information provided by the divers and daily briefs on the incident response teleconference to scope the problem and develop four principal courses of action (COA) for Fitzgerald's initial salvage response. These COAs were further refined after assessments were complete and the extent of the damaged structure and ship systems was better understood.

2-2.1 COA 1: Cofferdam

Fabricate a large box cofferdam and install over entire affected area. The cofferdam would be approximately 22 ft by 22 ft, with a 3 ft standoff and an estimated weight of 25,000 lbs. Once the cofferdam was installed, the salvage team would dewater flooded spaces and offload enough fuel, water, ammunition, and other flexible loads to meet draft, list and trim requirements for docking. The ship would then be docked for assessment and decision on the final disposition of the ship.

2-2.2 COA 2: Belly Bands and Lift Bags

Attach external lift bags to the ship with belly bands to provide the buoyancy required to meet draft, list and trim requirements for docking. The ship would then be docked for assessment and decision on the final disposition of the ship.

2-2.3 COA 3: Patch

Install a patch to establish watertight integrity to dewater flooded spaces and offload enough fuel, water, ammunition, and other flexible loads to meet draft, list and trim requirements for docking. The ship would then be docked for assessment and decision on the final disposition of the ship.

2-2.4 COA 4: Heavy Lift

Contract a heavy lift vessel to carry the ship from Yokosuka to an undetermined location in CONUS for repairs, similar to USS Cole (DDG 67).

2-3 COA Selection

The team quickly recognized that the amount of additional buoyancy Fitzgerald required to meet docking conditions would require large and cumbersome lift bags. The narrow sill entrance to the only available dry dock in Yokosuka (Dry Dock No. 4), made this an impractical and high risk COA and the team retired COA 2.

On the daily brief teleconference on 20 June, COMPACFLT expressed a desire to dock the ship in Yokosuka at the earliest available opportunity. The team therefor retired COA 4.

The advantage of the box cofferdam of COA 1 was that the SRF and MDSU dive teams had extensive experience installing cofferdams, although never this size. With proper design and fit up, the team could have reasonable assurance of water tight integrity around the underwater damage. The disadvantage of the cofferdam was its size which required more time and material to fabricate and would be difficult to install due to weight, waterborne area, and the need to restrain the buoyant force of the cofferdam. If the fit-up was unacceptable, there would be limited options to adjust, as the cofferdam would be structurally stiff. Additionally, the three-foot protrusion of the cofferdam would increase the ship’s beam beyond 66 feet, mandating a very precise entrance into the 82 feet wide sill of Drydock four.

The advantage of the COA 3 patch was that the team could immediately start preparing it. A salvage patch had already been installed in AMR 1 and leak rate could be maintained by the ship’s installed eductors. A Program of Ship Salvage Engineering (POSSE) analysis (Appendix A) determined the ship could meet docking conditions if AMR 1 had minimal water intrusion, all forward tank groups could be defueled and dewatered, the anchor and anchor chain were removed, and the sonar dome was dewatered. Any bending or flexing of the hull, particularly those typically experienced during a docking evolution, could cause the installed AMR 1 salvage patch to fail and put USS Fitzgerald in an unsafe condition to dock. A rolled steel patch welded onto the shell would stop free communication to the sea and provide additional safety to the AMR 1 patch. In addition, the flooded spaces of Berthing 2, forward vacuum collection and holding tank (VCHT) pump room and IC/Gyro could be pumped down, giving the salvage team options regarding which tanks needed to be dewatered or other weight removal decisions. The disadvantages of the patch would be would be the cost and time to install.

During the 22 June 2017 coordination teleconference with NAVSEA, the team determined that a welded external patch (meeting the intent of COA 3) provided an acceptable margin of safety COA 1 was selected as the backup plan if patching and pumping efforts proved ineffective. MDSU and SRF divers immediately began site preparation for landing the patch. Patch design was finalized, SRF production shops began fabricating the patch, and NAVSEA 00C executed its contract with Phoenix International to mobilize certified underwater welders to install the patch.

2-4 Patch Design

2-4.1 Initial Design

The plan was to fabricate four panels, 5 ft x 20 ft (5 ft x 18.25 ft after fit up) of 3/8-inch-thick DH-36 steel, to cover the hole and indented portion of the shell plating. Three 4 in x 20 ft (4-inch x 18.25 ft after fit up) 3/8 in thick flat bars would cover the vertical seams between the patch panels. Perimeter welds would be 1/4-inch root weld then filled in to a 5/16-inch weld.

2-4.2 NAVSEA Recommendations

There were concerns about the ability of the unstiffened patch design to withstand the hydrostatic pressure. SUPSALV recommended that additional horizontal T-stiffeners be added to the design to ensure the patch did not buckle and fail under the expected stress levels. The patch was redesigned to have four horizontal T-stiffeners installed over the patch panels and flat bars. The stiffeners would have an 8 in flange and 13 in web, with a length of 24 ft, extending past the patch by 4 ft to join undamaged frames forward and aft of the affected area. Design calculations for stiffeners can be found in Appendix C. Welding requirements called for 1/4-inch root welds filled in to a 5/16-inch weld. However, since the majority of the stiffener welding was onto the DH-36 steel patch panels, the Phoenix International team used carbon steel welding rods saving time and money. SRF provided chemical lab analysis of the steel patch panels to verify and validate the use of the carbon steel welding rods.

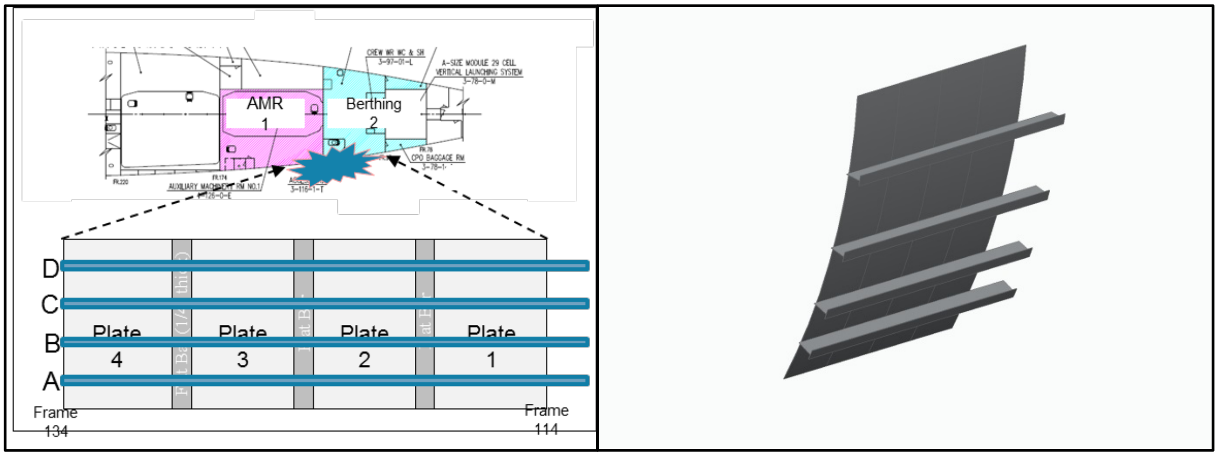


Figure 2-4. Fitzgerald Patch Design.

Figure 2-5. View of Fitzgerald's welded patch after dry docking.

2-5 Patch Installation

2-5.1 Site Preparation

MDSU and SRF divers were tasked with site preparation of the underwater patch panel landing locations. This required extensive cutting away of material, paint removal, masker belt foundation plate removal, and grinding the perimeter of the shell penetration. SRF and MDSU divers conducted site preparation during daylight hours and Phoenix International divers welded at night. Welding operations were shifted to the night to deconflict with ammunition offload and defueling operations scheduled for daylight hours 24 June -1 July 2017.

2-5.2 Panel and Flat Bar Installation

SRF's Shipfitter Shop (Shop 11) fabricated four patch panels delivering two to the pier on 26 June 2017 and then one each on 27 and 28 June 2017. The panels were cut on the pier from their original 20 ft vertical length to 18.25 ft to account for the landing area above the 5-126-1-F fuel tank. The three flat bars were delivered on 29 and 30 June 2017.

Table 2-3. Plate and flat bar installation schedule.

25-JUN Night Shift	Welded two guide tabs to support #1 plate installation.
26-JUN Night Shift	Fit up plate #1.
27-JUN Night Shift	Fit up plate #2, prepared plate 3.
28-JUN Night Shift	Fit up plate #3; fit up complete on plates 1, 2, and 3. Began production welding on plates #1, #2, and #3. Piece contoured and fit into place on forward side of plate #1. Prepared plate #4.
29-JUN Night Shift	Fit up plate #4; fit up complete on all plates. Continued production welding (root pass).
30-JUN Night Shift	Flat bar #3 tacked into place. Continued production welding (root pass).
1-JUL Night Shift and 2-JUL Day Shift	All three flat bars fit up and tacked welded in place.

2-5.3 Patch Installation Timeline Adjustments

The team expected installation of the original unstiffened patch to complete between 3-5 July 2017 which would support a planned docking date of 7 July 2017. With the requirement for additional stiffeners, the welding team was augmented to support 24 hours a day operations and the new estimated completion date was shifted to 10 July.

2-5.4 Stiffener Installation

SRF Production shops fabricated the stiffeners. Two were delivered to the pier on 1 July 2017 and the next two delivered on 3 July 2017. The web of the stiffeners increased to 21-inches to provide excess material that would be removed during the fit up process. Pad-eyes were also added to assist with the rigging.

Table 2-4. Patch stiffener installation schedule.

2-JUL night Shift and 3-JUL Day Shift	Stiffener A fit up
3-JUL Night Shift and 4-JUL Day Shift	Stiffener A tacked into place, Stiffener B fit up and tacked into place
4-JUL Night Shift and 5-JUL Day Shift	Stiffener C fit up and tacked into place
5-JUL Night Shift and 6-JUL Day Shift	Stiffener D fit up and tack into place
6-JUL Night Shift and 7-JUL Day Shift	Continue fill welding
7-JUL Night Shift and 8-JUL Day Shift	Complete production welding 10% magnetic testing (MT)

2-5.5 Issues with Making the Patch Watertight

On 2 July 2017, as Phoenix International divers welded the perimeter of USS Fitzgerald's patch panels and closed up free communication with the sea, the divers experienced water flow through the unsealed portions of the flat bar and patch panels. The water in Berthing 2 and the access trunk continued to leak through the AMR 1 patch. The leak rate was such that eventually all the water in Berthing 2 would drain into AMR 1 (in which the ship's installed eductors were dewatering). This leak was causing flow from the sea through the unsealed portions of the patch and flat bar, making it difficult to weld the patch completely shut. This had the potential to impress the full hydrostatic pressure of the external seawater on the patch prior to completing the stiffener installation. To resolve this, MDSU and SRF divers installed hoses from the ship's firemain system and stationed a watch to keep Berthing 2 completely flooded until the stiffeners could be installed. While it is counterintuitive to intentionally add water to a stable ship in a damaged condition that already had numerous compartments flooded, maintaining the water level was critical to equalizing pressure across the patch to complete the weld. With the pressure differential equalized, the patch was able to be completely seal welded and Berthing 2 and the other flooded compartments were dewatered on 9 July 2017.

2-5.6 Weather

On 3 July 2017, the team received reports of tropical storm 05W Nanmadol heading towards mainland Japan. It was forecasted to reach the Tokyo area at midnight on 4 July 2017, with sustained winds of 30 knots with gusts up to 40 knots. Because of the potential impact to crane operations, the stiffener installation schedule was slightly modified. The decision was made to fit up and tack in place the A and B stiffeners prior to the high winds forecasted, instead of continuing with production welding on the A stiffener. In this way, the production welding would be able to continue despite the potential loss of crane operations due to high winds as the storm passed over Yokosuka. No other weather impacts changed the production and docking schedule.

2-6 Weight Removal

The required docking characteristics for draft, list and trim, required removal of approximately 2,000 LT from the ship. A tabular list of the trim changes is included in Appendix B and detailed below individually.

2-6.1 Ammunition Offload

Preparation for ammunition offload began early as it was required to be removed for dry docking. Total weight of the ammunition onboard was estimated at 300 LT. The ship was unable to offload at the typical anchorage and required a pierside offload. The required waivers were submitted and approved expediently. There was a concern about pulling Vertical Launch System (VLS) missile canisters with the ship listing heavily to starboard. Denting or crumpling the canisters while pulling them via crane could have been catastrophic. The primary focus was to reduce the list of the ship to approximately 1 deg to support safe crane operations. Dewatering of AMR 1 and its access trunk provided the biggest list correction, and by 23 June 2017, the ship was in a condition to offload the missiles and other ammunition.

On 24 June, Commander Fleet Activities Yokosuka (CFAY) Security established explosive arc safety barriers to mitigate the blast radius. The Naval Munitions Command Yokosuka team provided oversight and support for the offload evolution. SRF provided temporary power to the forward VLS launcher hatches, greatly expediting the evolution which otherwise would require cranking each hatch open. The team finished ahead of schedule on 24 June, and were able to pull the Harpoon launchers, work which was planned for the next day. Effort continued the next day and ammunition offload was complete at 1400 on 25 June 2017.

2-6.2 Anchor Removal

SRF FTA set up power to Fitzgerald's anchor windlass to assist in anchor chain removal. The initial brief was conducted on 3 July. Ship's force in conjunction with SRF riggers commenced the evolution on 6 July and completed on 7 July 2017 without incident.

2-6.3 Defueling and Dewatering Pumping Plan

Although the original pumping plan did not require emptying some of the fuel tanks, the un-determined scope of repairs in dock meant that it would be prudent to defuel the ship in order to have more production flexibility once in dock. DDGs have a seawater compensated fuel storage system; as the ship takes fuel from the storage tanks, the volume is replaced by seawater in order to maintain stability. Defueling therefore makes the ship heavier, since seawater is denser than F76 fuel. The operation had three parts, (1) defuel all storage tanks, (2) dewater designated tanks, and (3) once the patch and stiffener installation was complete, dewater the flooded compartments to reach docking criteria.

USS Fitzgerald's crew paused on the morning of 27 June for a memorial service for the Sailors who lost their lives. In that time, SRF FTA set up temporary power to the forward fuel transfer pump. The defueling brief was held the afternoon of 27 June, and ship's force working with Destroyer Squadron (DESRON) 15 began defueling operations on 28 June at 0830. By the end of the day, 75% of tank groups 5 and 6 were defueled. Also on 28 June, representatives from the Office of Judge Advocate General (OJAG) conducted a ship walkthrough with Marine Surveyors in order to assess damage for litigation actions. Defueling resumed on 29 June 2017, completing tank groups 5 and 6.

The POSSE model of the ship accounted for the reported flooded spaces, liquid load, ammunition, stores, and other miscellaneous weight. The Tank Level Indicators (TLIs) were inoperable on the forward tanks, some sounding tubes were inaccessible and the latest liquid load report from the ship was taken at midnight on 16 June 2017, before the transit back to Yokosuka. These factors, as well as ship changes and equipment loads not available in the model, created a small delta between the predicted and actual draft, list and trim.

During the defueling and dewatering operations, the salvage team noticed that the delta continued to grow between the actual drafts and the predicted drafts. By 1 July 2017, the ship's forward draft was almost a foot deeper than POSSE analysis predicted. The salvage team investigated the ship to validate the POSSE analysis and identified two spaces not damaged by the collision, the anchor chain locker and forward VLS, with 6 ft of water. MDSU divers set up the high capacity pumps to dewater those spaces, and the ship's draft once again closely matched the POSSE analysis.

Later discussions with ship's force revealed the source of the water: 1) the anchor chain locker often flooded and was pumped out regularly, but ship's force had not done so since the collision. The crew had set up an in-line eductor in order to remove approximately 3 in of water in forward VLS. The discharge of this eductor was connected to eight hoses running to the fantail and over the side. The eductor lacked the required head pressure, and the water remained in the space. The resolution to these discrepancies validated the computer model and showed its effectiveness in identifying unseen problems.

Defueling continued on tank groups 1 and 2. While defueling tank group 1, compensating water was discovered much earlier than anticipated. Defueling was stopped on tank group 1 and shifted to tank groups 3 and 4 until the team could identify the discrepancy. Defueling of tank groups 3 and 4 completed on 1 July 2017 without incident.

Indication of unexpected compensating water in the fuel storage tanks in tank group 1 led to concern that the integrity of the fuel tanks was compromised. Further investigation into the compensating water system revealed possibility that with the heavy list and trim that the ship experienced transiting back to Yokosuka could have allowed sea water to mix with fuel in the system.

The team went forward with defueling tank group 1, placing the discharge into an oily waste because of the unknown amount of water left in the tank).

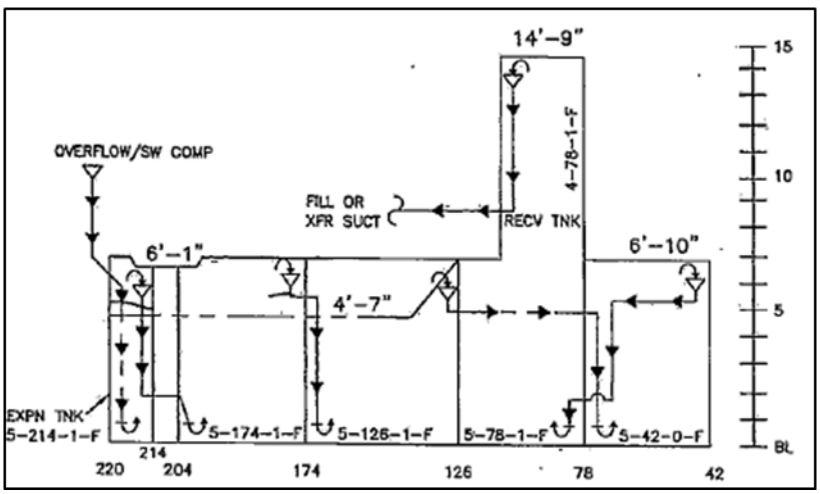


Figure 2-6. Tank group 1 schematic.

The salvage team modified the pumping plan numerous times as it learned more details of the damage and the impact on defueling and dewatering tanks. The final determination was to fully dewater tank groups 3 and 4, and partially dewater tank groups 1, 2, 5 and 6. dewatering of the remaining flooded spaces could begin once the patch and stiffeners were installed. MDSU and SRF divers set up 6-inch 2,200 GPM, 4-inch 830 GPM, and 3-inch 450 GPM pumps in Berthing 2 with hoses up the escape trunk discharging over the starboard side of the forecastle. This weight removal, coupled with removing the anchor, anchor chain, and dewatering the sonar dome, would meet the docking criteria of 0 deg list, between 0.3-2.0 foot trim by the bow, and provide enough clearance over the sill to meet a 3-hour tide window for docking.

2-6.4 Sonar Dome Dewatering

Calculations showed that dewatering the sonar dome would provide approximately one foot of draft reduction forward. However, dewatering the sonar dome required aligning low pressure air to maintain dome pressure and providing firemain to the sonar dome educator. Ship's force, FTA and divers in the flooded spaces were able to align low pressure air and firemain to dewater the sonar dome.

2-6.5 Ship Systems Preparation for Docking

SRF FTA personnel made a significant effort to ensure systems required for docking the ship were operational. The lube oil system was brought online and main reduction gears assessed to ensure the propellers could safely rotate to the docking configuration. Temporary power was rigged to multiple systems, including the anchor windlass. Furthermore, gas turbine generators were tested to ensure the ship would have power during the transit to dry dock and docking evolution.

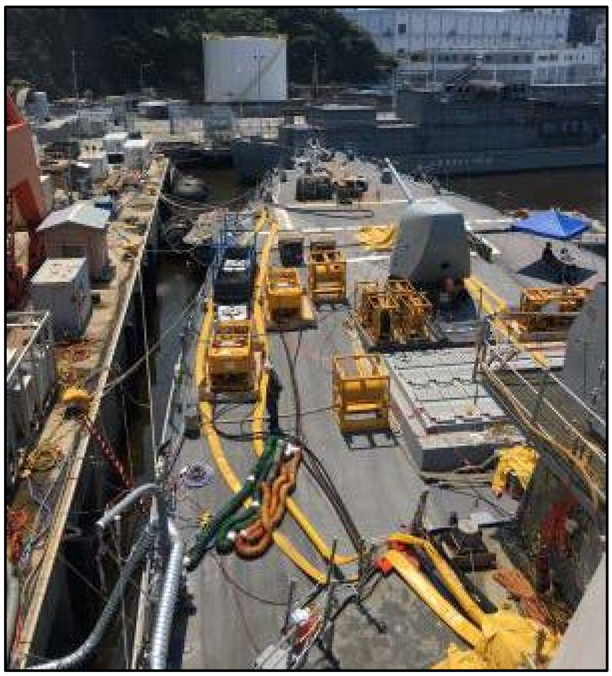


Figure 2-7. Layout of ESSM and other equipment on forecastle.

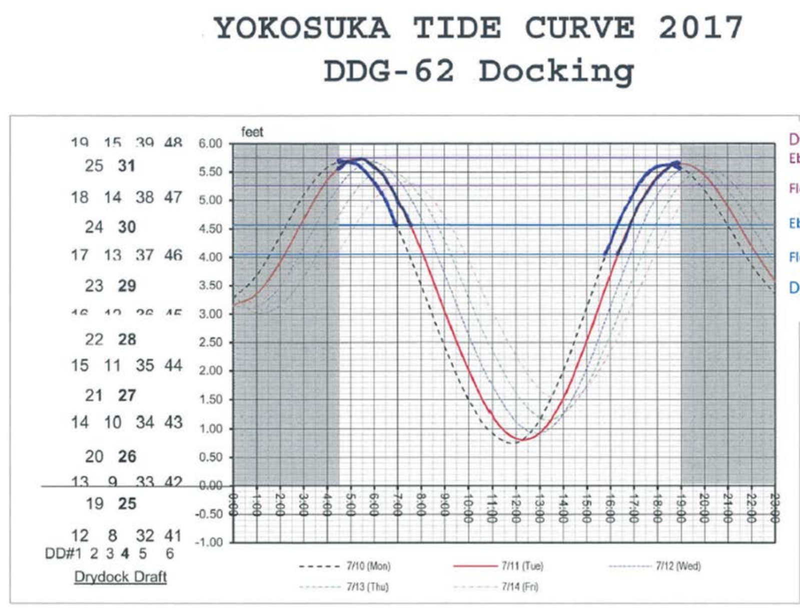
2-7 Dry Docking

2-7.1 Dry Dock 4

The dry dock block build was completed on 9 July 2017 to support the 11 July 2017 docking date. The damaged portion of USS Fitzgerald did not interfere with the standard block configuration. Divers performed a keel profile and verified that it was not damaged. The docking drawing did not include the as-built keel profile so the keel profile was performed looking for gross deflection, none of which was observed.

2-7.2 Tide Windows

Docking a damaged ship in tight constraints at Dry Dock 4 made it desirable to minimize the draft while maintaining stability. The standard operating procedure at SRF for docking ships requires an 18-inch clearance on ebb tide 6-inch greater than requirement (of NSTM 997). The Docking Officer discussed this with the SRF Commanding Officer, reducing the requirement to 12-inches to broaden the limited tide window. The SRF docking team achieved the desired drafts of 20’-0” forward and 19’-0” aft. Figure 2-8 depicts the tide window and calculated clearance for USS Fitzgerald’s docking.



		High Tide				Low Tide			
		Time	Feet	Time	Feet	Time	Feet	Time	Feet
7/10/2017	(Mon)	4:43	5.68	18:29	5.64	11:47	0.75	-	-
7/11/2017	(Tue)	5:18	5.71	19:01	5.64	0:02	3.15	12:20	0.79
7/12/2017	(Wed)	5:54	5.68	19:33	5.61	0:37	3.08	12:52	0.92
7/13/2017	(Thu)	6:32	5.54	20:05	5.54	1:13	3.02	13:25	1.15
7/14/2017	(Fri)	7:15	5.31	20:40	5.48	1:52	2.95	13:59	1.48

Figure 2-8. Tide windows for potential docking days.

2-7.3 Docking Evolution

In preparation for the docking evolution, the salvage team created a Salvage Emergency Response Bill (Appendix D) which included personnel from ship’s force damage control team. The Bill included watchstanders for each space along with rovers and personnel at the ship’s controlling stations. The emergency response team practiced walkthroughs and drills to ensure all personnel understood their roles and the integration of ship’s force and the salvage team. Additionally, all Zebra and Circle William fittings were closed forward of frame 174 to maximize watertight integrity.

The docking evolution was completed without incident.

Chapter 3 - USS John S McCain Salvage Response and Emergent Repair

3-1 Ship Response and Casualties

USS John S McCain arrived in Changi Naval Base, Singapore at approximately 0453 EDT 21 August 2017. USS AMERICA Amphibious Ready Group personnel were standing by to begin dives, damage assessment and to support USS John S McCain pierside. This section documents the initial assessment, salvage response, and repair actions proceeding John S McCain's heavy lift on M/V TREASURE.

3-1.1 System Status

Flooding in shaft alley resulted in loss of a number of engineering systems. Upon arrival at the Changi Naval base, the ship's engineering plant status was as follows:

Gas Turbine Main (GTM) engines – 1A, 1B, 2A, and 2B all operational
Gas Turbine Generators (GTG) – 1, 2, and 3 all operational
Switchboards – All switchboards operational
Shafts – Both shafts operational.
Shaft Bearings – Port thrust bearing submerged. 1B and 2A line shaft bearings submerged.
Fire Pumps – NR 5 fire pump was submerged. NR 1, 2, 3, 4, and 6 were operational.
Sea Water Service (SWS) Pumps – Number 5 SWS pump was submerged. NR 1, 2, 3, 4, and 6 were operational.
Air Conditioning (AC) Plants – Number 4 AC was submerged. numbers 1, 2, and 3 were operational.
Vacuum Collection and Holding Tank (VCHT) – Aft VCHT pumps and tank were out of commission, forward VCHT was operational.

3-1.2 Initial Recovery Efforts

At 1825 on 21 August 2017, divers from SRF and Japan Regional Maintenance Center (SRF-JRMC) Yokosuka and Sasebo entered the water in SCUBA gear to conduct initial external damage surveys. These divers were already in Singapore to support cofferdam installations for planned maintenance on USS John S McCain. In addition, the Battle Damage Repair (BDR) diving system was mobilized from the Singapore Emergency Ship Salvage Material (ESSM) warehouse. On 22 August, the BDR system was deployed to provide surface supplied diving capability to perform search and recovery in the ship's internal spaces. Divers from Marine Expeditionary Unit onboard USS America (LHA-6) also assisted with debris removal by performing SCUBA dives external to the hull.

By 24 August, divers from Southwest Regional Maintenance Center (SWRMC) and additional divers from SRF-JRMC arrived, and search and recovery operations shifted to 24/7 on 25 August. The primary focus was to recover the sailors' remains trapped in the space. Divers split into two teams, working from 0900-2100, and from 2100-0900. Stay times were limited to 3.5 hours to mitigate diver exposure to fuel, biohazards, and other dangers. Space entry was through the external hull breach into Berthing 5. A hydraulic cutter/spreader (Jaws of Life), and cutting wheels were used routinely to cut through racks, lockers, and other debris to find and recover missing crew members. Removed debris was offloaded to a work boat and transferred immediately to the USS John S McCain fantail and for eventual scrapping.

This work proceeded slowly – the underwater environment was packed with debris. Figure 3-1 shows the damage that occurred in Berthing 3 (directly above Berthing 5), and illustrates the difficulties the divers faced underwater. Space to maneuver/work was extremely confined. The first remains were recovered 23 August. All remains were recovered by 27 August 2017, 6 days after the initial collision.

Figure 3-1. Berthing 3 damage similar to that seen underwater in Berthing 5.

3-2 USS John S McCain Repair Decision / Destination

Before making the decision to heavy lift USS John S McCain, Seventh Fleet leadership had to decide which organization would perform the repairs. The options included a commercial repair yard with a drydock in Singapore, a Western Pacific U.S. Navy drydock in Japan, and commercial shipyards in the United States. On 27 August 2017, the Fleet activities calling in to the teleconference considered issuing a market survey to obtain the availability of floating drydocks and graving yards within the western Pacific area, but decided to let the Seventh Fleet maintenance team evaluate their options before going public with the survey. The SRF salvage and planning team began evaluating local repair facilities and obtaining scheduling information to aid in the decision process. Figure 3-2 shows an early draft of western Pacific area repair options;

Criteria: Dock Availability	C7F AOR					CONUS
	Singapore	Sasebo	Yokosuka	Yokohama	Other Port	
Dock Type	G/F	G	G	G/F	G/F	G/F
Dock Certification	Note 3			Note 3	TBD	
Dock Schedule	Note 1		Note 2	TBD	TBD	TBD

Criteria Evaluation (NSA Lead / CLWP/CNRMC input):

- Dock Availability
  - Dock Type(s) Available: (Graving /Floating)
  - Dock Certification:
    - G= NAVSEA certified
    - Y= NAVSEA reviewed
    - R = Unknown NAVSEA compliance
  - Schedule:
    - G= available between 1OCT17 – 1MAY18 for 4-6 month duration
    - Y= available between 1DEC17 – 1JUN18 for 4-6 month duration
    - R= availability exists but for duration less than 4 months or starting after JUN2018

Notes:

1. Initial CLWP temp repair market research indicated short duration immediate availability (30 days), sources sought will clarify for permanent repair
2. Yoko dock availability: DD#4 – BAR (7NOV17-05JUL18); DD#5 – STE (20DEC-19SEP18); DD#6 – BLR (Thru 9JAN18), DD Maintenance (JAN18-JUN19)
3. Both locations listed have performed emergent repairs on temp certified docks (INGERSOLL/BELLEAU WOOD) in past but not recent

Figure 3-2. Permanent Repair Options for John S McCain as of 28 August 2017

As consideration was being given to where USS John S McCain could be repaired, the SRF team was also evaluating the transit courses of action. The options and requirements were outlined in Figure 3-3 on 29 August 2017. The team concluded it was infeasible to maneuver the ship anywhere on its own power. In addition to the longitudinal strength concerns, the status of the power train components was uncertain and a seaworthy patch and some berthing repairs would be needed. Those temporary repairs were considered high risk.

Towing the ship was only a viable option if the tow was to a Singapore repair facility. That would require the U.S. Navy to accept the risk of an uncertified drydock. The potential advantage was the time saved returning the ship to operational status. Other challenges with this alternative were the need to find support facilities for the project team, crew separation from their families in Yokosuka, and the potential for an increased number of departures from specifications because U.S. Navy certified repairs and procedures were not established in Singapore.

Heavy Lift remained the only feasible transit option for repairs at the established facilities in Japan or Continental U.S. That solution required either a Military Sealift contract or the NAVSEA 00C Western Pacific Salvage Contract with SMIT Salvage.

Permanent Repair Location / Mode	1. Singapore	2. WESTPAC	3. Japan	4. US
A. Heavy Lift	N/A	POSSIBLE	POSSIBLE	POSSIBLE
B. Tow	POSSIBLE NAVSEA Risk Assessment of Dock	NOT RECOMMENDED Longitudinal Strength Insufficient	NOT RECOMMENDED Longitudinal Strength Insufficient	NOT RECOMMENDED Longitudinal Strength Insufficient
C. Ship's Power	N/A	NOT RECOMMENDED Longitudinal Strength Insufficient Power Train Status Unknown	NOT RECOMMENDED Longitudinal Strength Insufficient Power Train Status Unknown	NOT RECOMMENDED Longitudinal Strength Insufficient Power Train Status Unknown

Figure 3-3. John S McCain Transport Options as of 29 August.

On 3 September, the Navy decided to heavy lift the ship to SRF in Yokosuka, Japan. Commander Pacific Fleet chose to use the NAVSEA 00C Western Pacific salvage contractor SMIT, to subcontract to Dockwise to conduct the heavy lift. This decision also led to tasking SMIT to develop a hull patch to cover the open side of USS John S McCain and stabilize the hull during the lift.

Boskalis, the parent company of SMIT Salvage, also owns Dockwise. Boskalis established an intercompany agreement with Dockwise to conduct the lift and transport. The heavy lift ship TREASURE was available and capable of performing the lift. Due to TREASURE's deck length and configuration, the lift would be an angled lift.

3-3 USS John S McCain Preparations for Lift

The major events that took place following the 28 August 2017 recovery phase involved getting the ship prepared for transit on the heavy lift ship. The major events that went into this effort included patching and dewatering spaces, executing a lightering plan to reduce trim, conducting an ammunition offload, defueling, and patch construction and installation. The overall schedule for these events is illustrated in Figure 3-4. The lightering plan, patch construction/installation, and the heavy lift are further detailed in the following sections.

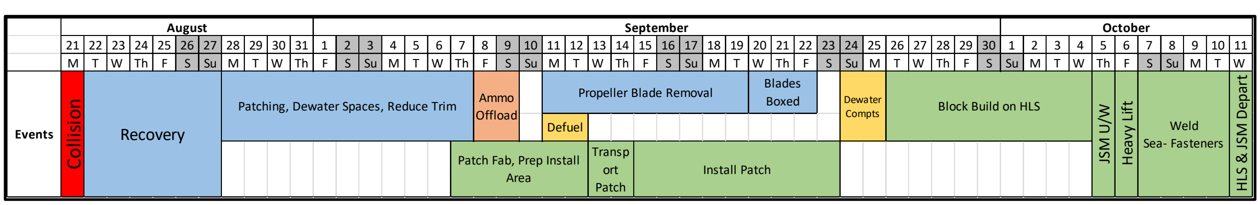


Figure 3-4. Timeline of recovery and salvage efforts on the USS JOHN S. MCCAIN, from collision to heavy lift ship onload.

3-3.1 Loading Plan Overview

Upon initial arrival in Singapore following the collision, John S McCain had a large aft trim. The initial drafts were 21.0 ft forward, and 24.5 ft aft, for a mean draft of 22.8 ft and a trim of 3.5 ft aft. To reduce the excessive trim and to track the numerous weight changes on the ship, a loading plan was developed. This plan incorporated the cumulative weight changes associated with the installation of a large external hull patch and the pumping plan for dewatering of flooded spaces and selected tanks along with ammunition offload and defueling. Table 3-1 gives an overview of the changes in weights made leading up to the docking.

For the purposes of trim and draft change calculations, naval architects used constant values for the longitudinal center of flotation (LCF), tons per inch immersion (TPI) and moment to trim 1 inch (MT1).

LCF = 214.5 ft fwd of Stern Ref Point TPI = 52.5 LT MT1 = 1500 ft-LT

The actual final drafts prior to heavy lift were measured to be 20.3 ft forward and 20.9 ft aft, for a mean draft of 20.6 ft and a trim of 0.6 ft aft, which were acceptable. This actual data compared closely to the changes calculated in Table 3-1. A POSSE model of the ship was also used for the purposes of tracking calculations and weight changes and outputs from POSSE can be found in Appendix H.

Because the majority of the flooding and weight removals were symmetrical, the list on the ship was negligible for most of the salvage. The exception was the application of the external patch which introduced a 1-degree list to port. To compensate, fuel was moved from the port side fuel service tanks back into the compensated fuel storage tanks forward.

3-3.2 Patch Design and Installation.

The prime contractor for the patch was SMIT. SMIT subcontracted patch construction to Keppel Shipyard Singapore. Construction for the patch began on 7 September 2017, completed on 12 September 2017, and the patch was delivered to the ship on 14 September 2017. The primary patch lifting and installation was done by SMIT Cyclone, a large shear leg crane barge which arrived 12 September 2017, and stayed in position through patch welding completion and propeller blade removal. SMIT personnel and subcontracted personnel from Phoenix International welded the patch. The barge served as a staging point for the work.

The initial design for the patch was created by SMIT after being provided offsets of the hull by SRF-JRMC. Calculations for the stiffness of the plate were provided by the contractor and validated by NAVSEA 00C. The patch measured 14.3 m x 9.7 m (47.0 ft x 38.1 ft), extended from frame 300 to 347, and weighed approximately 28.5 LT.

Table 3-1. USS John S McCain weight changes by date and location

Date (Approximate)	Description	Weight Change (LT)	Change in Draft (ft)	Location (ft fwd of LCF)	Change in Trim (ft aft)
Dewatering Flooded Spaces					
30-Aug	Dewater Berthing 6	-103	-0.16	-62.51	-0.36
30-Aug	Dewater Berthing 7	-96	-0.15	-62.51	-0.33
1-Sep	Dewater Aft Gyro	-80	-0.13	-54.38	-0.24
1-Sep	Dewater Aft Power Conversion Room	-60	-0.10	-72.87	-0.24
Empty Compensating Water from Selected Fuel Tanks					
3-Sep	Remove 50% of Comp Water from 3-354-0-F	-74	-0.12	-105.39	-0.43
6-Sep	Remove 50% of Comp Water from 3-370-0-F	-62	-0.10	-125.17	-0.43
Defuel the Ship (Replace Fuel with Compensating Water)					
13-Sep	TG 1 - 4-78-1-F	8.4	0.01	170.01	-0.08
13-Sep	TG 1 - 5-78-1-F	10.6	0.02	151.85	-0.09
13-Sep	TG 1 - 5-42-0-F	9.5	0.02	194.74	-0.10
13-Sep	TG 1 - 5-126-1-F	13.1	0.02	103.66	-0.08
13-Sep	TG 1 - 5-174-1-F	8.6	0.01	66.35	-0.03
13-Sep	TG 2 - 4-78-2-F	8.4	0.01	170.01	-0.08
13-Sep	TG 2 - 5-78-2-F	11.4	0.02	151.85	-0.10
13-Sep	TG 2 - 5-126-2-F	13.8	0.02	105.35	-0.08
13-Sep	TG 2 - 5-174-4-F	12.7	0.02	60.92	-0.04
13-Sep	TG 3 - 4-174-1-F	16.1	0.03	68.12	-0.06
13-Sep	TG 3 - 5-220-3-F	6.9	0.01	17.05	-0.01
13-Sep	TG 3 - 5-254-3-F	0.0	0.00	-20.47	0.00
13-Sep	TG 3 - 5-300-1-F	0.0	0.00	-61.77	0.00
13-Sep	TG 4 - 5-220-4-F	12.2	0.02	17.05	-0.01
13-Sep	TG 4 - 4-272-2-F	14.2	0.02	-29.71	0.02
13-Sep	TG 4 - 5-264-2-F	0.8	0.00	-26.28	0.00
13-Sep	TG 4 - 5-300-2-F	0.0	0.00	-61.8	0.00
Ammunition Offload					
9-Sep	Remove Aft VLS	-159	-0.25	-95.7	-0.85
8-Sep	Remove Fwd VLS	-77	-0.12	169.3	0.72
8-Sep	Remove 5-Inch Ammunition	-36	-0.06	200.3	0.40
9-Sep	Remove Harpoon Missiles	-12	-0.02	-71.7	-0.05
Transport Preparations					
14-Sep	Remove 4 Propeller Blades	-11	-0.02	-184.2	-0.11
15-Sep	Apply Patch	30	0.05	-64.3	0.11
Totals					
		Total Weight Change (LT)	**Total Change in Draft (ft)**		**Total Change in Trim (ft aft)**
		-593	**-0.94**		**-2.55**

The patch incorporated multiple longitudinal and vertical stiffeners at various locations to counter the hydrostatic pressures encountered by the ship during transit to the heavy lift ship. The patch design also incorporated two manhole covers, one above and one below the waterline, to facilitate access for divers and other salvage personnel into and out of the spaces. The full drawing of the hull patch can be seen in Appendix I and the stiffened patch calculations can be found in Appendix J.

SMIT Cyclone capacity is 1,000 tons. This was a larger crane than needed to lift the patch. However, it was selected due to its immediately availability. While on station, the barge positioned itself perpendicular to USS John S McCain and held itself in place by two anchors placed out at 45 degrees and mooring lines attached to the ship as shown in Figure 3-5, and pictured in Figure 3-6.

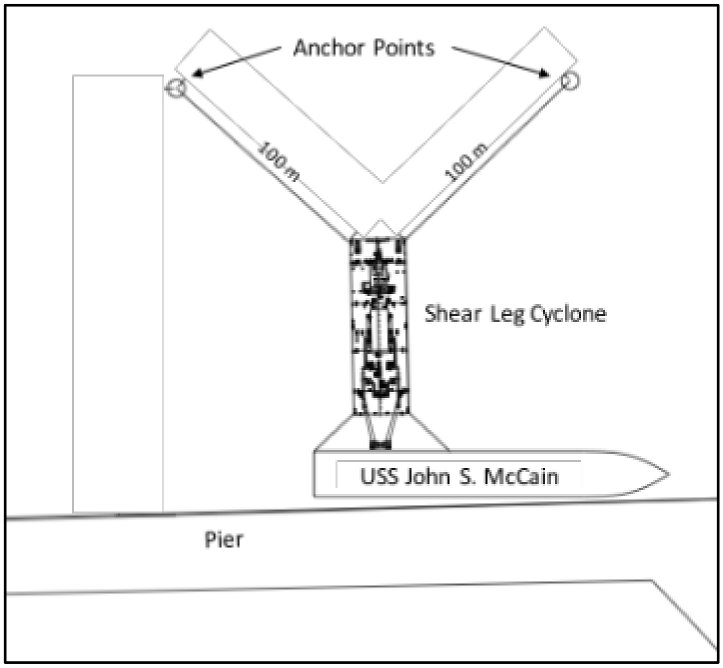


Figure 3-5. Ship and crane arrangement.

Figure 3-6. SMIT Cyclone with shear leg crane

The crane held the patch to the hull as it was welded. The crane rigging attached to four lifting padeyes placed on the vertical frames of the patch. In addition, several L-shaped “frame catchers” were attached to the hull just below the 1st and 2nd platforms at frames 299 and 348 (see Appendix J for drawing). These were designed to catch the longitudinal girders that extended approximately 7 ft beyond the side edges of the patch. Four 5-ton padeyes were also welded onto the ship near the bottom of the patch, which served as attachment points for rigging to pull the bottom of the patch into the hull. Additional rigging was attached to makeshift hard points on the main deck of the ship to prevent the top of the patch from swinging outwards (see Figure 3-7).

The welding of the patch was a continuous operation. The contractor teams worked in 12 hour shifts, with the SMIT contractor team working during the day and the Phoenix sub-contractor team working during the night. While the majority of the hull was made of DH-36 steel, certain sections were made of HY-80. This HY-80 welding amounted to approximately 25% of the total welding, all of it below the waterline. The welding to the HY-80 sections could only be done by Phoenix divers because of their qualified weld procedures and welders for HY-80 work.

Figure 3-7. John S McCain’s patch during installation.

As soon as the patch was fit up against the hull, it was apparent that the shape of the patch did not perfectly match up with the shape of the hull. Some areas of the plating had gaps of up to 2-4 inches and some of the stiffeners had gaps of up to 6 inches. The teams were able to get past these difficulties using a combination of tightening rigging, screw dogs, and added plates covering the gaps. However, it did add time to the overall patch installation process.

Figure 3-8. Rigging patch to hardpoints on USS John S McCain's deck.

3-3.3 Propeller Blade Removal

DDG 51 Class propellers extend below the hull far enough to interfere with the planned heavy lift on load process. In order to back the hull over the heavy lift platform's deck, the blades extending below the baseline requiring their removal. SUPSALV's underwater ship husbandry operations lead arrived in Singapore on 09 September 2017 and began organizing the propeller removal. At that point, Navy Divers were on site continuing around the clock patching and dewatering operations. Propeller removal began after those critical activities were completed.

On 1 September 2017, 12 hours per day propeller removal operations commenced. ESSM equipment arrived and was arranged on the pier, USS John S McCain set pitch full ahead on port and starboard hubs and rigging points were located and prepared for use. Initially, just the lower two blades for each hub were to be removed but on 14 September 2017, the decision was made to remove all blades. This extended the scheduled period of blade removal from 11-15 September 2017 to 11-23 September 2017. On 22 September 2017, the final blades were boxed and the ESSM equipment was packed up for shipment. Figures 3-8 through 3-11 show the progress of the SWRMC dive team and their SUPSALV engineering lead.

Figure 3-9. ESSM equipment loaded on pier on 11 September to support USS John S McCain propeller blade removal.

Figure 3-10. 14 September image of the first 4 propeller blades lined up on the pier.

Figure 3-11. The first blade is lowered onto newly constructed blade box. Boxes were built to keep the blades safe during their shipment back to Yokosuka.

Figure 3-12. Ten blade boxes, ready to be sealed and shipped on 22 September.

3-3.4 Final Preparations before Heavy Lift

Following blade removal and installation of blanks on the hubs, the team welding the patch continued welding and spaces were prepared for heavy lift. Upon arrival, the Navy heavy lift team, (10 subject matter experts from the NAVSEA 00C and the Navy Reserve Heavy Lift Unit) received the transport manual and began reviewing the block build and finalizing engineering drawings.

The patch welding completed 23 September 2017 and shaft alley, berthing 4 & 5 were pumped down successfully. Heavy lift ship Treasure arrived in Singapore and moved to Keppel shipyard for block build and installation of the alignment posts. A suitable location for loading was selected on the west side of the Tuas peninsula along the eastern edge of the Johor Strait. Figure 3-12 is a chart showing the location.

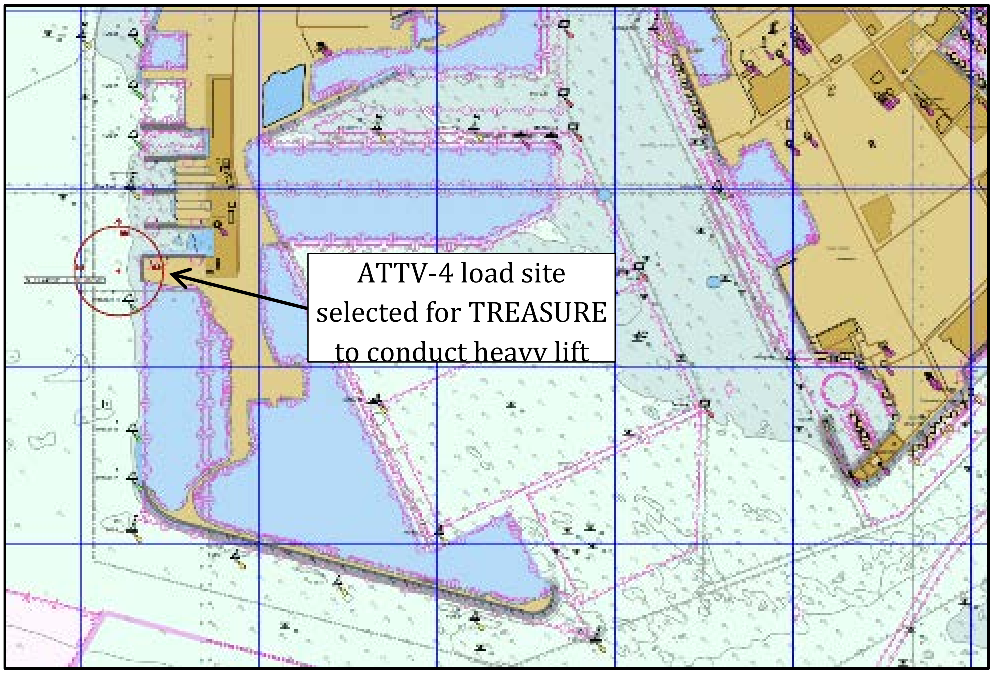


Figure 3-13. Load site on eastern edge of Singapore harbor selected for loading John S McCain.

Chapter 4 - USS John S McCain Heavy Lift

4-1 USS John S McCain Heavy Lift Planning

On 22 August 2017, the NAVSEA 00C Heavy Lift lead notified the Commanding Officer of the Navy Reserve Heavy Lift Unit of the USS John S McCain collision and the impending deployment in case heavy lift was needed. The Heavy Lift Unit had already been providing on-site support at SRF Yokosuka in preparations for the USS Fitzgerald heavy lift in September. Following the decision to heavy lift, NAVSEA 00C heavy lift lead requested support on 7 September 2017 to send Heavy Lift engineers to the Netherlands to assist the Heavy Lift contractor, Dockwise, in developing the transport manual for the evolution. The heavy lift engineers consisted of SEA00C, USNR HL PO, and UK MOD personnel. By 11 September 2017, the unit had detailed a team of 5 officers (a Heavy Lift Project Officer (HLPO), a Docking Observer (DO), and additional services and logistics technicians) to facilitate the completion of the U. S. Navy Towing Manual Appendix R (heavy lift checklist) and execution of the heavy lift onload at Changi Naval Base, Singapore. The original plan called for the onload of USS John S McCain on 25 September 2017 after patch installation, and departure to Ship Repair Facility Yokosuka on 29 September 2017. USS John S McCain was to be offloaded at SRF on 14-16 October 2017. The team compiled an Onload Action List and maintained the list throughout the process. It can be found in Appendix M.

There were several delays that impacted the project. SMIT took longer than expected to execute a contract with Dockwise. In fact, a contract was never executed, the HL operation was performed under an intercompany memorandum between SMIT, Dockwise and their parent company Boskalis. It took several iterations to finalize and approve the Transport Manual. Key areas of disagreement during technical review were the blocking and alignment post - catcher design drawings. There was also a delay in selecting the load site, which required a tide and current study and approval from the Singapore Marine Management Agency before selection. On 26 September 2017, M/V Treasure arrived at Keppel Shipyard to commence the final block build. By then, most technical issues had been resolved, a load site had been selected, and the onload date was projected for 05 October 2017. At the final block build inspection, the Navy Heavy Lift team discovered interference between one of the cradles and a sea chest fairing, which required a minor adjustment to the blocking arrangement and further delayed the onload to 06 October 2017.

Other considerations during the Towing Manual Appendix R preparations included the determination of power requirements. Ship force conducted a load test to measure electrical load. A final analysis established a ship power requirement of 400 kW to run one A/C plant, one potable water pump, a forward VCHT pump, and single low-pressure air compressor to provide the dry air for the waveguides and to maintain pressure to the sonar dome. It was determined that M/V Treasure could meet those power requirements with no need for a separate generator. Treasure provided one electrical cable connected to the USS John S McCain’s amidships shore power riser. To avoid running the A/C system to control humidity in the ship, which would require additional connections for sea water and discharge, the team distributed desiccant in designated areas throughout the ship. NAVSEA 05 provided the recommended desiccant distribution plan used for USS Fitzgerald which was adopted for USS John S McCain. The desiccant distribution plan is provided in Appendix K. When this decision was made, the team thought this was to be the most cost effective COA. The cost of the desiccant, while high was about one half the cost of using a generator and associated support logistics during the journey.

The Heavy Lift team had to focus on towing requirements to support the loading of USS John S McCain at the Sudong anchorage on the west side of island, 30 miles from Changi Naval Base . A key issue was how to properly lock the rudder for the tow. NAVSEA 05 determined that no additional mechanical locks were required because the tow speed would be limited to 3 knots. The rudder was secured by hydraulically isolating the ram and using installed ratchets. Unique consideration was given to the removal of personal electronics containing lithium ion batteries from the damaged compartments. The technical recommendation from NAVSEA 05 was that devices that had been submerged were not a risk for fires, however the team removed devices that were easily recoverable and turned them over to ship's force for disposition.

Figure 4-1. Heavy Lift Project Officers CDR Elmer Roman, L, CAPT Dave Ferris, R discussing the onload plan for USS John S McCain

4-1.1 Transport Manual Review

On 07 September 2017, the combined HL team (SEA00C, UK MOD, and USNR HL team members) traveled to Papendrecht, Netherlands to visit the headquarters of Boskalis which provides engineering services to Dockwise. The purpose was to develop a blocking and sea fastening design for the heavy lift of USS John S McCain. Simultaneously, the SEA00C HL SME team lead and NAVSEA 00C personnel supported the design and fabrication of USS John S McCain's patch in Singapore. The primary concern was the static and dynamic loading on the patch and the impact on the patch's integrity, given USS John

S McCain's 30-mile tow from Changi Naval Base to its onload anchorage. Ultimately, additional stiffeners were added to ensure integrity.

NAVSEA 00C personnel also assisted Boskalis with the design of the onload build. The intent was to complete both the onload and the transit build but by the time of 00C's departure on 14 September 2017, however only the onload build design was completed. There were multiple reasons for the slow progress, the primary being that USS John S McCain was to be loaded 26 degrees off of TREASURE's longitudinal. Chapter 8 and Appendix Q (HL Calculations) of the U.S. Navy Towing Manual are based on the USS Cole (DDG 67) evolution in October 2000. While the USS Cole was also loaded at an angle to M/V Blue Marlin's longitudinal, the angle was not as extreme as USS John S McCain's. NAVSEA 00C personnel had to consider modifications to the U.S. Navy Tow Manual calculations to address the extreme loading angle. Ultimately this resulted in a much greater pitch. This, in turn, caused a much greater longitudinal acceleration than would be calculated by the U.S. Navy Tow Manual approach. The increased longitudinal acceleration required numerous strong boxes to prevent USS John S McCain from sliding off Treasure. Figure 4-2 shows longitudinal bracing on M/V Treasure's deck.

Figure 4-2. Strong Box Configuration

The NAVSEA 00C Naval Architect also performed a shear stress analysis and determined that the original plan to load the aft end of USS John S McCain onto the forward end of M/V Treasure would result in excessive shear near the location of the damage. Because of this analysis, NAVSEA modified the stowage plan to place the USS John S McCain's forward end onto the forward end of M/V Treasure. Figure 4-3 shows the final stowage plan which was completed at the time of NAVSEA 00C departure for Singapore on 14 September 2017. The SEA00C SME remained to oversee all follow-on activities.

Two key decisions were made in the Netherlands. The first was to use only docking blocks for both the onload and transit build. The reason for this decision was the availability of as-built docking block geometry (height, bevel, etc.). The disadvantage of using only docking blocks is that some are located only on longitudinal strength members, which are not as strong as the intersection of a frame and a longitudinal point. Given the dynamics associated with a heavy lift, the 26-degree load angle, the age of USS John S McCain and the damage caused by the collision, there was not sufficient hull strength at the side block locations to withstand the repetitive fatigue loading during the transit. It is important to recognize that Chapter 8 of the Tow Manual calls for the side blocks to be placed under the asset's major structural members, such as main transverse bulkheads and secondary frames. Moreover, Chapter 8 recommends that side blocks should have enough effective surface area to span two frames. It also states that the vessel's docking drawing “will provide recommended locations.”

The second key decision was to reduce the maximum allowed side block pressure from 800 psi to 370 psi. Based on Naval Ships Technical Manual (NSTM) Chapter 997, the U.S. Navy Towing Manual calls for a maximum pressure of 800 psi per side block pressure. 800 psi is a practical and safe limit which may result in permanent deformation, but not failure, of side blocks, and considered acceptable for one load of earthquake or hurricane forces, where ship survival is the priority. In a heavy lift, the frequency of the forces acting on the blocks over an extended period of time while the “docked ship” is at sea demands a lower maximum pressure. USS John S McCain is also older than USS Cole was when she was lifted in October 2000. Finally, 370 psi is the allowable timber compressive stress of Douglas Fir for distributed loading on keel blocks of width greater than 3 ft. This will be incorporated into Rev 4 of the U.S. Navy TOWING MANUAL.

Despite these precautions, hull cracks formed near the side blocks during the transit from Singapore to the Philippines. Paragraph 4-2.5 of this after-action report provides further detail.

4-2 USS John S McCain Heavy Lift – Singapore Preparation and Transit

4-2.1 Onload blocking configuration

M/V TREASURE provided 130 meters of longitudinal deck space. However, the superstructure fore and aft of the deck required that the USS John S McCain (LOA 154 meters) be transported diagonally, with the bow and stern each extending laterally beyond the deck of the M/V Treasure.

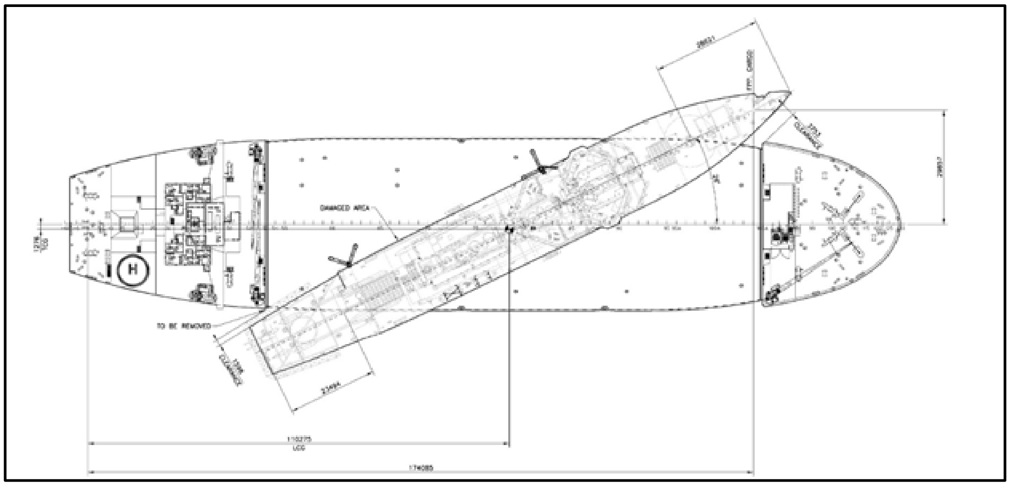


Figure 4-3. USS John S McCain stowage plan on M/V Treasure

The keel blocks consisted of a mixture of hard and soft wood with a nominal height of 575 mm. Grillage structure at the fore and aft limits of the keel blocks comprised a steel base, wood, and a steel top plate totaling 575 mm tall. During the onload operations, lateral stability was provided by four cradles and eight side blocks (four port and four starboard). The onload blocking configuration is detailed in Appendix L and shown in Figure 4-4 below.

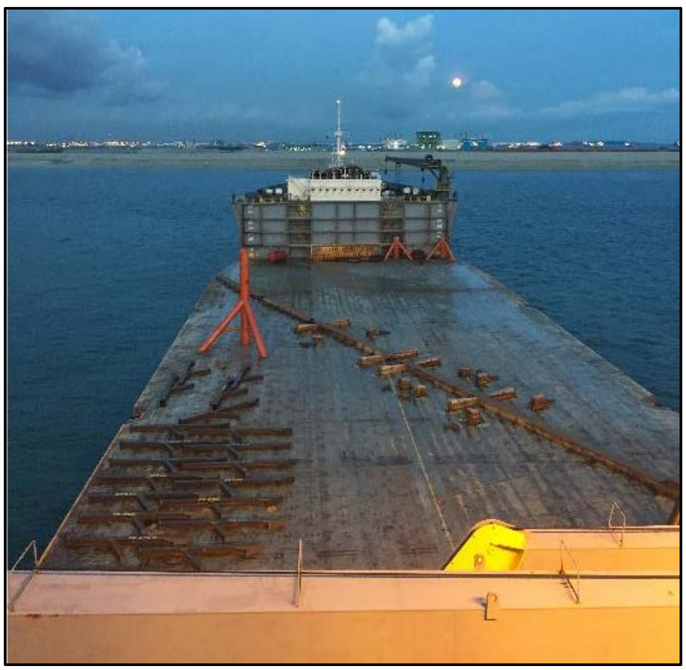


Figure 4-4. Blocking a0rrangement on M/V Treasure

Two guide posts were placed to port of the keel blocks to facilitate the proper positioning of USS John S McCain, prior to the start of deballasting operations. USS John S McCain was outfitted with a port-side “catcher” that would hold the vessel in position without risking damage to the sonar dome. Figure 4-5 shows the catcher being delivered to John S McCain.

Figure 4-5. Staging the catcher prior to welding onto USS John S McCain

4-2.2 Final Block Conditions prior to transit

The USS John S McCain's blocking plan called for eight additional side blocks to be installed to properly support and secure the vessel during its transit. These additional blocks, four per side (Figure 4-6) were installed once the vessel had been landed and the deck was dry. See Appendix L for details.

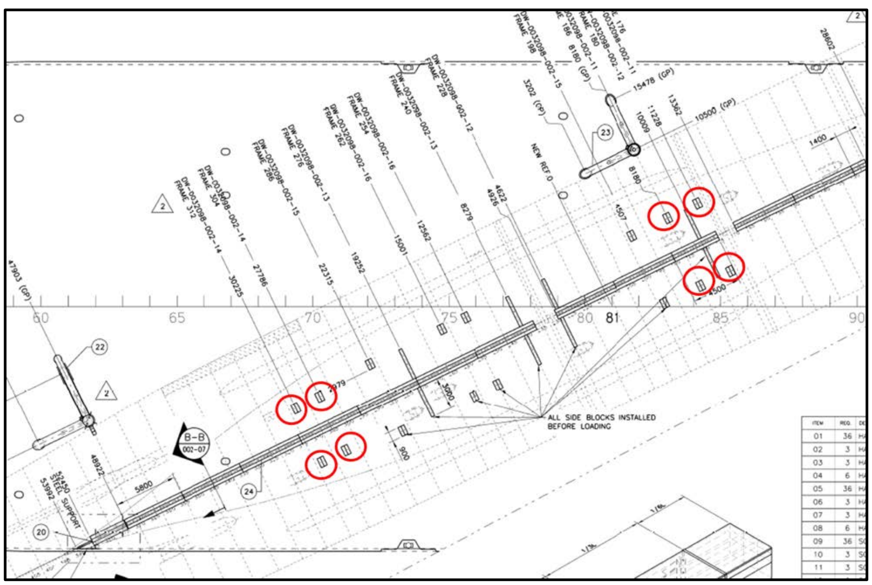


Figure 4-6. Additional side blocks installed prior to transit

4-2.3 Lift Operations

The process of positioning the USS John S McCain is detailed in the diagrams provided in Figure 4-7. Four tugs guided USS John S McCain into close proximity of M/V Treasure. Four crossed tugger lines were passed between USS John S McCain and M/V Treasure. These lines were taken to power and used to orient the USS John S McCain above the cribbage. The port-side catcher on the USS John S McCain captured the forward-most guide post, further limiting the motion of the destroyer. Deballasting operations commenced once USS John S McCain was in the proper position. During this phase of the evolution, the stability of both the USS John S McCain and M/V Treasure were continuously monitored. The tugs were disconnected once USS John S McCain was landed on the docking blocks, was firm against the guide posts, and had passed through to point of instability. Seafastening components were positioned once the deck of the M/V Treasure was dry and welding commenced after fully deballasted.

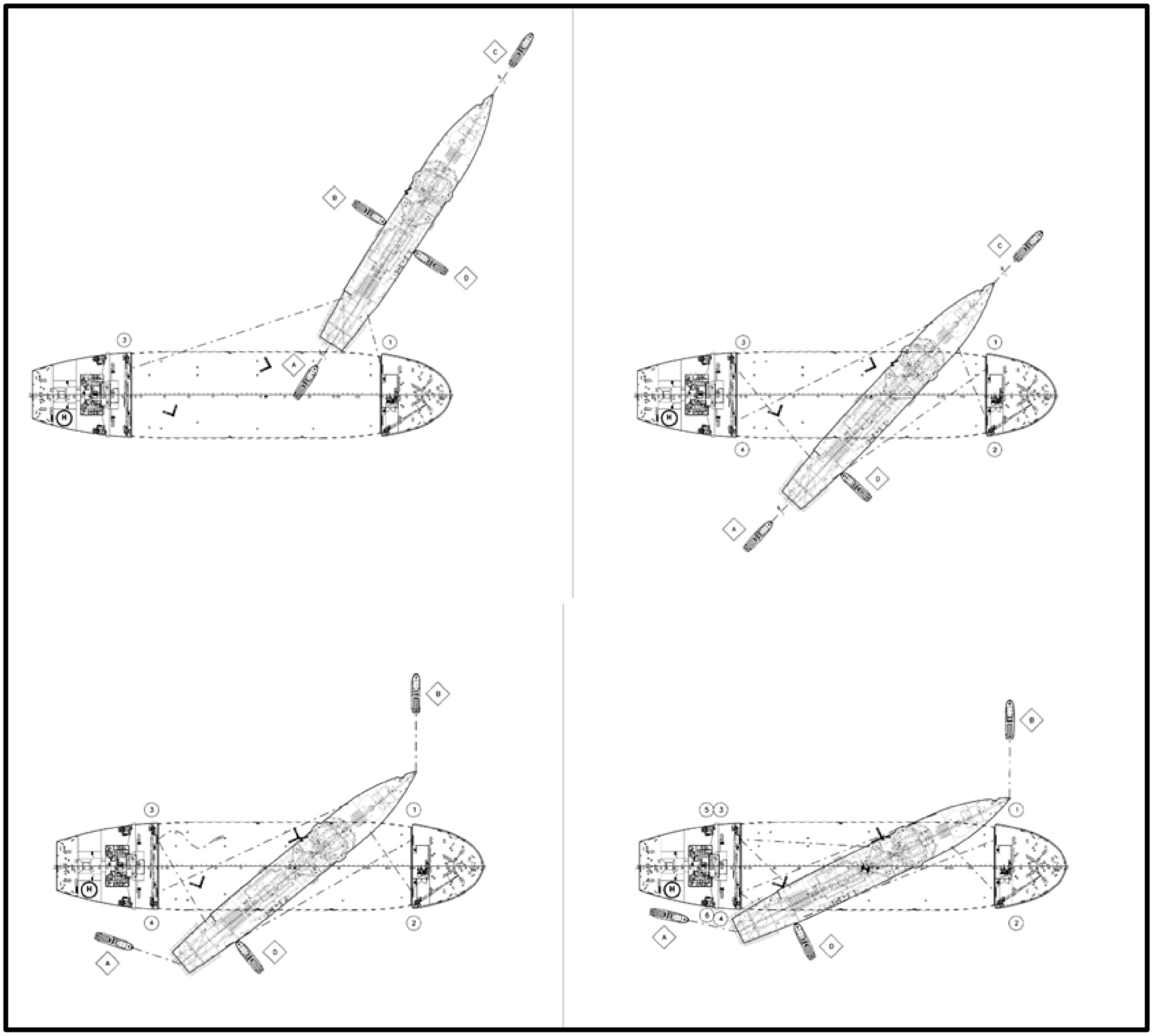


Figure 4-7. Initial loading sequence of USS John S McCain in Treasure

4-2.4 Sea Fastening

Lateral support was provided through the addition of 48 spur-shores positioned along the length of the vessel. Longitudinal support was accomplished through the addition of 18 strongboxes. The strongboxes were consolidated into six groups of three. In each group, the center strong-box was welded to the hull of the USS John S McCain, and then bracketed by the remaining two which were welded to the deck of M/V Treasure. Refer to Appendix L for the sea fastening diagram. This securing method allowed for independent movement of the John S McCain and M/V Treasure thereby preventing sea motion loads from the transport into John S McCain. Spur shores had to be adjusted after installation as the M/V Treasure continued ballasting to get to sailing draft. Dockwise practice dictates spur shores should not be installed until the transport vessel is in its final sailing condition. This practice was not followed for the John S McCain seafastening.

4-2.5 Transport to Yokosuka (Daily reports / Actual sea states)

USS John S McCain departed Singapore 10 October 2017. The maximum sea state during the transit between Singapore and the Philippines was sea state 4, well below the sea state 7 design of the build. Despite this relatively calm transit, the ship experienced cracking near the side blocks at frames 198 and 268. The exact cause of the cracking was not identified. Torsion and bending of USS John S McCain hull girders from M/V Treasure motions are suspected contributors. This was likely exacerbated by the angled loading of USS John S McCain on M/V Treasure. Repairs were effected in the Philippines and additional cribbing was added to support the hull for the remainder of the voyage to Japan. The additional action taken in the Philippines are provided in Section 4-3.

During the first six days of the transit, the maximum winds, swell, pitch angle, roll angle and pitch period were as indicated in Table 4-1 below.

Table 4-1. Most Extreme Conditions Experience by M/V Treasure (Singapore to Philippines)

Roll Angle	Roll Period	Pitch Angle	Pitch Period	Wave Height	Wind
6 degrees	10 seconds	2 degrees	9 seconds	1.5 meters	30 knots

Given the lighter seas during the transit from Singapore to the Philippines, the dynamic loading was well within the designed capacity.

Table 4-2 shows keel, side block and shore stay pressures for various sea states. It was important to maintain a hull pressure of less than 800 psi (the current US Navy Tow Manual Chapter 8 and Appendix Q requirement) and less than 370 psi (the more stringent standard adopted by NAVSEA 00C Heavy Lift SME and the heavy lift team). In both cases the number of blocks and shores were determined sufficient to ensure a safe transit. Additionally, the maximum roll angle experience by M/V Treasure (6 degrees) would have translated to 5.4 degrees on John S. McCain given the 26 degrees off longitudinal loading further reducing the hull pressure at each side block.

Table 4-2. Maximum Keel Block, Cradle and Side Block Pressures Designed (SS 7) and Actual (SS 4)

Sea State	Maximum Keel Block Pressure	Total Area of Side Blocks plus Cradles	Block and Cradle Pressure without Shores	Block, Cradle, & Shore Pressure
7	208 psi	12,276 sq in	1325 psi	928 psi
4	174 psi	12,276 sq in	470 psi	263 psi

From Table 4-2, the maximum side block pressure should have been 263 psi, well below the 370 psi design pressure. Upon inspection in the Philippines, many of the shores were no longer in contact with the hull. These gaps rendered the shoring ineffective, and it is possible that pressures reached the 470 psi. While this exceeds 370 psi, it was well below the 800 psi as indicated in the U.S. Navy Tow Manual. Because of this, other factors must have contributed to the damage to the USS John S. McCain. Examining the John S McCain loading on the M/V Treasure placed approximately 1/3 of McCain's weight to port with 2/3 of the weight to starboard as centered on the M/V Treasure's main centerline longitudinal deck support girder. This caused M/V Treasure to corkscrew about the main longitudinal support girder resulting in the pre-tensioned spur shores to come in and out of contact with the John S McCain hull.

Figure 4-8. USS John S. McCain and USS Fitzgerald in Tokyo Harbor. With two ships in the same image, a comparison of the number and arrangement of shore stays is possible.

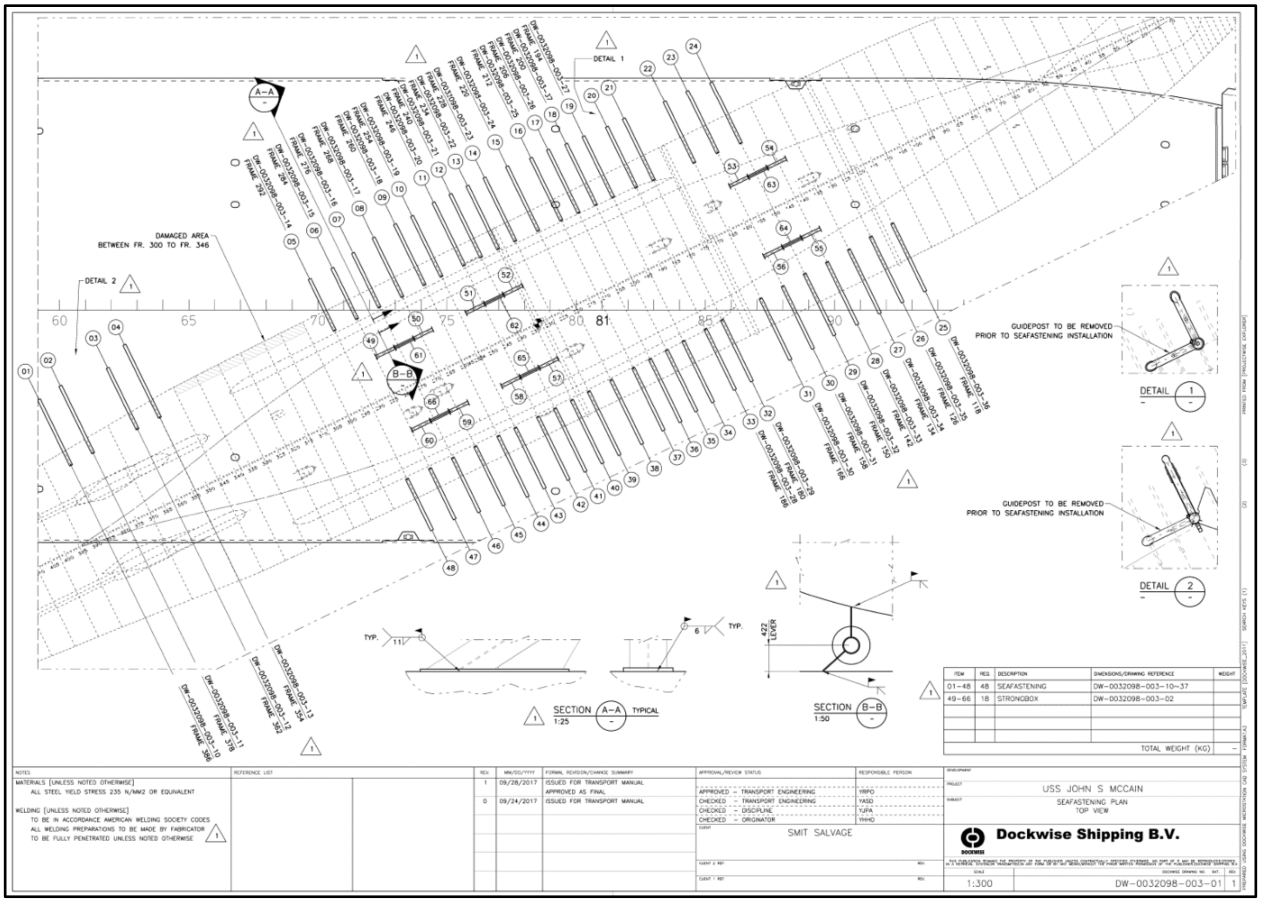


Figure 4-9. USS John S McCain Seafastening Plan

Figures Figure 4-12 and Figure 4-13 show that the shoring on the USS John S McCain was not longitudinally symmetric. This is due to the port side damage and the 26-degree load angle. It is possible that portside shores one through four were so far aft that they were ineffective. Paragraph 4-3 details the damages from the transit and changes made to reduce the risks in the transit from the Philippines to Japan.

4-2.6 USS John S McCain Damage During Transit

As detailed previously, block placement (Section 4-1.1) and movement of USS John S McCain in transit may have caused hull cracking. During the daily inspection of cargo and seafastening on 19 October 2017, the crew of the M/V Treasure observed water leaking from a crack in USS John S McCain's hull at frame 268, port side. Approximately 100 mm of crack was visible extending beyond the hull block. Approximately 15 mm of hull deflection was noted where the block touched the hull.

Figure 4-10. Crack at frame 268, port side

Figure 4-11. Hull deflection of approximately 15 mm at block interface

4-3 USS John S McCain Repairs in Subic Bay, Philippines

4-3.1 Determining the Causes of Damage

Two primary root causes were established for the cracking. One was not enough blocking at the intersections of longitudinal and transverse framing structures in the original block build. Block locations were based on routine dry dock block placements, but for the dynamic nature of a heavy lift transit, ensuring that a significant portion of blocks are located at transverse framing will enhance structural strength while also providing necessary overturning support. The docking drawings is a good place to start when designing a heavy lift blocking plan but should not be considered the overall build plan as it is designed for a static condition verse a dynamic condition encountered during transport.

The other finding was that the spur shores were not fully contacting the hull. The lack of contact allowed for some rocking motion while transiting. The angled orientation exacerbated the motion difference between USS John S McCain and M/V Treasure. Additionally, John S. McCain was much stiffer than the transport ship as M/V Treasure's deck flexed throughout the transit. Dockwise proposed that there may have been free surface effect inside USS John S McCain but investigations done in Subic Bay disproved that theory.

The root causes of the hull cracking was confirmed using finite element analysis performed by Naval Surface Warfare Command, Carderock and the NAVSEA Reserve Acquisition unit. The modeling simulated cyclic loading (i.e., stresses through a range of sequential block loading configurations) of the hull from blocks both on and off a transverse frame, examined at both eight foot and six foot frame spacing. The difference in block pressures for the configurations studied indicated that the locations of the selected blocks enabled hull cracking under the observed rocking conditions as the hull plate flexed about the longitudinal strength members. (Appendix N).

4-3.2 Block Modification Plan

For transport to Yokosuka, 10 of the original side blocks were shifted to align with frames on USS John S McCain and 20 additional side blocks were added. Figure 4-12 shows the location for the repositioned blocks and the new blocks.

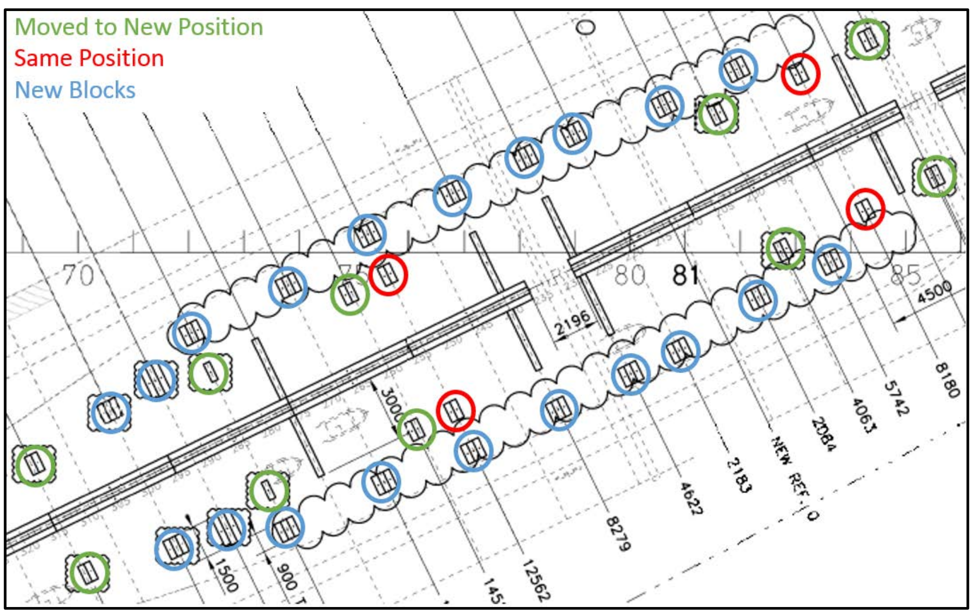


Figure 4-12. USS John S. McCain Block Modification Plan

4-3.3 Material Sourcing

The additional blocking required approximately 60 tons of hard wood which could not be sourced locally in Subic Bay. SRF coordinated delivery of hardwood as government furnished material via multiple commercial flights from Japan. This process took approximately two weeks.

4-3.4 Production

Dockwise contracted Keppel Shipyard Subic to perform block construction and installation. The assembled blocks were stacked rows of hard wood planks. Each row was 3 timbers bolted together. The outer faces of the blocks were then secured with a large metal plate. Production was slower than anticipated. One limitation was that Keppel had a single machine that was capable of drilling the rows of blocks. Also, the blocks were not of uniform shape, and a great deal of work was required to level the rows of blocks by hand using electric planers (Figure 4-15). The Heavy Lift team, along with SMIT and the Dockwise load master devised a field expedient production technique to obtain consistent monolithic side blocks. The yard did not have enough threaded rod on hand to complete all blocks and took time to source commercially. Keppel initially proposed to build all 18 side blocks prior to beginning installation, however the Heavy Lift team was able to convince them to conduct production and installation operations in parallel. To speed installation, Keppel resourced additional manpower to the project, purchased additional electric planers, and agreed to work two 12-hour shifts.

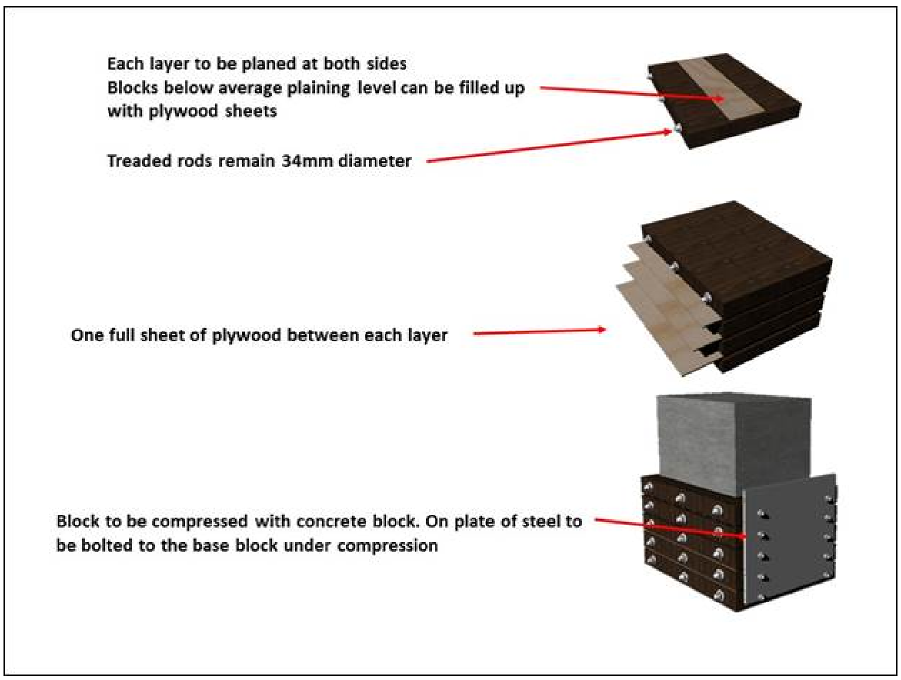


Figure 4-13. Block design diagram at Subic

The heavy lift team and SMIT Salvage Master observed the block construction plan and aided in revising the construction strategy to save time. To mitigate the gaps due to uneven wood block sizes and reduce required planing time, a layer of plywood was placed between each row of blocks, and the blocks were preloaded prior to installing the metal plates on the ends. The end plates ensured the compressed blocks retain their as-assembled configuration, (Figure 4-16 shows blocks under compression). The blocks and soft caps were assembled at Keppel Shipyard and final adjustments were done onboard M/V Treasure. Original estimates predicted 17 days to construct and install the blocking and, with focused management, that schedule was met. Final block installation was completed on 25 November.

Figure 4-14. Typical hardwood blocks before machining flat.

Figure 4-15. Manual planing of hardwood

Figure 4-16. Preloaded block with plywood between layers

4-4.5 Block Installation / Ballasting Plan for Sea Fastening Install

The heavy lift team discussed that since the USS John S McCain had settled into the original block build, the additional blocks would provide lateral stability but would not carry a significant load. To increase block loading and to maximize the fit of the new blocks, it was decided to heel M/V Treasure approximately 1 degree to starboard and install blocks on the port side. This process was then reversed for starboard installation. Where access allowed, forklifts positioned the blocks against the hull. Due to the longitudinally angled load plan, several blocks were not accessible via forklift and were positioned manually. Each block was fit checked for contact and corrected with electric planers as required. Each blocks' soft cap was adjusted several times prior to acceptance. Blocks were installed one side at a time, beginning on the port side. Each side block was preloaded to 40 tons using manually operated hydraulic jacks prior to installation of transverse stoppers (Figure 4-17, Figure 4-18).

Figure 4-17. Manually positioning block on M/V Treasure

Figure 4-18. Transverse stoppers

In addition to block construction, all previously installed spur shores were removed and re-installed. This required removing welds and hydraulically jacking the shore inwards until achieving adequate contact. Contact was verified by the heavy lift team (Figure 4-19). Prior to compressing, each spur shore was verified to be centered on a frame, which required minor longitudinal adjustments to a small number of spur shores. Similarly, to the side block installation, M/V Treasure was heeled to one side while spur shores were tensioned on the opposite side.

Figure 4-19. Verifying spur shore contact and frame placement

4-3.5 Enhanced Sea Fastening

To prevent further leaks from the cracked compensated fuel tanks and fathometer trunk, Keppel manufactured and installed box patches. For the fuel tanks, the soft caps of the blocks acted as damage control plugs, and minimal leakage was observed while in Subic Bay. The blocks were loaded, and the team discussed how the leak rate would be affected by removing the blocks to install the patches. Another concern was how best to execute the removal of loaded side blocks. The team developed a method to keep the soft caps in place, while removing the lower portion of the blocks. Small metal frames were welded to the hull of USS John S McCain around the soft caps, and lag bolts were installed through the frames into the cap, (Figure 4-20). Once the soft caps were secured, hydraulic jacks and sledgehammers were used to remove the loaded blocks.

Figure 4-20. Soft cap “DC plugs” under box patches

The box patches were welded to the hull and fitted to the frames that held the soft caps. The leak rate of the cracks did increase slightly when the loaded blocks were removed. The patches were fitted with a drain pipe and valve to allow for drainage during the welding process (Figure 4-21).

Figure 4-21. Completed box patch

A leak in the fathometer trunk was determined to be caused by weld burn-through while securing a strong box during sea fastening in Singapore. Before departure, the leak was sealed with epoxy. When USS John S McCain arrived in Subic Bay, the epoxy seal was leaking. The trunk contained castor oil which Keppel indicated was a safety issue for welding on the tank. The solution was to assemble a larger box patch that could be welded outside the boundaries of the fathometer trunk and concrete was used to fill the box to form a seal (Figure 4-22).

Figure 4-22. Concrete filled box patch around Fathometer Trunk

4-3.6 Instrumentation

While the blocking plan was repaired in the Philippines, NAVSEA 00C Naval Architect, Emergency Ship Salvage Material (ESSM), and USNR heavy lift personnel installed a strain monitoring sensor system on the ship to record data on static and dynamic effects during transit. The sensor system included a network of accelerometers, strain gauges, and displacement sensors installed on the weather deck and hull of the USS John S McCain as well as on the pontoon deck of the M/V Treasure. The complete system description, operation, layout, and deployment is provided in Appendix P of this report.

4-4 USS John S McCain transit to Yokosuka and Offload

4-4.1 Transport to Yokosuka (Daily reports / Actual sea states)

M/V Treasure departed for Yokosuka on 28 November. NAVSEA 00C Naval Architect rode the ship to monitor transit conditions and instrumentation readings. During the seven-day voyage the ship experienced 35 knot winds and rolls up to 8 degrees. John S McCain rode well, with no changes in block or shore spur contact.

4-4.2 Offload

Following USS John S McCain's arrival in Yokosuka and mooring at anchorage A136 (Figure 5-7) on 5 December, Dockwise commenced seafasatening removal. All seafastenings were removed by 7 December but the offload was delayed waiting for an appropriate weather window. When that window arrived on 12 December, M/V Treasure pre-ballasted and the SUPSALV team boarded to supervise offload. Offload was completed the morning of 13 December without issue. John S. McCain was towed to the SRF JRMC to begin permanent repair work.

Figure 4-23. USS John S McCain offloading from M/V Treasure

Chapter 5 - USS Fitzgerald Heavy Lift

5-1 USS Fitzgerald Heavy Lift Planning

After docking the USS Fitzgerald on 10 July, Ship Repair Facility (SRF) Japan Regional Maintenance Center (JRMC) began evaluating repair tasks and separating them into “repair in house” (in SRF JRMC drydock) and “repair after transit/permanent repair” (U.S. shipyard). The possibilities of moving USS Fitzgerald back to the United States on her own power or via heavy lift were still being weighed, putting the repair package in a state of flux.

A heavy lift planning meeting was held on 17 July to focus the efforts of multiple organizations in the event that heavy lift transport was selected. At that time, two heavy lift contract options were under consideration: Military Sealift Command (MSC) contract, and the SUPSALV salvage services contract. The pros and cons were as follows:

- MSC Contract (Primary Choice)
  - Low Risk / Lower Cost
  - MSC heavy lift contract experience - executed most heavy lift contracts in past 20 + years including: USS Cole (DDG 67), MCMs, PCs, Fast Missile Craft
  - Experienced MSC contracting officer
  - MSC request for proposal (RFP) allows the Navy to establish requirement and parameters
  - Firm Fixed Price transport contract
- NAVSEA Salvage Services Sub Contract (secondary choice)
  - Low Risk / Higher Cost
  - Third party between Navy and heavy lift contractor
  - Increased pass through costs
  - Cost Plus contract

The MSC contract option was the primary choice because it would best meet the needs of the Navy. The salvage services contract would introduce a third party between the Navy and the carrier, adding pass through cost. The Navy also would not control the terms of the contract with the heavy lift subcontractor.

Principle decisions being addressed with these planning meetings were hotel services, force protection, ship configuration, and routing the transit.

5-1.1 Services Required During Transport

Consideration was given to whether ammo would be retained aboard, necessitating magazine cooling, as well as firefighting water pressure, electronics system cooling, and how many of ship’s force would ride during the transit. These decisions helped establish equipment layup conditions and what hotel services requirements would be identified in the RFP.

5-1.2 Heavy Lift Ship Configuration

The loading configuration would impact the results of the market survey. The primary options were a "straight on" load with the USS Fitzgerald's sonar dome over hanging the stern of the heavy lift ship and an "angled" load with the sonar dome and the propeller blades over hanging the port and starboard sides of the heavy lift ship (Figures 5-1 and 5-2). Both configurations would benefit from removing the lower 2 blades of each propeller.

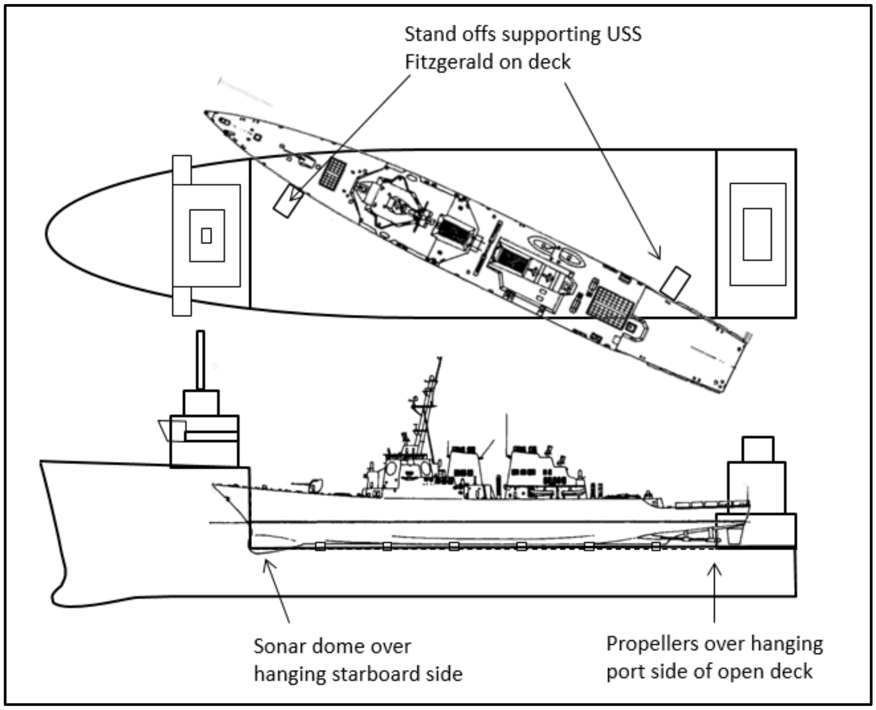


Figure 5-1. Angled Load Configuration

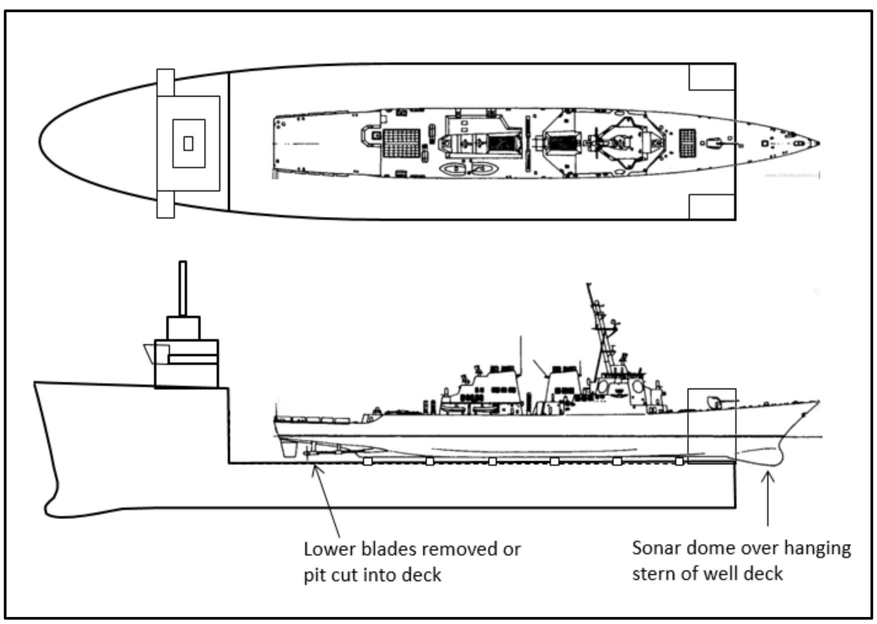


Figure 5-2. Straight-On Load Configuration

5-1.3 Route Options

Considerations for each proposed route are addressed below. At this point, the destination had not been determined so each route option included potentially terminating in the United States shipyards at Supervisor of Shipbuilding Gulf coast or New England coast.

- Cape Hope:
    - Monsoon season in Indian Ocean
    - Approximate transit time of 67 days
- Suez Canal:
    - Force protection concerns in Suez and Mediterranean
    - Approximate transit time of 61 days
- Straits of Magellan:
    - Cyclone season in Pacific, and unfavorable Straits weather conditions
    - Approximate transit time of 70 days
- Panama Canal:
    - Take Great Circle route to avoid cyclones and transit through canal
    - Possible security concerns in canal
    - Canal limited to 47-meter beam (no angled deck configuration)
    - Approximate transit time of 39 days
    - HL vessel would require Panama Canal certification

A final decision was made to send USS Fitzgerald back to the Gulf Coast shipyard via the Panama Canal.

5-2 Contracting the Heavy Lift.

The team worked to support a, senior leadership desired, 14 September 2017 lift date. Senior leadership was briefed on a timeline of 7 days to contract award based on the USS Cole (DDG 67) lift of 2000. When USS Cole was lifted, only one heavy lift ship capable of doing the lift existed (M/V Blue Marlin) resulting in a sole source contract. Since 2000, the heavy lift market has expanded ten-fold, resulting in numerous heavy lift ships capable of lifting USS Fitzgerald. This necessitated in a competitive heavy lift contract. Military Sealift Command initiated a market survey which indicated that no capable heavy lift ships would be available until the end of October or early November. Despite these challenges, a competitive contract was awarded to Dockwise in 17 days. The additional time to award did not impact the operation due the heavy lift ship availability. It was clear after the market survey that 14 September date was not obtainable.

In an effort to support the timely award of a contract, SUPSALV and MSC provided cost and schedule estimates and information to the team to support the USS Fitzgerald transit decision. This would enable immediately issuing an RFP if a heavy lift option was selected. Planners were also addressing site selection for onload near Yokosuka, and offload location options near Bath, Maine and Pascagoula, MS.

5-2.1 Hull Patch Assessment

SRF identified several issues with the temporary patch concerning watertight integrity under the expected stresses during heavy lift operations and towing.

Specific issues with the patch were that:

- The patch was not fully watertight; wood and resin were used to aid in obtaining a watertight seal
- A number of welds failed visual testing citing excessive weld build-up.
- Two stiffeners showed mild deflections

The decision was made early in the drydock availability to replace the entire patch. Doing this during drydock allowed for the removal of bent and crushed shell plating and frames, greatly aiding clean-up of the flooded compartments.

5-2.2 Military Sealift Command RFP

MSC released the Request for Proposal (RFP) on 1 August 2017. The tentative timeline estimated contract award by 14 August 2017 and heavy lift load preps/lift on 1 September 2017. Because the destination had not been determined, offerors were responding to both New England and Gulf Coast destinations. The New England destination dictated the heavy lift ship and cargo would be exposed during offload to higher sea states with minimal shelter from the north Atlantic Ocean weather in December. Bidders submitted questions and the solicitation was extended to 11 August 2017.

Docking drawings were not releasable, so a table of offsets was provided to the bidders. This table was inaccurate, challenging the bidders' preparation of blocking diagrams.

An extensive work list was prepared for SRF which included installing a new hull patch, placing specified equipment in layup, removing propeller blades, shoring up the superstructure where the hull was damaged, and undocking USS Fitzgerald between 5 to 7 September 2017. The ship was to operate no equipment from undocking thru transport.

Multiple bids were received and on 11 August 2017 evaluations commenced. Bid review / technical assessment and clarifications was conducted. During the course of the proposal review, Seventh Fleet leadership began to realize that a heavy lift vessel would not be available by 14 September 2017 but the RFP still indicated that date. Contract award was estimated for 25 August 2017. Meanwhile SRF began removing the propeller blades, systems were being placed in layup, and the superstructure was being shored.

MSC awarded the USS Fitzgerald heavy lift contract to Dockwise on 25 August 2017. The key contract dates were:

- 13-15 October Transport Manual Review
- 16 October Tug inspections, load site inspection and Contractor walk-thru of USS Fitzgerald
- 26 October Arrival MV Transshelf
- 27-28 October Laydays (Contractor Is required to be ready to load). Note, this is well after the RFP load date of 1 September and prior to the actual load date of 24 November.

5-3 NAVSEA Heavy Lift Detachment.

At the request of NAVSEA 00C, the U.S. Navy Reserve Heavy Lift Unit assembled a response team to support planning the heavy lift. Planning commenced on 5 August 2017 and all teams were deployable on 19 August 2017. The response objectives included the support and execution of all heavy lift evolutions and maintaining a continuous presence at the Ship Repair Facility (SRF) Yokosuka, Japan to assist their project team as subject matter experts for heavy lift requirements.

The team arrived at SRF Yokosuka on 28 August 2017. It established contact with the SRF project team, ship's force, and SRF base personnel to coordinate the heavy lift preparations. The team established work space in quarters assigned to NAVSEA 00C by SRF located between drydocks four and five adjacent to the docked USS Fitzgerald.

Figure 5-3. The Heavy Lift command center located between drydock 4 and drydock 5 in Yokosuka, Japan

The NAVSEA 00C and USNR heavy lift team coordinated the response across disparate locations; NAVSEA 00C headquarters in Washington, D.C. provided liaison with senior leadership, the Dockwise support team was headquartered in the Netherlands and the heavy lift reserve units in the Washington, DC and Baltimore, MD and Yokosuka, Japan worked together to plan the lift.

While planning for the USS Fitzgerald tow and heavy lift, the NAVSEA 00C heavy lift SME in Yokosuka was re-deployed to Singapore to assist with the response to the incident involving the USS John S McCain. A second USNR heavy lift team was also deployed to Singapore to assist in the execution of the USS John S McCain heavy lift.

The heavy lift team in Yokosuka continued the planning and coordination for the tow and heavy lift of the USS Fitzgerald. The U.S. Navy Towing Manual Appendix H (Checklist for Tow) and Appendix R (Checklist for Heavy Lift) preparations and inspections were completed. The team provided support to the SRF and ship's force project team on all preparations related to the readiness of the USS Fitzgerald for towing and heavy lift, such as the receipt and setup of Emergency Ship Salvage Material and heavy lift equipment, as well as the setup, installation, and testing of dewatering equipment on the USS Fitzgerald for the tow from the drydock to the lift location. The heavy lift and SRF teams coordinated with ship's force for the review and removal of hazardous materials (HAZMAT) and screening of HAZMAT remaining onboard.

To support logistics coordination in parallel with the heavy lift planning, the heavy lift team set up daily coordination meetings with ship's force and SRF representatives. These meetings were instrumental for providing responses to ship's force questions and requests. Major events included defueling, undocking, and removal of major equipment and systems.

As the evolution planning proceeded, the heavy lift and SUPSALV teams coordinated the installation and verification of equipment and systems needed for heavy lift, including the Smart TOW system installed by ESSM personnel. The team confirmed the availability of required systems such as navigational lights, towing jewelry, compressed air, and firefighting equipment.

The team also led scheduling and executing internal transport manual review sessions in advance of the receipt of the Transport Manual from Dockwise. Before the receipt of the Transport Manual, the heavy lift team completed separate calculations and planning as documented Section 5-6 of this report. The heavy lift team was present at SRF Yokosuka, Japan from 28 August 2017 through the departure of USS Fitzgerald on 10 December 2017

Figure 5-4. Heavy Lift personnel brief USS Fitzgerald crew on the preparations and expectations for the ship's tow and heavy lift

5-4 USS Fitzgerald Heavy Lift – Transport Manual Development and Advanced Planning

5-4.1 Transshelf Preparations

At the time of contract award, M/V Transshelf was at a Chinese shipyard undergoing structural improvements that were independent of the USS Fitzgerald heavy lift but necessary to ensure that USS Fitzgerald could be safely heavy lifted. Dockwise also used the Chinese shipyard to provide keel blocks, side blocks, and shoring that were precut specifically for the onload and transit of USS Fitzgerald. The keel blocking included steel caps at both ends of the keel line to ensure that the large overhangs at both ends did not cause excessive keel block loading. Steel grillage was also installed on Transshelf's deck adjacent to the planned site of the bow and stern of USS Fitzgerald to dissipate the overhang load onto the structure of Transshelf.

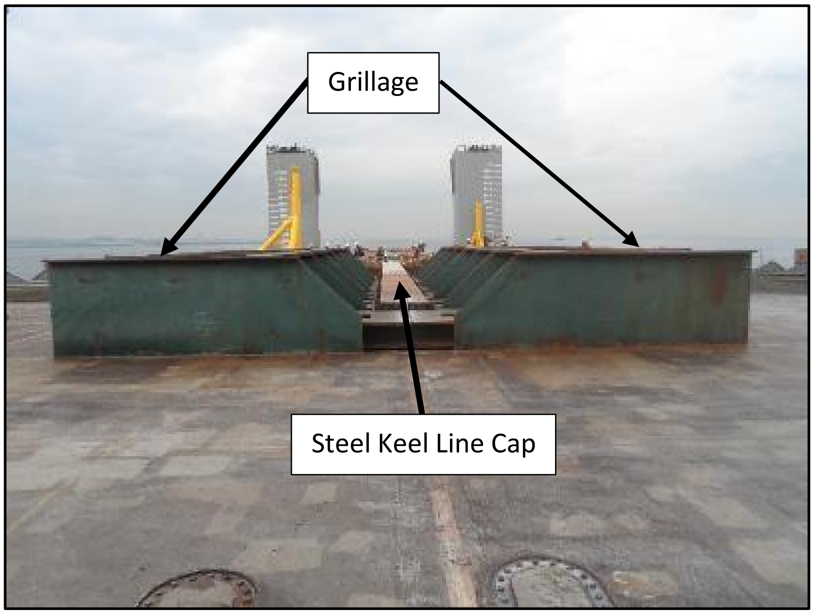


Figure 5-5. Aft Grillage and steel cap over keel blocks

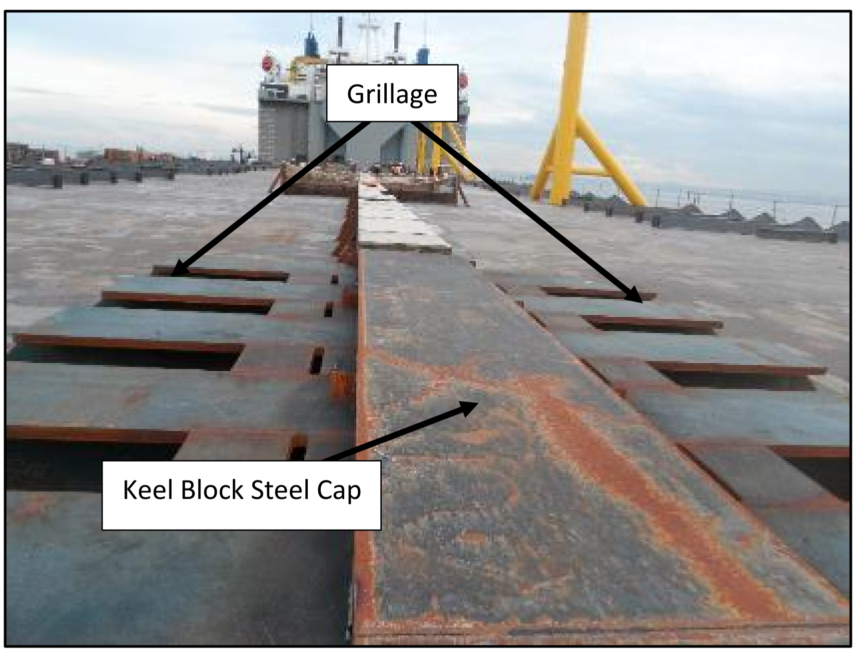


Figure 5-6. Foward grillage and steel cap over keel blocks

M/V Transshelf departed China on 15 November and arrived at Tokyo Bay A-136 Ammo Anchorage 20 November, a few miles from USS Fitzgerald in Berth 8 (Figure 5-7)

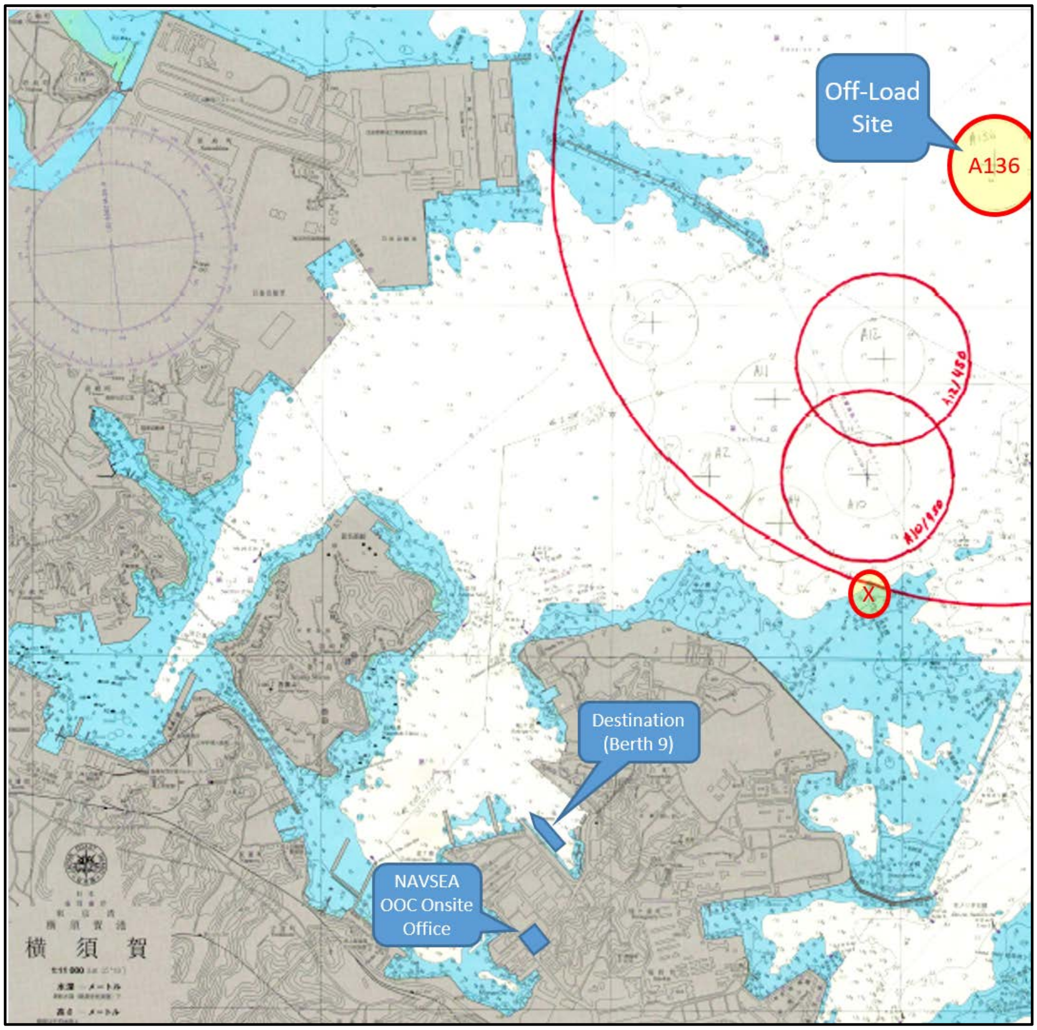


Figure 5-7. **M/V Transshelf Anchorage A136. Onload Site for USS Fitzgerald and offload site for USS John S McCain**

M/V Transshelf arrived with the block build nearly complete, though nearly all of the side blocks were too low and needed to be built up. The SUPSALV heavy lift team began their inspection of M/V Transshelf on 21 November 2017.

5-4.2 Panama Canal Transit Planning

One complication to the Japan to Pascagoula, MS track was the Panama Canal transit. The Panama Canal Authority (PCA) has established regulations for transit and sets the schedule for vessels requesting passage. Dockwise communicated their intention to transit the canal on M/V Transshelf with USS Fitzgerald as cargo, and the PCA had reservations about the configuration of the load. Specifically, a typical vessel in transit has a tug made up forward and another tug made up aft for braking. With USS Fitzgerald's bow dome over hanging the stern of M/V Transshelf, the PCA was unclear on where it would make up a stern tug. The proposed solution was to make up the stern tug up to the bow chocks of USS Fitzgerald. Dockwise and SUPSALV engineers initially had a concern that this stern tug configuration could put unplanned forces on the sea fastenings. Additionally, the PCA was concerned about the vulnerability of the sonar dome to inadvertent bumps by the trailing tug. After numerous calls and meetings, an agreement was reached permitting tying the stern line to USS Fitzgerald and giving the PCA immunity to incidental contact after NAVSEA concluded that a tug would not unseat Fitzgerald's sea fastenings and the dome could handle a moderate bump. During the actual transit, the PCA stern tugs had ample room to make up a stern line to the stern quarter of M/V Transshelf and USS Fitzgerald's bow chocks were not used.

5-5 USS Fitzgerald Transport Manual Technical Review

The USS Fitzgerald Transport Manual was supposed to be delivered to the government on 13 October 2017. On 14 October, a 30% complete draft was received. Most of the blocking drawings, pumping plan, sea fastening drawings, and other data were missing. NAVSEA 00C notified Dockwise that it was impossible to provide a technical review of their work. The major delay in the USS Fitzgerald transport manual production was that Dockwise was working the John S McCain transport manual and did not have sufficient heavy lift technical personnel to work both manuals simultaneously. Dockwise shortages were the result of corporate restructuring after Boskalis acquired Dockwise. Dockwise stated it would bring the completed manual with them when they arrived in November. This shortened the period of time the Navy heavy lift team had to review the manual and would put the Navy heavy lift team at a disadvantage if contractual debate developed over readiness delays. Dockwise delivered the complete transport manual on 4 November 2017. A review of the TM resulted in 15 technical discrepancies which were provided to Dockwise on 8 November. One of these discrepancies resulted in damage to USS Fitzgerald which is discussed in paragraph 5-6.6. A copy of the final approved TM with the review comments is provided as Appendix E. Final loading plan approval was obtained on 22 November, just 2 days before the onload.

5-6 USS Fitzgerald Heavy Lift

5-6.1 Onload Blocking Configuration

Appendix E shows the onload blocking configuration. A key lesson learned from the USS John S McCain's hull cracking was to place all side blocks on frames rather than use docking block position. The challenge when not using docking blocks is to calculate the block heights and bevel. Appendix G shows the calculations prepared in accordance with U.S. Navy Towing Manual Chapter 8.

The block layout did not use the side block locations shown on the docking drawing. This was done to align the block loads with the intersections of frames and longitudinal stiffners. At the time of the writing of this report there is a debate regarding the use of docking blocks strictly for on load since the onload block heights and shapes are based on as built measurements. If docking drawing blocks are not used, the heights of the onload blocks must be calculated from the best available data and compared to calculations/drawings provided by the contractor.

5-6.2 Hull Form Data Discussion

The data used for determining block heights for USS Fitzgerald was Table of Offsets design data for the first flight of the DDG 51 class. This table lists hull form points for the as designed ship. Figures 5-8 and 5-9 are examples of offset tables.

WATERLINE HALF-BREADTHS										
DISTANCE FROM FP	WL0100 10-00-00	WL0110 11-00-00	WL0120 12-00-00	WL0130 13-00-00	WL0140 14-00-00	WL0150 15-00-00	WL0160 16-00-00	WL0170 17-00-00	WL0180 18-00-00	WL0190 19-00-00
228-00-00	26-00-10	26-07-01	27-00-10	27-05-08	27-09-11	28-01-07	28-04-12	28-07-13	28-10-09	29-01-03
229-00-00	26-00-15	26-07-06	27-00-15	27-05-12	27-09-15	28-01-10	28-04-15	28-07-15	28-10-11	29-01-04
230-00-00	26-01-04	26-07-11	27-01-03	27-05-15	27-10-02	28-01-13	28-05-01	28-08-01	28-10-13	29-01-06
231-00-00	26-01-09	26-07-15	27-01-07	27-06-03	27-10-05	28-02-00	28-05-04	28-08-03	28-10-14	29-01-07
232-00-00	26-01-14	26-08-03	27-01-11	27-06-06	27-10-08	28-02-02	28-05-06	28-08-05	28-11-00	29-01-08

Figure 5-8. Waterline Table of Offsets

COMPLETE TRANSVERSE FRAME 228.00 (AUTK 238.00)

	MOLDED												INNERTRACE	
NAME	H.B.	HGHT.	CUTNO	DIMA	DIMB	DIMC	DIMD	ALPHA	BETA	GAMMA	THETA	GIRTH	H.B.	HGHT.
SEAM 4053	11/04/08	0/09/03	0	0/00/00	0/00/00	0/00/00	0/00/00	0	18000	26995	900	11/04/15	0/00/00	0/00/00
LONG 501	11/03/00	0/08/15	0	0/00/00	0/00/00	0/00/00	0/00/00	0	18000	26992	905	11/03/07	0/00/00	0/00/00
LONG 502	11/03/00	0/08/15	0	0/00/00	0/00/00	0/00/00	0/00/00	0	18000	26992	905	11/03/07	0/00/00	0/00/00
LONG 401	9/00/00	0/05/06	940	1/00/00	0/04/00	0/00/04	0/00/04	0	18000	26992	625	9/00/03	9/00/00	1/05/05
LONG 402	9/00/00	0/05/06	940	1/00/00	0/04/00	0/00/04	0/00/04	0	18000	26992	626	9/00/03	9/00/00	1/05/05
LONG 301	6/09/00	0/02/15	940	1/00/00	0/04/00	0/00/04	0/00/04	0	18000	26994	423	6/09/01	6/09/00	1/02/14
LONG 302	6/09/00	0/02/15	940	1/00/00	0/04/00	0/00/04	0/00/04	0	18000	26994	423	6/09/01	6/09/00	1/02/14
SEAM 4183	5/06/00	0/01/15	0	0/00/00	0/00/00	0/00/00	0/00/00	0	18000	26997	335	5/06/00	0/00/00	0/00/00
LONG 201	4/06/00	0/01/05	0	0/00/00	0/00/00	0/00/00	0/00/00	0	18000	26998	264	4/06/00	0/00/00	0/00/00
LONG 202	4/06/00	0/01/05	0	0/00/00	0/00/00	0/00/00	0/00/00	0	18000	26998	263	4/06/00	0/00/00	0/00/00
LONG 101	2/03/00	0/00/06	940	1/00/00	0/04/00	0/00/04	0/00/04	0	18000	27000	094	2/03/00	2/03/00	1/00/05
LONG 102	2/03/00	0/00/06	940	1/00/00	0/04/00	0/00/04	0/00/04	0	18000	27000	094	2/03/00	2/03/00	1/00/05
SEAM 4013	1/00/00	0/00/00	0	0/00/00	0/00/00	0/00/00	0/00/00	0	18000	27000	215	1/00/00	0/00/00	0/00/00
CLIN 1	0/00/00	0/00/00	0	0/00/00	0/00/00	0/00/00	0/00/00	0	18000	27000	0	0/00/00	0/00/00	0/00/00

Figure 5-9. Complete Frame Table of Offsets

Figure 5-10 below shows points from the waterline Half Breadth table and the complete Transverse Frame table. Note the lack of points in the waterline table (blue points) set below 300 mm (~1 ft) and the high curvature rate. Linear interpolations between too few points with a high rate of curvature can introduce unacceptable errors and block designs that do not accurately reflect the hull shape. As block heights change more transversely, than longitudinally it is recommended to use the transverse frame tables if it is necessary to design blocks from hull tables.

Note that the Table of Offsets is “Molded”. This means the shape of the hull inside the plating is tabulated. Plate thickness from structural drawings must be used to adjust the molded offsets to the final block offsets.

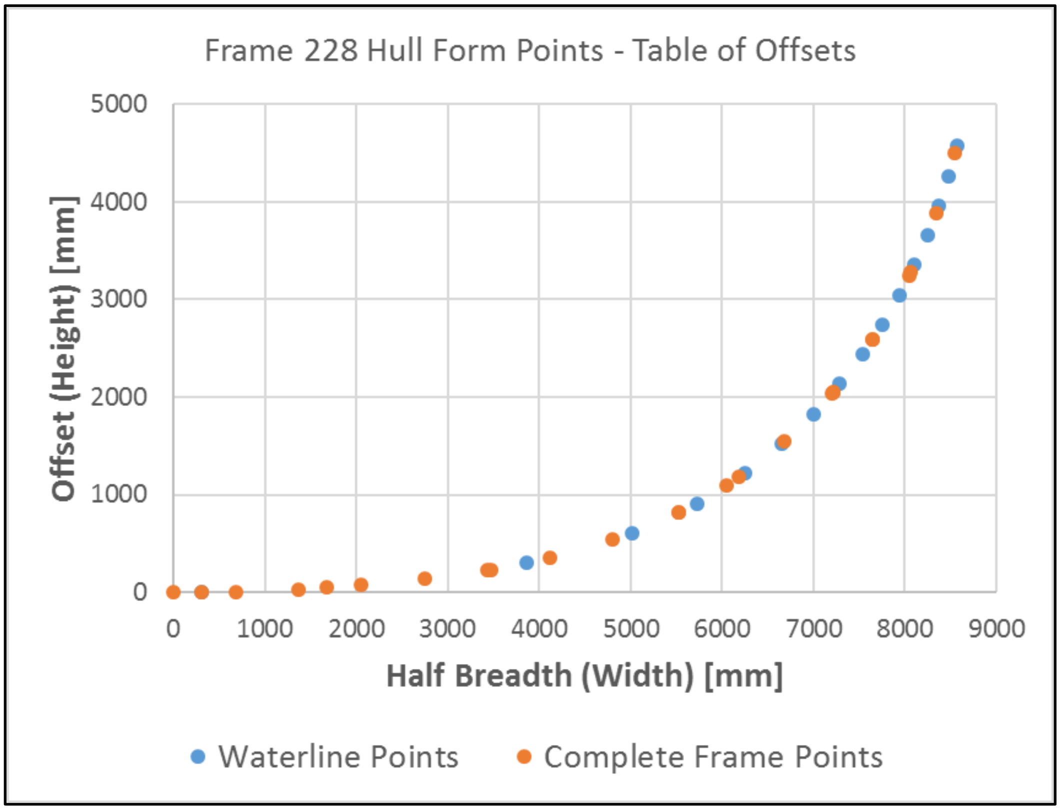


Figure 5-10. Complete Frame and Waterline Offsets Plot at Frame 228

An additional verification was required to ensure blocks were placed at the intersection of a longitudinal and frame. SUPSALV worked with the contractor to identify the structural frames on a docking drawing so that the onload blocking met this requirement. Figure 5-11 shows the heavy lift team measuring the blocks and cradles. Final block configuration is documented in Appendix E.

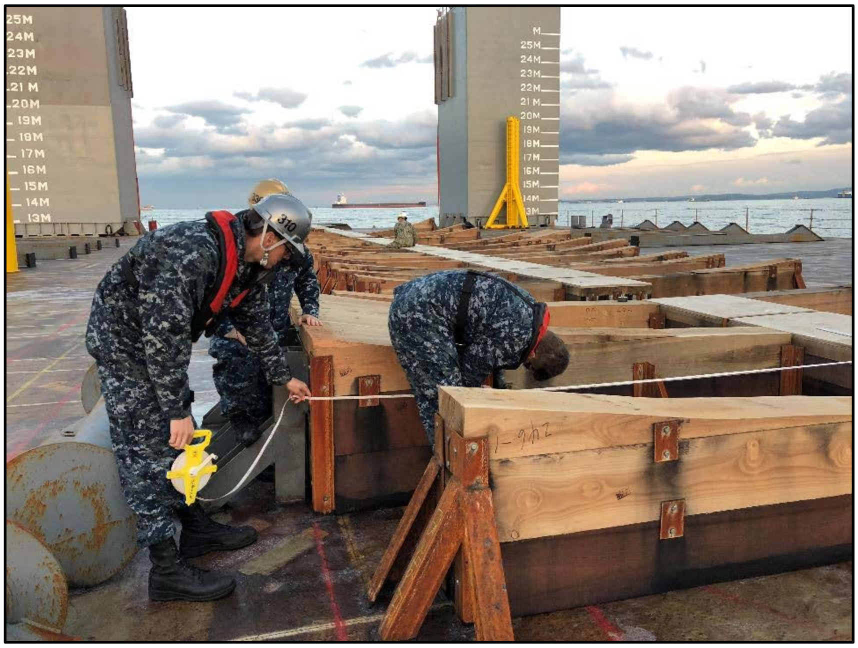


Figure 5-11. Heavy Lift Team Measuring and Repairing Onload Blocking

5-6.3 Forward Guide Post and Catcher Calculations

On 20 November 2017, Dockwise subcontractor, AngloEastern completed installation of the catcher. Initial QA checks raised concerns that the catcher may have been improperly located on the hull of USS Fitzgerald. Any inaccuracy longitudinally or transversely in the catcher would result in USS Fitzgerald not landing in the proper location on the block build. Independent reviews by both Dockwise and the SUPSALV heavy lift team determined that while the drawing could be easily misinterpreted the catcher had in fact been installed in the correct location.

5-6.4 Aft Guide Post and Bumper Calculations

On 21 November 2017, the heavy lift team began working the aft guide post and bumper calculations because the Independent Marine Surveyor (IMS) expressed concern over its location. The result of the investigation was the determination that the bumper block was designed and cut backward. The forward USS Fitzgerald edge had about 20mm less clearance than the aft edge. This caused the cargo to guide down a wood edge rather than a surface. After review, it was confirmed that a minimum clearance of 16mm at lower forward corner allowed for safe landing so the determination was made not to make any changes in the location of the aft guide post. (Figures 5-12 and 5-13).

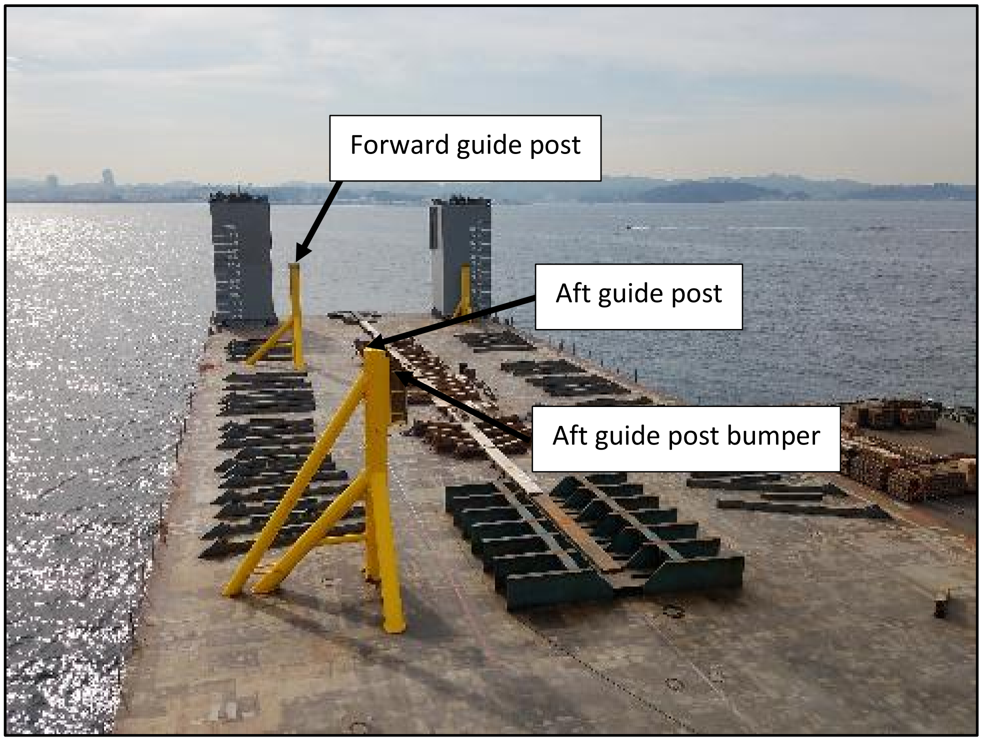


Figure 5-12. Forward and aft guide posts

Figure 5-13. Aft guide post and bumper

5-6.5 Loading Vertical Clearance

The calculation and logic used to determine vertical clearance at submerged depth is depicted in Figure 5-15. Establishing this depth and ensuring Dockwise agreed to and verified conditions prior to and during the onload were critical to the onload process.

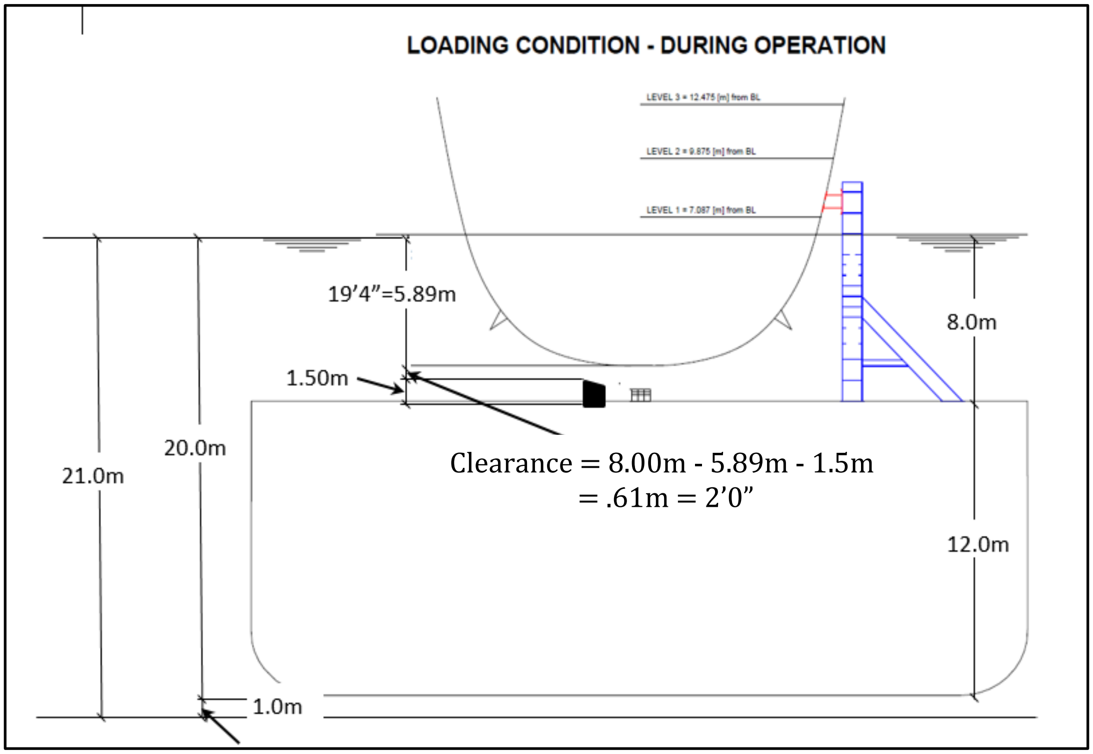


Figure 5-14. Loading Vertical Clearance

5-6.6 Unload and grillage damage

On November 23, M/V Transshelf ballasted down and USS Fitzgerald was positioned for lift. When USS Fitzgerald landed on her keel blocks the morning of 24 November, its hull suffered hull impingement on both port and starboard at frame 346 by the support grillage built on the heavy lift vessel's deck. Before the lift, the HLPO repeatedly asked the contractor's engineering team to verify that the grillage was clear of the hull and was ensured that it was. The heavy lift team is required to check the clearance of all obstructions to the hull. Using the same Table of Offsets as detailed above, a verification of the damage was conducted after the casualty. It can be seen in Figure 5-15 that the casualty could have been averted by conducting a check before the lift. The damage occurred symmetrically across the centerline. See Appendix F for a detailed grillage and box patch analysis.

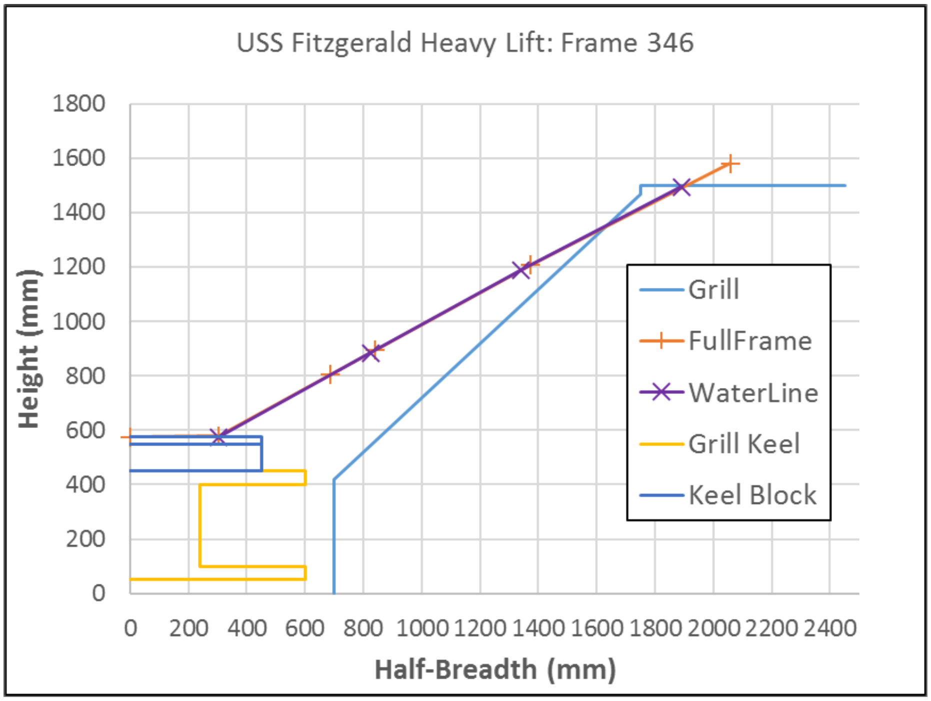


Figure 5-15. Starboard grillage and hull interference

Figure 5-16. Port side damage due to interference with grillage, also found on starboard side

Figure 5-17. Portside box patch being welded to USS Fitzgerald hull

5-6.7 Sea Fastening

After box patches were installed and hull integrity was assured, seafastening began. Using the same technique from USS John S McCain, blocks were positioned on the starboard side after listing M/V Transshelf to port. Then the ship was listed to starboard to allow placing the port side blocks. The same process was employed to place the spur shores beginning on 3 December with heeling the ship to starboard to install the port side spur shores. The process was reversed and the starboard side spur shores were installed between 6 and 8 December. Upon completion and installation of transverse stoppers, M/V Transshelf was cleared to depart the morning of 9 December. Figure 5-18 shows USS Fitzgerald in the final stages of sea fastening.

5-6.8 Transit to Pascagoula

With sea fastening complete, M/V Transshelf departed Yokosuka at 0800 on 09 December. The intended route was provided as a series of way points in a spreadsheet. Those points were plotted on a chart and are shown in Figure 5-19 as a solid red line. M/V Transshelf mostly followed this plan, crossing the international date line on 21 December and dropping anchor on the west coast of Panama on 10 January. M/V Transshelf bunkered and resumed the transit on 12 January. The bunkering was required for to support USS Fitzgerald discharge. The Panama Canal authorities decided that M/V Transshelf would transit the first set of locks on the morning of 12 January, moor in Gatun Lake, and wait until the next day to finish the transit though the Atlantic side locks. This was a 2-day transit plan. The Panama Canal Authority gave a requirement for a strict daylight passage and said that there were three container ships ahead of M/V Transshelf which were very slow and their scheduled passage could not be altered. As a result, arrival in Pascagoula was one day later than originally predicted. Transshelf cleared the sea buoy off of Cristobal around 1730 14 January and began her sea passage up the east coast of central America.

Figure 5-18. Heavy Lift Project Officer directing Production Operations

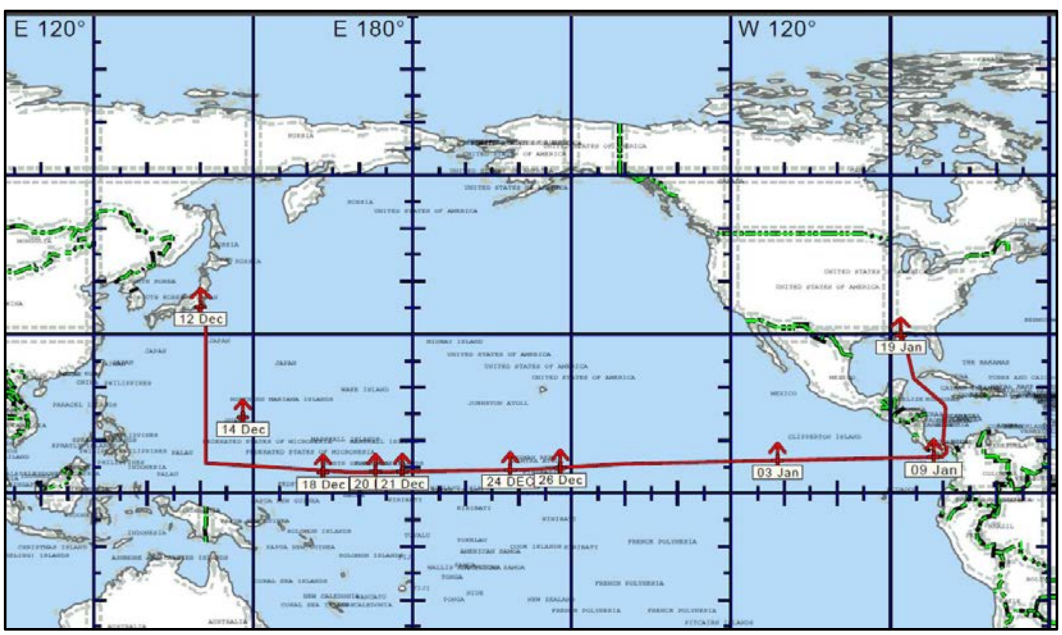


Figure 5-19. M/V Transshelf voyage to Pascagoula, MS.

Figure 5-20. M/V Transshelf and USS Fitzgerald during Panama Canal passage on 12 January.

5-6.9 Offload

USS Fitzgerald arrived at the Port of Pascagoula, South Dock on 18 January 2018 aboard M/V Transshelf. She was subsequently offloaded at the Huntington Ingalls Industries (HII) Shipyard ballasting pit on 24 January 2018.

Several critical actions were to be completed while M/V Transshelf was moored prior to offload. First, most of the spur shores were removed leaving three shores on either side to provide stability for the transit from the port to the ballasting pit. Figure 5-21 shows the shore removal plan. A valuable lesson learned was to have a heavy lift team member present for the removal work. In this case, two of the shores required to be kept in-place were partially cut by the sub-contractor. The HL team and Dockwise team had to approve alternate shores or order re-welding of shores to the M/V Transshelf deck to support the vessel during transit. Once on station over the pit, the last six shores were removed before deballasting began. Following shores, the strong boxes, bent plates and side blocks were removed, see Figure 5-22.

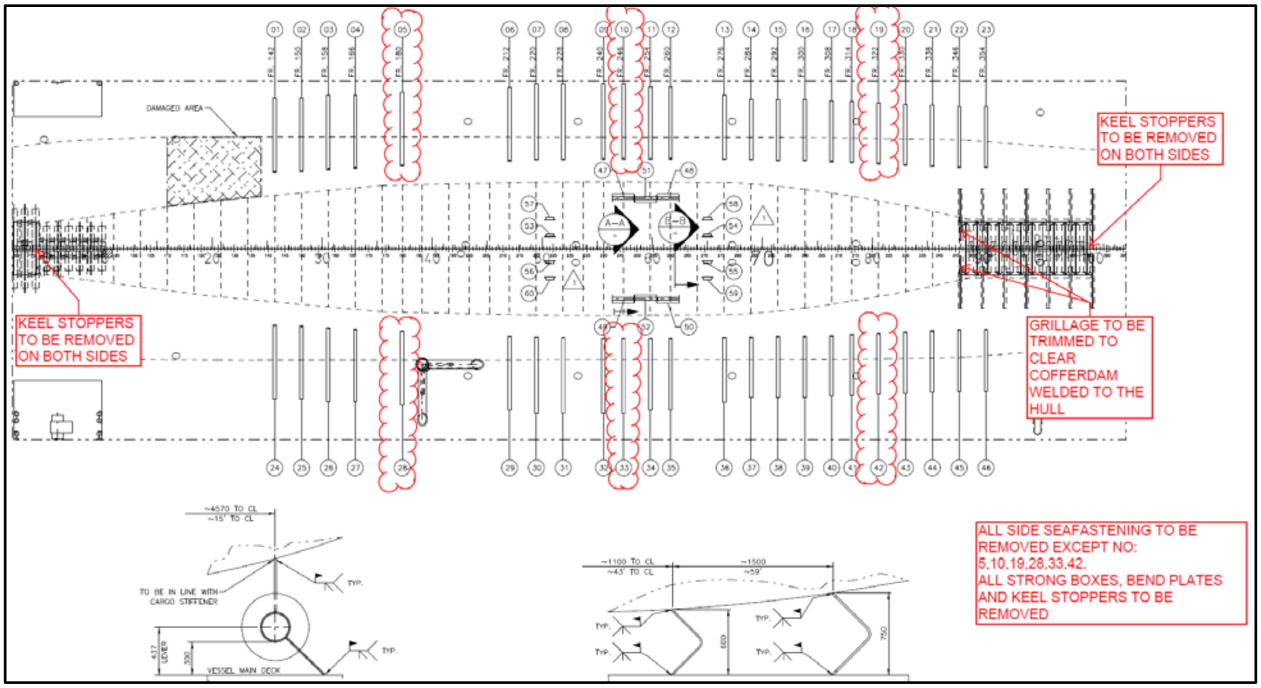


Figure 5-21. Sea fastening removal plan

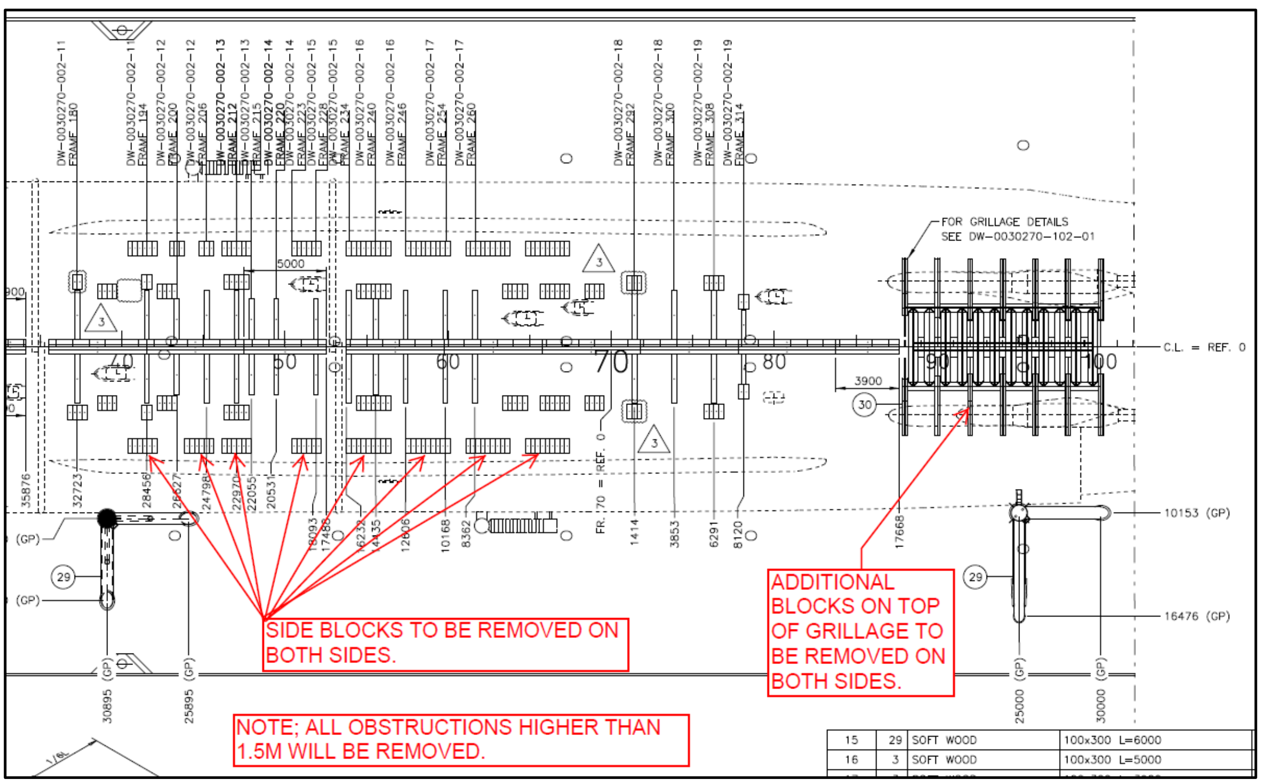


Figure 5-22. Side block removal plan

Additional grillage was removed to provide adequate clearance for the box patches (paragraph 5-6.6). Figure 5-23 shows the clearance as transported while Figure 5-24 shows the grillage cut away from the box patches prior to offload.

Figure 5-23. Grillage removed prior to offload

Finally, after much discussion with Dockwise, additional bumpers were added to the M/V Transshelf's aft caissons. The concerns of the heavy lift team were three-fold. First, Dockwise refused to remove the catcher from the port side of USS Fitzgerald's hull, reducing the clearance between the starboard side of USS Fitzgerald and the aft caisson. Second, the starboard side had a temporary patch over the collision area that was not designed to take impact from the caisson. Finally, the onload experience showed that the clearance to either caisson could easily be a concern even in favorable loading conditions.

There were no major incidents during the offload operation. Inspection of the blocks afterward indicated that there could be soft caps still attached to the hull, and HII was cautioned to do a full diver check before attempting to dock. Figure 5-25 shows the offload log maintained by the Services Officer.

23 Jan 2018	
1845	All 00C personnel onboard M/V Transshelf
1915	Notice of readiness tendered and accepted
2300	USS Fitzgerald water-tight integrity crew onboard
2355	Condition Zebra set on USS Fitzgerald
24 Jan 2018	
0006	Decision made to proceed
0030	Water on the deck of Transshelf
0459	Drafts: 14 m aft, 18.8 m fwd (drafts are measured from keel of M/V Transshelf, aft is on the caissons)

0518	Initial hold point
0600	Grounding strap and LP air hose disconnected
0625	USS Fitzgerald line handling crew aboard. Water tight check crew departed
0645	Remaining line handling crew aboard Dive radio secured
0658	Caissons manned with line handlers Drafts: 16 m aft, 18.6 m fwd
0726	Drafts: 17 m aft, no fwd reading
0740	Secure bumpering to catcher
0741	Drafts: 18 m aft, no fwd reading
0744	Stern float-off
0747	Bow float-off
0752	Drafts: 21 m aft, 19.7 m fwd
0804	Pilot aboard
0825	All 4 tugs on station
0837	3 tugs made-up
0844	Drop 2 bow lines
0847	Commence pull-out
0848	Drop aft port spring line
0900	Patch and catcher clear of caissons
0903	Stern starboard tug disconnected
0921	Drop caisson-amidships lines
0930	USS Fitzgerald clears sill
0930	Drop stern lines

Figure 5-24. Offload log

Figure 5-25. USS Fitzgerald nearly ready to float free of M/V Transshelf at dawn the morning of 24 January.

Chapter 6 - SUPSALV Contract Support

SUPSALV's small staff of engineers, divers, salvors, and UWSH operations managers are able to support multiple operations and activities across the Fleet and around the world by leveraging their expertise through use of a series of contracts. The Navy's salvage capability is a function of Fleet operators (Mobile Diving and Salvage Units and Fleet Readiness Support Groups), Military Sealift Command (T-ARS, T-ATF Class salvage and towing ships) and SUPSALV (with subject matter experts, engineers, and contract support).

SUPSALV has contracted with GPC to maintain 00C owned salvage equipment and support operations when tasked. This system of emergency salvage and pollution response equipment with experienced operators, called Emergency Ship Salvage Material (ESSM), is pre-staged throughout the world at 4 manned ESSM bases and 5 additional unmanned storage facilities. Two of these facilities, located in Sasebo, Japan and Sembawang, Singapore, were used to provide emergency response equipment to CTF 73 salvage and repair personnel during their response to USS Fitzgerald and USS John S McCain casualties.

SUPSALV's Western Pacific Salvage contract holder, SMIT, maintains offices and equipment throughout the world, including Singapore, and were ready to respond when SUPSALV issued tasking.

Phoenix International holds SUPSALV's Diving Services contract. Under this contract, Phoenix provides underwater ship repair, divers, and engineers when tasked by SUPSALV to support planned and emergent repairs to U.S. Navy vessels.

The following delivery orders, tasked to the contractors described above, supported USS Fitzgerald and USS John S McCain salvage response and heavy lift operations.

GPC – ESSM Contract

Supported USS Fitzgerald with Smart Tow equipment and installation, DO 17F4A81 – $63,000

Supported USS Fitzgerald with pumping equipment and operators, DO 17F4A96 – $80,000

Supported John S McCain salvage response with ESSM equipment in Singapore and provided installation of instrumentation equipment in Subic Bay, DO 17F4A95 – $191,000

Supported USS John S McCain Port and starboard controllable pitch propeller blade removals with ESSM equipment and operators DO 17F4A97 – $100,000

Phoenix - Diving Services Contract.

Supported USS Fitzgerald's cofferdam installation by performing underwater welding, DO 17F4H09 – $1,148,000

SMIT – Western Pacific Salvage Contract

Supported USS John S McCain's Salvage and Heavy Lift. Verbal Delivery Order 17F4F01 issued 5 September tasked for Salvage Response and (eventually) Heavy Lift services for USS John S McCain. The operational cost plus Award Fee DO tasked SMIT to provide casualty response to USS John S McCain to secure flooded compartments, make the ship safe for transport, and (with amendment) transport the ship from Singapore to Japan. SMIT subcontracted to Dockwise to conduct the heavy lift. Additionally, SMIT was directed to hire Phoenix to perform the HY80 welding on the John S McCain patch. DO 17F4F01 – $12,166,000

Chapter 7 - Conclusion

7-1 Overview

The period between USS Fitzgerald's collision in June 2017 and its undocking in Pascagoula, MS in January 2018 marked an intense 7-month period of activity that not only kept salvors and the heavy lift team busy over the period but also overlapped the activities associated with the entire John S McCain collision, salvage response, heavy lift, transport, voyage repairs in Subic Bay, Philippines, and undocking in Yokosuka, Japan.

7-1.1 Operation Tempo Challenges

Responding to two collisions and needing to plan and conduct two heavy lift operations in such a short period of time was a serious test for the U.S. Navy, the Fleet salvage and repair teams in the western Pacific, and SUPSALV's heavy lift capability. The ship collisions were 64 days apart and the heavy lifts were just 48 days apart. Additionally, after the USS John S McCain lift, there was a three-plus week reblocking effort in Subic Bay which overlapped the USS Fitzgerald onload. This pace of operations reduced the ability of the engineering teams from Dockwise and SUPSALV to crosscheck each other and validate the engineered solutions the other team had developed. In a perfect world, SUPSALV would have given Dockwise enough time to fully complete the Transport Manuals and conducted an independent validation of the plans.

7-1.2 Capable Salvage Officers Serving in COMLOG WESTPAC Maintenance Roles

Seventh Fleet was lucky to have fully capable maintenance engineers who were also engineering duty officer - divers on staff at Commander Logistics Group Western Pacific / CTF 73. These versatile engineers were up to the task of managing the immediate response team on site, overseeing search and recovery efforts, managing diving safety, planning the near term actions to stabilize the ships, and conducting the detailed engineering analysis needed prior to drydock or heavy lift.

7-1.3 Heavy Lift Team Training Paid Off

One result of the numerous table top exercises and actual heavy lifts conducted by the US Naval Reserve Detachment supporting SUPSALV was the competence the heavy lift team demonstrated over the course of the two heavy lift operations.

7-1.4 Existing Towing Manual Requirements are Insufficient to Secure the Load

Blocking and seafastening requirements specified by the U. S. Navy Towing Manual were insufficient for the aging hull of DDG 56 and angled configuration on M/V Treasure. The lessons learned include new blocking placement guidelines and block compression loading standards which are being incorporated into the Towing Manual Revision in development. Additionally, seafastening will be tightened port and starboard by heeling the ship to the opposite side while tightening both side blocks and spur shores. A summary of these changes planned for the next Towing Manual revision are identified in Appendix O.

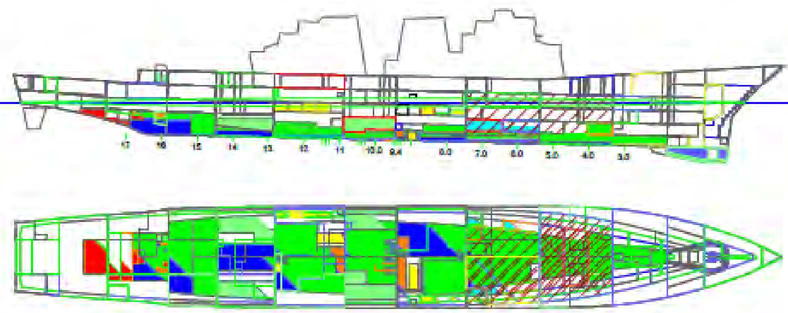
7-1.5 Differences Exist between Contracting Options

There were significant differences in the MSC contracted heavy lift operation and the SMIT contracted heavy lift operation including cost to the Navy and control over the carrier's actions. While it was convenient to task SMIT to subcontract with a heavy lift carrier to conduct the lift, the cost difference between the MSC contract, which was firm fixed price, and the SMIT/Dockwise contract, which was time and materials, was significant (greater than a two-to-one ratio).

Appendix A – FITZGERALD POSSE Initial and Final Conditions

Damaged

Trim and Stability Summary



Loading

Intact Displacement	8,873 LT	Specific Gravity	1.025
Flooding	1,614 LT		
Outflow	0 LT		
Total Displacement	10,476 LT		

Stability		Trim	
GMt Upright (Corrected)	6.38 ft	LCF Draft	23.67 ft
GMt @ Equil	6.40 ft	LCF	263.24A Ft-FP
		LCB	217.32A Ft-FP
		LCG	217.50A Ft-FP
		KB	14.53 Ft-BL
		TCB	1.31S Ft-CL
		TCG	0.66S Ft-CL
		TP1in	47.4 LT/in
		MT1in	1,316 ft-LT/in
		Trim at Perps	11.15F ft
		Heel Angle	5.00S deg

Drafts - Perps		Drafts - Marks	
AP	18.82 (18-9.9) ft	Aft	18.94 (18-11.3) ft
MS	24.40 (24-4.8) ft	MS	24.30 (24-3.6) ft
FP	29.97 (29-11.6) ft	Fwd	29.85 (29-10.2) ft

Strength –At Sea–

Shear (Min)	-734 LT	186.40A Ft-FP	— %
Shear (Max)	588 LT	349.50A Ft-FP	— %
Moment (Max Hog)	75,766H ft-LT	255.78A Ft-FP	— %
Moment (Max Sag)	— ft-LT	— Ft-FP	— %

Notes

Drafts from Keel

Hull from Offsets

GMt from GZ Curve Slope

Tanks from Tables

Damaged
Righting Arm Summary

Angle deg	GZ ft	Draft AP ft	Draft FP ft	Trim deg	Flooded LT	CDisp LT	CTrim ft	Iter	#Calcs
0.00	-0.56	18.94	29.73	1.33F	1,557	0	0.00	7	7
1.00S	-0.45	18.92	29.78	1.33F	1,568	0	0.00	3	3
5.00S	0.00	18.82	29.97	1.37F	1,614	0	0.00	3	3
10.00S	0.57	18.59	30.20	1.43F	1,677	0	0.00	3	3
20.00S	2.05	17.86	30.06	1.50F	1,709	0	0.00	5	5
30.00S	3.91	16.58	29.10	1.54F	1,641	0	0.00	3	3
45.00S	5.47	13.52	27.45	1.71F	1,461	0	0.00	4	4
60.00S	5.25	9.13	25.51	2.01F	1,307	0	0.00	9	9
75.00S	4.16	-2.14	22.29	3.00F	1,205	0	0.00	23	55
								60	92

Notes

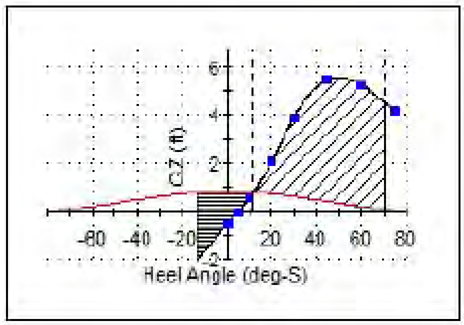
GZ Curve from Offsets

Tanks from Tables

Disp. of Remaining Intact Hull = 8,862

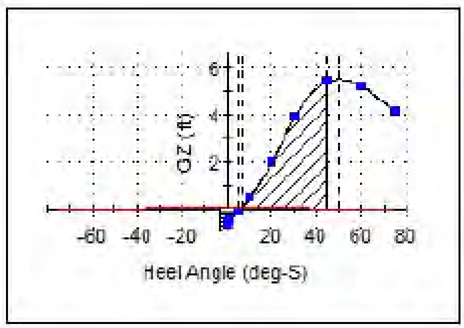
DDS079-1 2.2 USN Beam Winds Combined with Rolling

PASS	DDS079-1 2.2 USN Beam Winds Combined with		Value	Required
PASS	Maximum Righting Arm	ft	5.56	>=1.34
PASS	Reserve Area	ft-deg	218.14	>=51.19



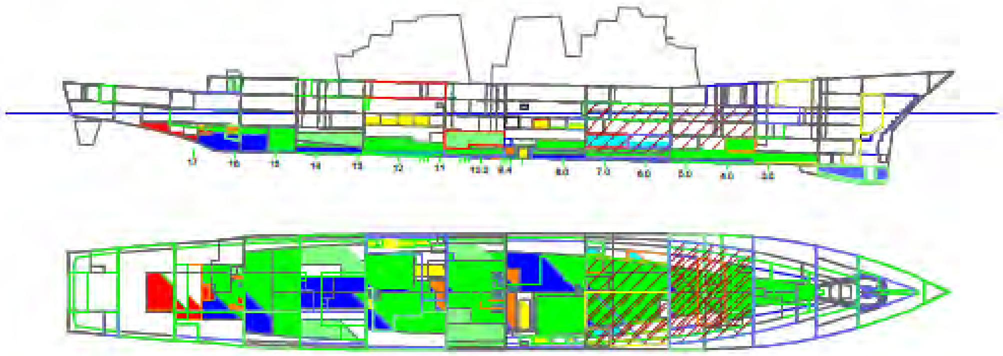
DDS079-1 3. USN Damage Stability Standards

PASS	DDS079-1 3. USN Damage Stability Standards		Value	Required
PASS	Static Angle of Heel (No Wind Moment)	deg	5.00	>=-15.00 and <=15.00
PASS	Angle to Margin Line (Static)	deg	N/A	>=5.00
PASS	Reserve Area	ft-deg	111.37	>=6.26
PASS	Maximum Righting Arm	ft	5.43	>=0.30



Damaged

Damage Summary



Damaged Spaces

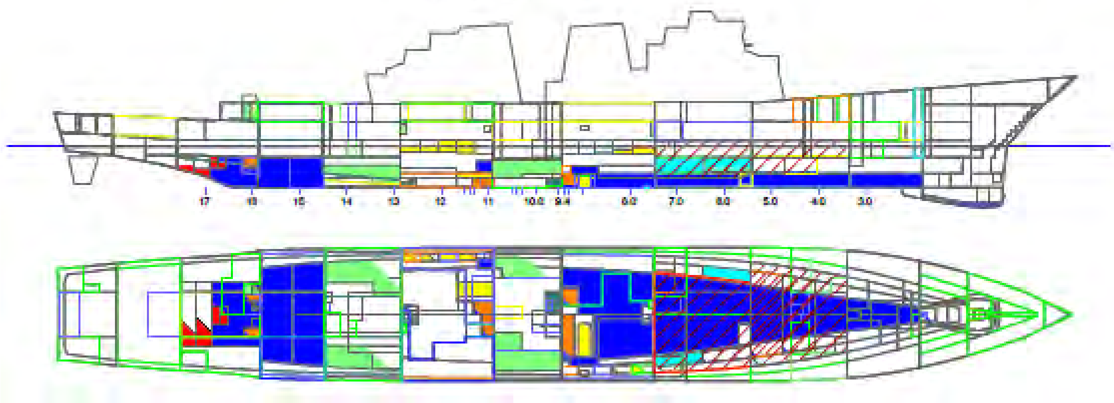
Name	Int Weight LT	Outflow LT	Flooding LT	Net Wt LT	LCG Ft-FP	VCG Ft-BL	TCG Ft-CL	Damage Opt
4-126-1-W	11	11	15	15	138.02A	12.25	19.14S	DAMAGED-Free Flood
2-126-1-C	0	0	128	128	147.52A	25.54	14.72S	DAMAGED-Free Flood
2-161-1-T	0	0	13	13	167.23A	25.81	25.33S	DAMAGED-Free Flood
2-78-01-L	0	0	179	179	105.97A	25.66	5.57S	DAMAGED-Free Flood
3-97-1-L	0	0	313	313	108.15A	19.26	0.00S	DAMAGED-Free Flood
4-110-0-E	0	0	107	107	118.17A	11.06	0.00S	DAMAGED-Free Flood
4-126-0-E	0	0	767	767	150.94A	14.47	3.59S	DAMAGED-Free Flood
4-94-0-C	0	0	92	92	102.21A	11.09	0.00P	DAMAGED-Free Flood
Damage Totals	11	11	1,614	1,614	132.44A	17.17	3.88S	

Abbreviations:

		Free-Floating Draft / Displacement Data		
		Intact	After Outflow	Damaged
Draft AP	ft	20.65		18.82
Draft FP	ft	22.08		29.97
Trim at Perps	ft	1.43F		11.15F
Static Heel Angle	deg	0.76S		5.00S
Draft Aft	ft	20.66		18.94
Draft MS	ft	21.35		24.30
Draft Fwd	ft	22.06		29.85
Total Weight	LT	8,873	8,862	10,476
VCG	ft	22.75	22.77	21.91
LCG	Ft-FP	232.87A	232.99A	217.50A
TCG	Ft-BL	0.09S	0.07S	0.66S
Buoyancy	LT	8,873		10,476
KB	ft	12.46		14.53
LCB	Ft-FP	235.73A		217.32A
TCB	Ft-BL	0.01S		1.31S
TPin	LT/in	52.2		47.4
MTin	ft-LT/in	1,474		1,316
KMt	ft	29.12		29.38
GMt(solid)	ft	6.36		7.50
FS Adjustment	ft	0.12		1.13
GMt Upright	ft	6.24		6.38
GM @ Equil	ft			6.40

FTZ Final

Trim and Stability Summary



Loading					
Intact Displacement	8,067	LT	Specific Gravity	1.025	
Flooding	65	LT			
Outflow	0	LT			
Total Displacement	8,120	LT			

Stability			**Trim**		
GMt Upright (Corrected)	4.55	ft	LCF Draft	20.27	ft
GMt @ Equil	4.55	ft	LCF	255.98A	Ft-FP
			LCB	231.92A	Ft-FP
			LCG	231.93A	Ft-FP
			KB	11.96	Ft-BL
			TCB	0.08S	Ft-CL
			TCG	0.03S	Ft-CL
			TP1in	51.1	LT/in
			MT1in	1,412	ft-LT/in
			Trim at Perps	0.18F	ft
			Heel Angle	0.28S	deg

Drafts - Perps			**Drafts - Marks**		
AP	20.19 (20-2.3)	ft	Aft	20.19 (20-2.3)	ft
MS	20.28 (20-3.4)	ft	MS	20.28 (20-3.4)	ft
FP	20.37 (20-4.4)	ft	Fwd	20.37 (20-4.4)	ft

Strength –At Sea–					
Shear (Min)	-370	LT	186.40A Ft-FP	—	%
Shear (Max)	451	LT	349.50A Ft-FP	—	%
Moment (Max Hog)	60,223H	ft-LT	260.87A Ft-FP	—	%
Moment (Max Sag)	—	ft-LT	— Ft-FP	—	%

Notes

Drafts from Keel

Hull from Offsets

GMt from GZ Curve Slope

Tanks from Tables

FTZ Final

Righting Arm Summary

Angle deg	GZ ft	Draft AP ft	Draft FP ft	Trim deg	Flooded LT	CDisp LT	CTrim ft	Iter	#Calcs
0.00	-0.02	20.19	20.37	0.02F	65	0	0.00	4	4
0.28S	0.00	20.19	20.37	0.02F	65	0	0.00	1	1
1.00S	0.06	20.19	20.37	0.02F	65	0	0.00	2	2
5.00S	0.40	20.14	20.35	0.03F	65	0	0.00	3	3
10.00S	0.85	19.98	20.30	0.04F	65	0	0.00	3	3
20.00S	1.84	19.20	20.06	0.11F	65	0	0.00	3	3
30.00S	2.97	17.60	19.49	0.23F	65	0	0.00	3	3
45.00S	4.73	13.66	17.06	0.42F	65	0	0.00	4	4
60.00S	4.68	7.67	12.50	0.59F	65	0	0.00	5	5
75.00S	3.74	-8.65	2.14	1.33F	65	0	0.00	9	9
								37	37

Notes

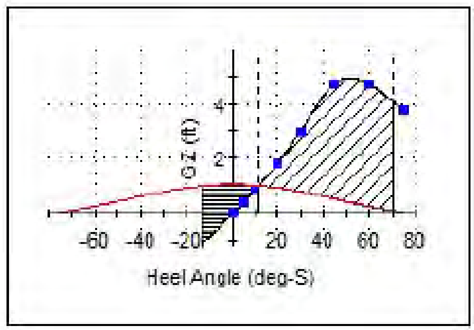
GZ Curve from Offsets

Tanks from Tables

Disp. of Remaining Intact Hull = 8,120

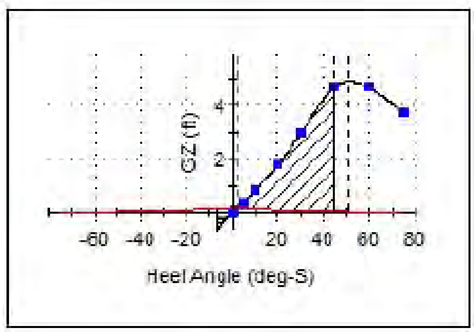
DDS079-1 2.2 USN Beam Winds Combined with Rolling

PASS	DDS079-1 2.2 USN Beam Winds Combined with		Value	Required
PASS	Maximum Righting Arm	ft	4.93	>=1.69
PASS	Reserve Area	ft-deg	176.64	>=39.66



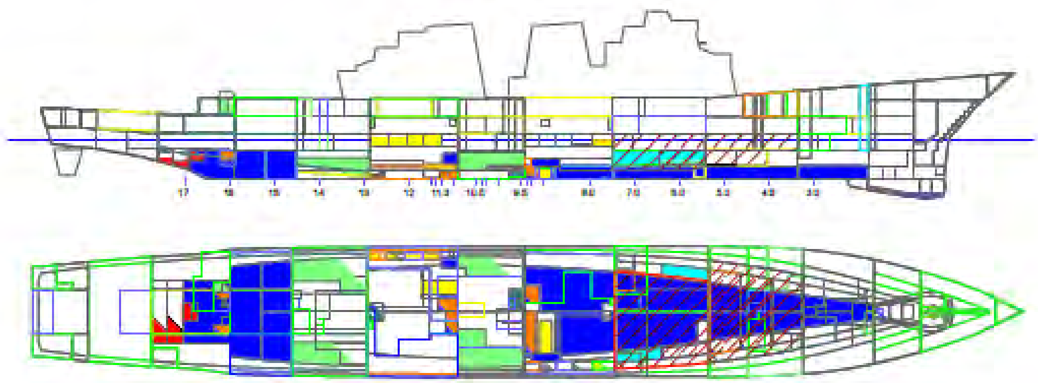
DDS079-1 3. USN Damage Stability Standards

PASS	DDS079-1 3. USN Damage Stability Standards		Value	Required
PASS	Static Angle of Heel (No Wind Moment)	deg	0.28	>=-15.00 and <=15.00
PASS	Angle to Margin Line (Static)	deg	N/A	>=0.28
PASS	Reserve Area	ft-deg	93.40	>=5.29
PASS	Maximum Righting Arm	ft	4.70	>=0.30



FTZ Final

Damage Summary



Damaged Spaces

Name	Int Weight LT	Outflow LT	Flooding LT	Net Wt LT	LCG Ft-FP	VCG Ft-BL	TCG Ft-CL	Damage Opt
4-126-1-W	11	11	1	1	138.73A	8.59	17.71S	DAMAGED-%Flood
3-97-1-L	0	0	16	16	109.16A	15.01	1.43S	DAMAGED-%Flood
4-110-0-E	0	0	5	5	118.20A	7.08	0.68S	DAMAGED-%Flood
4-126-0-E	0	0	38	38	154.18A	5.49	0.23S	DAMAGED-%Flood
4-94-0-C	0	0	5	5	102.23A	7.09	0.47S	DAMAGED-%Flood
Damage Totals	11	11	65	65	136.44A	8.07	0.78S	

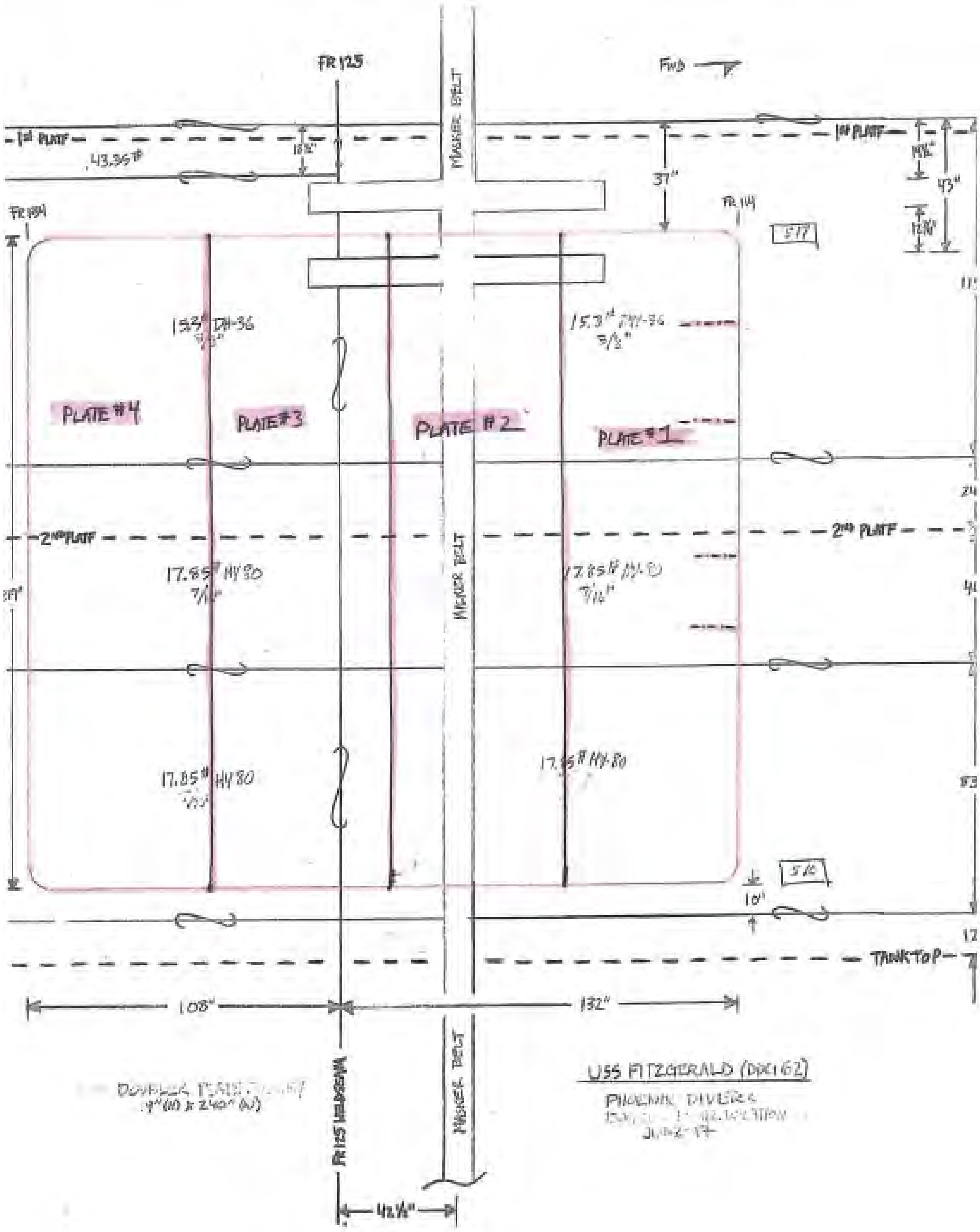
Abbreviations:

		Free-Floating Draft / Displacement Data		
		Intact	After Outflow	Damaged
Draft AP	ft	19.75		20.19
Draft FP	ft	20.28		20.37
Trim at Perps	ft	0.53F		0.18F
Static Heel Angle	deg	0.37S		0.28S
Draft Aft	ft	19.76		20.19
Draft MS	ft	20.01		20.28
Draft Fwd	ft	20.27		20.37
Total Weight	LT	8,067	8,120	8,120
VCG	ft	23.57	23.46	23.46
LCG	Ft-FP	232.56A	231.93A	231.93A
TCG	Ft-BL	0.05S	0.03S	0.03S
Buoyancy	LT	8,067		8,120
KB	ft	11.66		11.96
LCB	Ft-FP	233.68A		231.92A
TCB	Ft-BL	0.01S		0.08S
TPin	LT/in	51.1		51.1
MTin	ft-LT/in	1,418		1,412
KMt	ft	29.08		29.16
GMt(solid)	ft	5.51		5.70
FS Adjustment	ft	0.16		1.15
GMt Upright	ft	5.35		4.55
GM @ Equil	ft			4.55

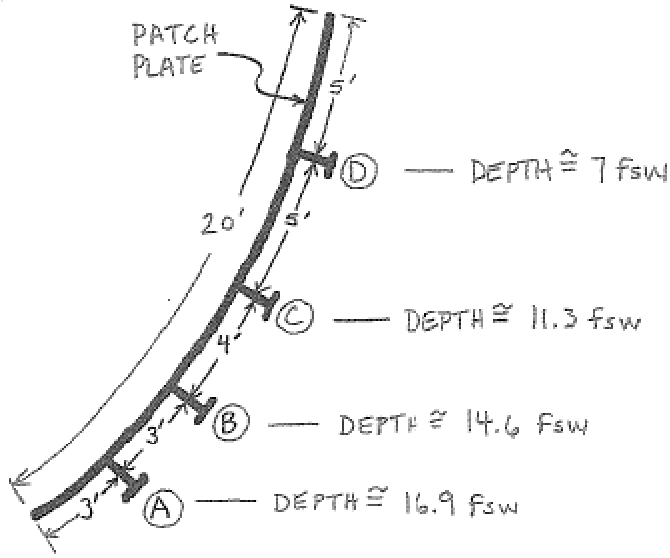
Appendix B – FITZGERALD Dewatering and Weight Change Steps

	Model			**Actual**		
Condition Change	**Trim (ft) by bow**	**List (deg)**	**Draft Fwd (ft)**	**Trim (ft) by bow**	**List (deg)**	**Draft Fwd (ft)**
Docking Requirement	< 2	< 1	20.2 – 21.4	< 2	< 1	20.2 – 21.4
Dewater AMR1	5.2	1.2	25.2	5.7	1.5	25.8
Fill Port Potable Water Tanks	5.2	0.8	25.2	5.7	1.2	25.8
Ammunition Offload	5.0	0.8	24.5	5.2	0.8	24.9
Defuel (aft, fwd, mid)	5.4	0.6	25.0	5.4	0.5	25.1
Dewater TG 3, 4	5.9	0.1	24.6	5.5	0.2	24.3
Partial Dewater TG 1, 2, 5, 6 and Remove Anchors and Chain	5.1	0.2	23.9	4.0	0.3	23.0
Dewater Sonar Dome and Flooded Compartments	0.3	0.2	20.4	0.3	1.2	20.1

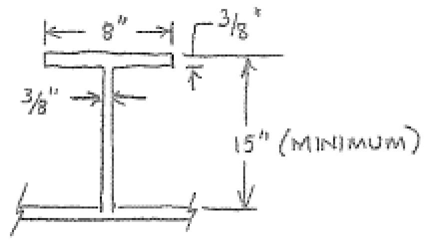
Appendix C – FITZGERALD Patch and Stiffener Design



USS FITZGERALD (DDG 62)
WELD ON PATCH & STIFFENER DESIGN
FOR 3/8" THICK MATERIAL



(A) = (B) = (C) = (D) =



DH 36 STEEL @ 51 ksi yield

σ_{MAX} = 41.7 ksi (for (A))

NOTE: CALCS DONE FOR BEAM LENGTH OF 24'

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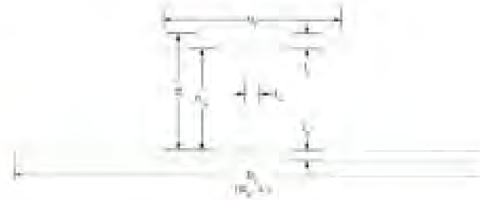
BEAM CALCULATIONS FOR STIFFENER A

Stiffener w/ attached effective plating Bending due to uniform lateral load (pressure)	
* Assumes simply-supported BCs (i.e. L* = L)	
E (elastic modulus) (lbf/in2)	29,000,000
hw (web height) (in)	15.000
tw (web thickness) (in)	0.375
bf (flange breadth) (in)	8.000
tf (flange thickness) (in)	0.375
bp, B (plate breadth, stiffener spacing) (in)	38.00
tp (plate thickness) (in)	0.375
L (stiffener length) (in)	288.00
Gamma (water density) (lbf/ft3)	65.0
D (water depth) (ft)	18.9



Effective breadth of attached plating (be, λ) 38.00

Cross-Section Member	breadth/height b, h (in)	thickness t (in)	sect. area a (in²)	centroid y (in)	1st moment (BL) ay (in³)	2nd moment (BL) ay² (in⁴)	2nd moment (local) I_o (in⁴)
Stiffener Flange	8.00	0.3750	3.000	15.563	46.688	726.574	0.035
Stiffener Web	15.00	0.3750	5.625	7.875	44.297	348.838	105.469
Plating	36.00	0.3750	13.500	0.188	2.531	0.475	0.158
		Sums =	22.125		93.516	1075.887	105.662

Aeff (effective area)	22.125	in²	Total Height	15.75	in
ybar (height of NA)	4.227	in	Ztop (effective Z to top of flange)	68.23	in³
I (effective 2nd Moment (moment of inertia) about NA)	788.29	in⁴	Zbot (effective Z to bottom of plate)	186.03	in³

Maximum Stiffener Bending Stress	
w (pressure distribution) (lbf/in)	274.14
Mw (bending moment due to pressure) (in-lbf)	2,842,258
δw (max. deflection due to pressure) (in)	1.08

If STIFFENERS are on PRESSURE SIDE of plate:	
σflange (maximum stress at stiffener flange) (lbf/in2)	-41,654

(+ is tensile, - is compressive)

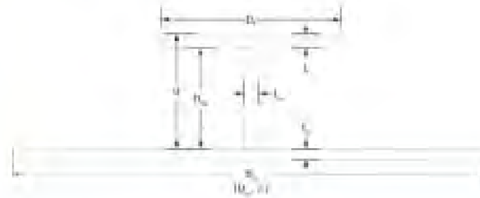
If STIFFENERS are on NON-PRESSURE SIDE of plate:	
σflange (maximum stress at stiffener flange) (lbf/in2)	41,654

S. POSEY (SEA 00C54)

29 JUNE 2017

BEAM CALCULATIONS FOR STIFFENER B

Stiffener w/ attached effective plating	
Bending due to uniform lateral load (pressure)	
* Assumes simply-supported BCs (i.e. L* = L)	
E (elastic modulus) (lbf/in2)	29,000,000
hw (web height) (in)	15.000
tw (web thickness) (in)	0.375
bf (flange breadth) (in)	8.000
tf (flange thickness) (in)	0.375
bp, s (plate breadth, stiffener spacing) (in)	42.00
tp (plate thickness) (in)	0.375
L (stiffener length) (in)	288.00
Gamma (water density) (lbf/ft3)	65.0
D (water depth) (ft)	14.6



Effective breadth of attached plating (be, L) 42.00

Cross-Section Member	breadth/height s, h (in)	thickness t (in)	net area a (in²)	centroid y (in)	1st moment (BL) ay (in³)	2nd moment (BL) ay² (in⁴)	2nd moment (local) i₀ (in⁴)
Stiffener Flange	8.00	0.3750	3.000	15.563	46.688	726.574	0.035
Stiffener Web	15.00	0.3750	5.625	7.875	44.297	348.838	105.469
Plating	42.00	0.3750	15.750	0.188	2.953	0.554	0.185
		Sums =	24.375		93.938	1075.966	105.688

Aeff (effective area)	24.375	in^2
ybar (height of NA)	3.854	in
I (effective 2nd Moment (moment of inertia) about NA)	819.63	in^4
Total Height	15.75	in
Ztop (effective Z to top of flange)	68.30	in^3
Zbot (effective Z to bottom of plate)	212.68	in^3

Maximum Stiffener Bending Stress	
w (pressure distribution) (lbf/in)	276.22
Mw (bending moment due to pressure) (in-lbf)	2,863,879
δw (max. deflection due to pressure) (in)	1.04

If STIFFENERS are on PRESSURE SIDE of plate:	
σflange (maximum stress at stiffener flange) (lbf/in2)	-41,586

(+ is tensile, - is compressive)

If STIFFENERS are on NON-PRESSURE SIDE of plate:	
σflange (maximum stress at stiffener flange) (lbf/in2)	41,586

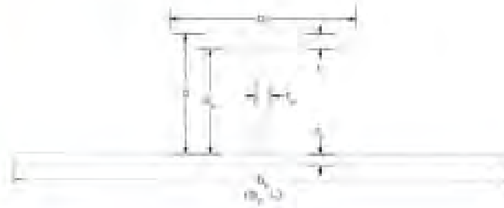
S. POSEY (SEA 00C54)

29 JUNE 2017

BEAM CALCULATIONS FOR STIFFENER C

Stiffener w/ attached effective plating	
Bending due to uniform lateral load (pressure)	
* Assumes simply-supported BCs (i.e. L* = L)	
E (elastic modulus) (lbf/in2)	29,000,000
hw (web height) (in)	15.000
tw (web thickness) (in)	0.375
bf (flange breadth) (in)	8.000
tf (flange thickness) (in)	0.375
bp, B (plate breadth, stiffener spacing) (in)	54.00
tp (plate thickness) (in)	0.375
L (stiffener length) (in)	288.00
Gamma (water density) (lb/ft3)	65.0
D (water depth) (ft)	11.5

Effective breadth of attached plating (be, λ) 54.00



Cross-Section Member	breadth/height b, h (in)	thickness t (in)	net area A (in²)	centroid y (in)	1st moment (BL) Ay (in³)	2nd moment (BL) Ay² (in⁴)	2nd moment (local) I₀ (in⁴)
Stiffener Flange	8.00	0.3750	3.000	15.563	46.688	726.574	0.035
Stiffener Web	15.00	0.3750	5.625	7.875	44.297	348.838	105.469
Plating	54.00	0.3750	20.250	0.188	3.797	0.712	0.237
		Sums =	28.875		94.781	1076.124	105.741

Aeff (effective area)	28.875	in^2
ybar (height of NA)	3.282	in
I (effective 2nd Moment (moment of inertia)about NA)	870.75	in^4
Total Height	15.75	in
Ztop (effective Z to top of flange)	69.84	in^3
Zbot (effective Z to bottom of plate)	265.27	in^3

Maximum Stiffener Bending Stress	
w (pressure distribution) (lbf/in)	274.71
Mw (bending moment due to pressure) (in-lbf)	2,848,154
δw (max. deflection due to pressure) (in)	0.97

If STIFFENERS are on PRESSURE SIDE of plate:	
σflange (maximum stress at stiffener flange) (lbf/in2)	-40,780

(+ is tensile, - is compressive)

If STIFFENERS are on NON-PRESSURE SIDE of plate:	
σflange (maximum stress at stiffener flange) (lbf/in2)	40,780

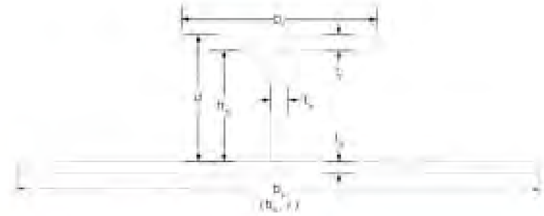
S. POSEY (SEA 00C54) 29 JUNE 2017

BEAM CALCULATIONS FOR STIFFENER D

Stiffener w/ attached effective plating
Bending due to uniform lateral load (pressure)
*** Assumes simply-supported BCs (i.e. L* = L)**

E (elastic modulus) (lbf/in2)	29,000,000
hw (web height) (in)	15.000
tw (web thickness) (in)	0.375
bf (flange breadth) (in)	8.000
tf (flange thickness) (in)	0.375
bp, B (plate breadth, stiffener spacing) (in)	54.00
tp (plate thickness) (in)	0.375
L (stiffener length) (in)	288.00
Gamma (water density) (lbf/ft3)	65.0
D (water depth) (ft)	7.0

Effective breadth of attached plating (be, λ) 54.00



Cross-Section Member	breadth/height b, h (in)	thickness t (in)	net area a (in²)	centroid y (in)	1st moment (BL) ay (in³)	2nd moment (BL) ay² (in⁴)	2nd moment (local) i_o (in⁴)
Stiffener Flange	8.00	0.3750	3.000	15.563	46.688	726.574	0.035
Stiffener Web	15.00	0.3750	5.625	7.875	44.297	348.838	105.469
Plating	54.00	0.3750	20.250	0.188	3.797	0.712	0.237
		Sums =	28.875		94.781	1076.124	105.741

Aeff (effective area)	28.875	in²	Total Height	15.75	in
ybar (height of NA)	3.282	in	Ztop (effective Z to top of flange)	69.84	in³
I (effective 2nd Moment (moment of inertia) about NA)	870.75	in⁴	Zbot (effective Z to bottom of plate)	265.27	in³

Maximum Stiffener Bending Stress

w (pressure distribution) (lbf/in)	169.89
Mw (bending moment due to pressure) (in-lbf)	1,761,458
δw (max. deflection due to pressure) (in)	0.60

If STIFFENERS are on PRESSURE SIDE of plate:

σflange (maximum stress at stiffener flange) (lbf/in2)	-25,221

(+ is tensile, - is compressive)

If STIFFENERS are on NON-PRESSURE SIDE of plate:

σflange (maximum stress at stiffener flange) (lbf/in2)	25,221

S. POSEY (SEA 00C54)

29 JUNE 2017

Appendix D – USS FITZGERALD Salvage Emergency Response Bill

SALVAGE EMERGENCY RESPONSE BILL

Stations

Bridge (w/ POSSE Computer)
LCDR Emge

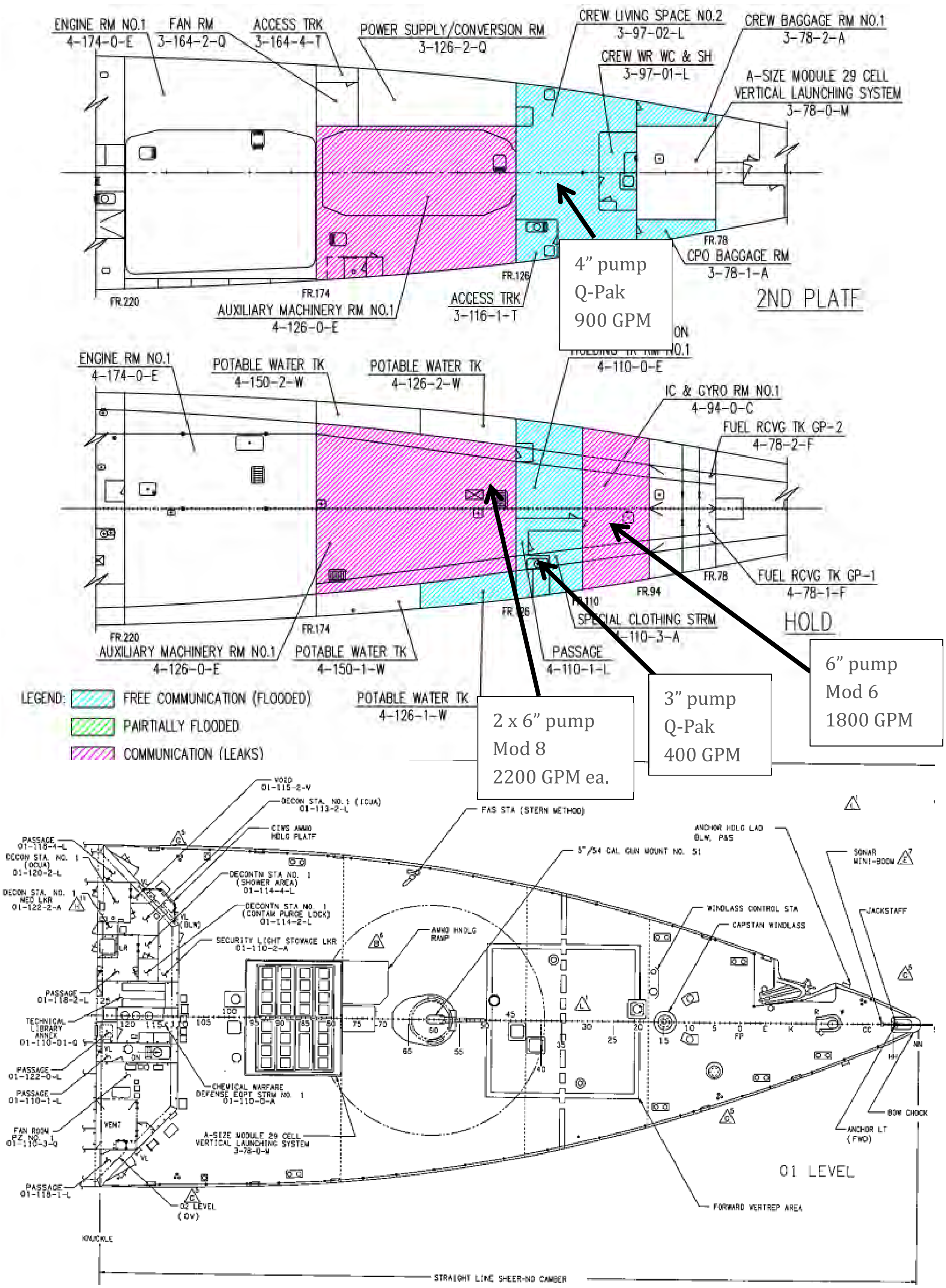
Roving
NDCS Parsons
NDCM Allison

Pump	Capacity	Watchstander #1	Watchstander #2
Mod 8	2200 GPM	ESSM GPC Tech	N/A
Mod 8	2200 GPM	ESSM GPC Tech	N/A
Mod 6	1800 GPM	MM2 Mazurmurray	ND2 Ras
Q-Pak	1300 GPM	ND2 Penner	ND2 Martinez

Space	Watchstander #1	Watchstander #2
AMR 1	ND2 Reese	ND3 Holbrook
Berthing 1	ND2 Mostak	NDSA Brown
Berthing 2	ND2 Mitchell	ND2 Villaloboz
IC & Gyro Rm No. 1	NDC Lutz	ND2 Guerrero

Ready Response Team (Staged in CPO Mess)
ND1 Riggs
ND1 Russo
ND1 Wilmot
ND2 Skonieski
ND2 Fox

Diving Medical Technician (Medical Gear on Forecastle)
HM1 Miller



ENGINE RM NO.1
4-174-0-E
FAN RM
3-164-2-Q
ACCESS TRK
3-164-4-T
POWER SUPPLY/CONVERSION RM
3-126-2-Q
CREW LIVING SPACE NO.2
3-97-02-L
CREW BAGGAGE RM NO.1
3-78-2-A
CREW WR WC & SH
3-97-01-L
A-SIZE MODULE 29 CELL
VERTICAL LAUNCHING SYSTEM
3-78-0-M
FR.78
CPO BAGGAGE RM
3-78-1-A
FR.126
ACCESS TRK
3-116-1-T
FR.174
AUXILIARY MACHINERY RM NO.1
4-126-0-E
FR.220
2ND PLATF
4" pump
Q-Pak
900 GPM
4-110-0-E
ENGINE RM NO.1
4-174-0-E
POTABLE WATER TK
4-150-2-W
POTABLE WATER TK
4-126-2-W
IC & GYRO RM NO.1
4-94-0-C
FUEL RCVG TK GP-2
4-78-2-F
FUEL RCVG TK GP-1
4-78-1-F
FR.78
FR.94
FR.110
SPECIAL CLOTHING STRM
4-110-3-A
HOLD
PASSAGE
4-110-1-L
FR.220
FR.174
AUXILIARY MACHINERY RM NO.1
4-126-0-E
POTABLE WATER TK
4-150-1-W
POTABLE WATER TK
4-126-1-W
LEGEND:
FREE COMMUNICATION (FLOODED)
PARTIALLY FLOODED
COMMUNICATION (LEAKS)
2 x 6" pump
Mod 8
2200 GPM ea.
3" pump
Q-Pak
400 GPM
6" pump
Mod 6
1800 GPM
FAS STA (STERN METHOD)
5"/54 CAL GUN MOUNT NO. 51
WINDLASS CONTROL STA
CAPSTAN WINDLASS
JACKSTAFF
BOW CHOCK
FORWARD VERTREP AREA
01 LEVEL
KNUCKLE
STRAIGHT LINE SHEER-NO CAMBER

Appendix E: USS Fitzgerald Transport Manual

Discussion

The transport manual required by contract to be created by Dockwise was delivered in several separate pieces. First, the Cargo Securing Manual (0030270-TRS-CSM_Rev 0, dated 03 Nov 2017, attached here in its entirety) includes the details of the loading, voyage, offload and pertinent calculations. Second, the drawings (DW-0030270, Rev 0 – 3 depending on the drawing number, dated Nov & Dec 2017, excerpts attached here) show the cribbage/block design, catcher design, guide post placement and line handling plan. Third, the Float-On Ballast Plan (0030270-TRS-ER-02, Rev 0, dated 3 Nov 2017, excerpt attached here). Lastly, the "HTV Steel Grillage Support Structures for USS Fitzgerald" (0030270-TRS-ER-01, Rev 0, dated 2 Nov 2017, not attached here) is a detailed engineering analysis of the grillage design.

Plan Development

The documentation presented here represents the final version before on-load. During the initial plan reviews, several changes were incorporated.

Based on the experience with USS John S McCain hull cracking on her voyage, more blocks were added than the original plan and were moved in-line USS Fitzgerald's frames.

Dockwise determined a longitudinal acceleration from experience and expected sea states. The heavy lift pointed out that this acceleration does not meet the requirements in the US Navy Tow Manual, Chapter 8, Table 8-4. Dockwise then added additional longitudinal support using Bent Plates (see drawing 003270-003). NAVSEA 00C prefers the use of Strong Boxes for this purpose, but because of the additional blocks, additional Strong Boxes would not fit.

The final block heights listed by Dockwise in the drawings are not the heights used during onload. Refer to Section 5-5.1 for a discussion of how the block heights were adjusted to the proper height.

Lastly, when reviewing the engineering report ER-01 and Drawing 0030270-002, the HLPO noted that Dockwise was to "ensure that there is sufficient clearance between the hull of Fitzgerald and the grillage." Dockwise responded "There is sufficient clearance between the grillage and hull of the USS Fitzgerald." During the onload, Dockwise's statement was proven incorrect when the grillage punctured the hull.

The following documents are included in this appendix section.

Cargo Securing Manual

Float-On Ballast Plan (partial)

Drawings (partial)

Transport Manual Review Comments

DOCKWISE SHIPPING B.V.

CARGO SECURING MANUAL

DOCKWISE

TRANSPORT OF THE USS FITZGERALD
ONBOARD OF THE TRANSSHELF
FROM YOKOSUKA (JAPAN)
TO PASCAGOULA (USA)

CONTRACT NR: 0030270

DOCKWISE DOC. NR: 0030270-TRS-CSM
CLIENT DOC. NR: -

REVISION: 0

CLIENT: MILITARY SEALIFT COMMAND

Rev.	Date	Originator		Disciplinary Check		Inter Disciplinary		Approval DW	
0	03/NOV/17	A. Santalla Diaz Transport Engineer	AS	N. Vernes Senior Transport Engineer	NV	S. de Jong Lead Superintendent	SdJ	R. Postma Lead Transport Engineer	RP
A	12/OCT/17	A. Santalla Diaz Transport Engineer		N. Vernes Senior Transport Engineer		S. de Jong Lead Superintendent		R. Postma Lead Transport Engineer	

REVISION LOG

Revision	Date	Reason for new revision	Applicable section(s)
A	12/Oct/17	Internal Issue For Review and Comment (IFRC)	All
0	03/Nov/17	Issue For Transportation	All

DISTRIBUTION MATRIX

External distribution	Team	Volumes	Media E: Electronic H: Hardcopy
Project Manager	CLIENT	1	E
Internal distribution	**Team**	**Volumes**	**Media** **E: Electronic** **H: Hardcopy**
Project Manager	DW	1	E
Project Superintendent	DW	1	H
Dockwise HTV	DW	1	H
Transport Engineering	DW	1	E

CONTENTS

1. GENERAL

1.1 Project scope

The USS Fitzgerald of Military Sealift Command needs to be dry transported. Military Sealift Command has contracted Patriot Shipping LLC to transport this vessel on the Transshelf, operated by Dockwise. The transport shall be done by the Transshelf and starts around 25-NOV-2017. The USS Fitzgerald will be loaded in Yokosuka (Japan) using the float-on method. After the voyage, via Panama Canal, it will be discharged using the float-off method in Pascagoula (USA). The USS Fitzgerald shall be placed onboard longitudinally with the bow facing aft. See the stowage plan drawings DW-0030270-001 for the global position of the USS Fitzgerald onboard the HTV.

1.2 Document scope

This document includes technical information for the transport of the USS Fitzgerald from Yokosuka (Japan) to Pascagoula (USA) onboard of the Transshelf. This document is used as a guideline for the voyage, loading- and discharge operation.
The calculations/drawings contained in this document are based on the currently available cargo properties. Neither Dockwise Shipping B.V. nor any of its corporate affiliates or employees of these corporate affiliates warrants the accuracy of these cargo properties.

Note - all measurements in this booklet are metric unless stated otherwise.

1.3 Abbreviations

CoG	Center of Gravity
CSM	Cargo Securing Manual
DW	Dockwise Shipping B.V.
GWS	Global Wave Statistics
HTV	Heavy Transport Vessel
hr	Hour
kn	Knot
LCG	Longitudinal Center of Gravity
m	Meter
MDR	Master Document Register
mm	Millimeter
MWS	Marine Warranty Surveyor
NPR	Noon Position Report
OEP	Operational Execution Plan
PS	Port Side
s	Second
SB	StarBoard side
SoW	Scope of Work
SPOS	Ship Performance Optimization System
TCG	Transverse Center of gravity
VCG	Vertical Center of Gravity

1.4 Reference Documents

[ref. 1]	Dockwise Engineering Guidelines and Criteria	--
[ref. 2]	Master Document Register[1]	0030270-MDR
[ref. 3]	Operational Execution Plan	0030270-TRS-OEP
[ref. 4]	Global Wave Statistics	--

[1] The MDR shows all the documents issued by the client and by Dockwise Shipping B.V. in preparation of this contract. The latest revision and issue date of each document is recorded in this register.

1.5 Calculation methods

All calculations for this transport are executed according to [ref. 1]. A copy of this document can be obtained by contacting the Dockwise head office in Papendrecht, The Netherlands.

1.6 Software description

The following software packages are used for the preparation of the transport of the USS Fitzgerald .

- DOSUITE version 5.3.1.0: In-house developed software for the assessment of heavy transports.;

- GHS version 14.92: A general-purpose hydrostatics program to perform stability calculations, which includes free-surface effects within the HTV's tanks. Global HTV strength calculations are executed with the help of this program as well.

- ShipMo: Hydrodynamics program for the analysis of ship motions. It includes both radiation-diffraction calculations based on strip theory, and viscous roll damping.

2. PARTICULARS OF VESSEL AND CARGO

2.1 Particulars of the vessel

The following table shows the vessel particulars of the HTV Transshelf.

PRINCIPAL CHARACTERISTICS:

Length o.a.		173.60	m
Length b.p.		162.00	m
Breadth		40.00	m
Depth		12.00	m
Draft submerged		22.00	m
Summer draft (B)		8.80	m
Summer draft (B-60)		9.07	m
Summer draft (B-100)		9.25	m
GRT		26,890	-
NRT		8,067	-
Deadweight		33,700	t
Deck space		40 x 132	m
Deck load		19-25	t/m^2
Anchors	forward	2 * 23.3	t
	aft	1 * 10	t
Chains	forward	2 * 385 m * 137	mm
Wires	aft	1 * 900 m * 77	mm

COMMUNICATION EQUIPMENT:

Inmarsat B and C (telex/telephone/fax)
SSB radio telephony
VHF radio telephony
Weather facsimile
NAVTEX receiver
GMDSS
SPOS[1)]
Octopus[2)]

NAVIGATION EQUIPMENT:

Two radars, one ARPA coupled
One GPS navigator
Echo sounders fore and aft
One Gyro compass
Magnetic log

BALLASTING:

Three main ballast pumps 500m^3/hr at 35m head
Two main fire pumps 100m^3/hr at 90m head
One emergency fire pump 60m^3/hr at 90m head
Four ballast/deballast compressors 3000 m^3/hr at 2 atg
One emergency deballast compressor 3000 m^3/hr at 2 atg

PROPULSION/MANOEUVRING:

Two Wärtsilä-Vasa 18V32 diesel engines of 6,750 kW each, driving two 4-bladed c.p. propellers.
Two mariner rudders
Two bow thrusters 500 kW each

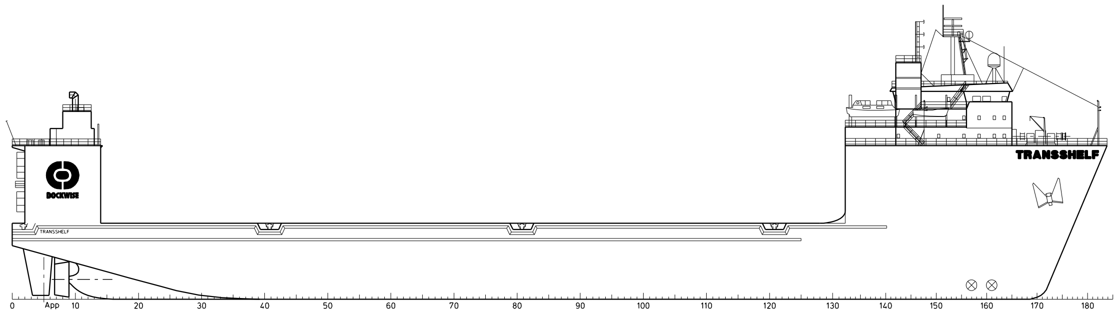
AUXILIARY ENGINES:

Two shaft gen. each of AC 840 kW, 380 V, 50 Hz
Two diesel gen each of AC 600 kW, 380V, 50 Hz
One cargo diesel generator of AC 292 kW, 380V, 50 Hz
One emergency diesel generator of AC 150 kW, 380 V, 50 Hz

CARGO HANDLING

Hydraulic winch	4 * 10	t
Store crane	1 * 7.5 t x 14	m

[1)] SPOS = Ship Performance Optimisation System (onboard weather display and voyage planning system by Meteo Consult)
[2)] OCTOPUS = Octopus Onboard System, (ship motion monitoring and decision support system by Amarcon)



2.2 Particulars of the cargo

The USS Fitzgerald is operated / owned by USS Navy. The USS Fitzgerald has the Dockwise cargo number 64354. The following are the main particulars of the cargo as per latest information supplied by the client.:

Weight		8100	[ton]
Longitudinal center of gravity	(measured from stern fr.0 – Fwd+)	-70.720	[m]
Transverse center of gravity	(measured from centerline – PS+)	0.000	[m]
Vertical center of gravity	(measured from baseline – Up+)	7.720	[m]
Length overall		154.000	[m]
Length between perpendiculars		142.000	[m]
Width		20.300	[m]
Width overall		20.300	[m]
Depth	(measured from baseline	11.100	[m]
Total height	(measured from baseline)	52.000	[m]
Trim	(in loading condition)	0.04 Aft	[deg]
Heel	(in loading condition)	0.0	[deg]
Protrusion of sonar dome		3.029	[m]
<u>Patched (Loading Draft)</u>			
Loading draft Aft Ship	(including protrusions)	6.100	[m]

The Dockwise cargo drawings DW-0030270-009 have been used for the preparation of this manual and are based on the client drawings as listed in [ref. 2].

Figure 2.1: 3D representation of the USS Fitzgerald

3. LOADING OPERATION

This chapter describes the preparation required prior to the loading operation and the execution of the loading operation.

3.1 Description of the proposed loading location

The USS Fitzgerald will be loaded in Yokosuka (Japan). Details of the proposed loading location are given in Attachment 1.

3.2 Preparation of the HTV

The HTV preparations include, but are not limited to;

- HTV's deck to be prepared in accordance with the cribbing plan drawing DW-0030270-002. The cribbing is a combination of: hard, soft and plywood with a total height of 575 [mm]. On grillage the combination will be: steel construction, soft wood and plywood with total height of 575 [mm];
- 2 guideposts to be installed in order to position the cargo correctly, in accordance with drawing DW-0030270-002 ;
- All equipment that is necessary for the loading operation to be checked by the vessel crew prior to the HTV's arrival in Yokosuka (Japan). The resources required for the transport are summarized in Attachment 4;

3.3 Preparation of the cargo

The cargo must be prepared as described in the contract. The preparations include, but are not limited to:

- Catcher to be installed at the location as indicated in drawing DW-0030270-004, in order to position the USS Fitzgerald correctly on the deck;
- The USS Fitzgerald to be ballasted as per loading condition (as per paragraph 2.2)
- All cranes and lifting equipment, if present, to be secured and stowed in transit condition;
- All anchors, if present, need to be fastened or rigidly connected to the cargo;
- Sufficient connection points (pad eyes, bollards or similar) to be present at the cargo's bow and stern, in order to be able to connect tugger-wires to the USS Fitzgerald ;

Furthermore Military Sealift Command must confirm that:

- Particulars of the cargo as stated in paragraph 2.2 are consistent with actual condition of the USS Fitzgerald ;
- Drawings of the cargo (in MDR) are, in all respects, consistent with the actual condition of the USS Fitzgerald ;
- Any protruding items, other than as listed in paragraph 2.2, are absent;
- Position of the guideposts will not result in any clash with cargo appendages.
- Removal of propeller blades which are protruding below the baseline.
- Repairing damaged area to have a watertight hull.

3.4 Weather conditions and limitations for loading operations

For the loading operation, favorable weather conditions are required. The operational limits are not strict limits and are subject to the interpretation of the Superintendent and the Master of the HTV. Also, the actual relative motion of the cargo with respect to the HTV is to be considered before the loading operation commences.

Guidelines for the limiting criteria are:

- Maximum wave height 0.5 [m]
- Maximum swell 0.3 [m]
- Maximum wave/swell period 5 – 7 [s]
- Maximum wind speed 15 [kn]
- Maximum current speed 0.5 [kn]

3.5 Loading procedure

Loading of the USS Fitzgerald will be carried out by means of the float-on method.

3.5.1 Loading meeting

Prior to the loading operation, a meeting with all relevant parties, if available, to be held in which at least the following must be discussed:

- Loading schedule & sequence;
- Responsibilities;
- Communication lines;
- Loading specific issues;
- Safety issues.

3.5.2 Submerging of the HTV

It is the HTV crew's responsibility to prepare a ballast plan for submerging, with the help of GHS software. After approval of the deck preparations by the attending Marine Warranty Surveyor, the HTV will ballast down to a draft of approximately 19.80 [m], achieving 6.60 [m] water above the cribbing. A water depth of 20.80 [m] will be required, see table below:

Required Water Depth	Aft	
Cargo draft (excluding protrusions)	6.10	[m]
Clearance	0.50	[m]
Cribbing side block	1.20	[m]
Vessel depth	12.00	[m]
Vessel loading draft	19.80	[m]
Under keel clearance	1.00	[m]
Required water depth	20.80	[m]

Table 3-1: Required water depth

3.5.3 Go / No Go moment

Final assessment of the environmental condition is to be performed by the Superintendent, the Master of the HTV and US Navy representative, after which is decided whether or not the cargo will be loaded.

3.5.4 *Loading of the cargo*

The following describes the loading steps as shown in drawing DW-0030270-005:

1. USS Fitzgerald to be brought close to stern the HTV with assistance of tugs.
2. First tugger-wire to be connected to USS Fitzgerald. Tugger-lines/wires will be brought to the cargo by dedicated line handlers. Military Sealift Command needs to arrange line handlers in order to connect these tugger-lines/wires.
3. Once all tugger-lines/wires are connected to the cargo, positioning of USS Fitzgerald to the correct position above the HTV’s deck can commence.
4. Once USS Fitzgerald is in position and the position is conformed by the divers, the de-ballast operation can start. Stability of the HTV during submerging/emerging to be positive at all times.
5. Once the cargo is on the cribbing, the tugs to be disconnected (at Superintendent's and/or Master's discretion). Disconnection of tugs, use of extra tugs, or the use of tugs on standby will be at the discretion of the Superintendent and the Master of the HTV, depending on local circumstances.
6. Sea fastening can be brought into position as soon as the deck is dry, but welding cannot start until the sailing draft has been reached.

4. VOYAGE

Attachment 2 lists all the results of the voyage calculations performed for the transit from Yokosuka (Japan) to Pascagoula (USA) via Panama Canal.

4.1 Route

The route as shown in Attachment 2 is used as base for the voyage calculations. The Master is to avoid adverse conditions and take all required precautions for sheltering or deviation from the intended track, when weather conditions are endangering the HTV's safe maneuverability and/or when environmental conditions are expected to reach the maximum allowable conditions as listed in paragraph 4.2.

4.2 Environmental conditions

The following environmental design conditions, based on a departure date of 25-Nov-2017, have been assessed using Dockwise's in-house wind and wave database.

- Significant wave height: 5.99 [m]
- Zero Upcrossing wave period: 7.7 to 10.7 [s]
- 1-hour wind speed: 60.00 [kn] (client requirement)

The HTV is equipped with SPOS[2], which offers onboard weather routing. The HTV will receive weather and routing information on a regular basis. In the areas 29, 42, 52, 108 and 109 (according to world area definitions as used in [ref. 4]) the weather routing is taken into account for the design wave height calculation, according to [ref. 1].

4.3 HTV ballast condition

The HTV ballast condition is designed, taking the following into account:

- HTV stability must be such that stability requirements are passed;
- The draft does not exceed the HTV summer load line draft;
- Global bending moment and shear force of the HTV are within allowable limits;
- The ballast condition is optimized in order to minimize the HTV's accelerations.

4.4 HTV stability

The HTV stability calculation is provided in Attachment 2. The results of the calculation show that the stability requirements are passed.

4.5 HTV strength

The global HTV longitudinal strength calculations are provided in Attachment 2. The shear force and global bending moment are written as a percentage of the maximum allowed value in sailing condition. The results show that the shear force and global bending moment are within the allowable values in sailing condition.

[2] The SPOS software offers the staff on board a simple but powerful tool in taking the decisions with regard to voyage planning in relation to weather conditions and display the weather forecast. Detailed charts with wind, sea and swell forecasts together with hurricane/typhoon forecasts and actual ice information are presented in SPOS.
In addition Routeguard is used. Meteoconsult as a meteorological office prepares a set of weather information for standards ocean regions. This information includes wind and wave forecasts but also tropical storm and ice information. Via e-mail, the weather information is sent to the vessel twice a day.

4.6 Motion response

The natural roll period of the total system is 8.88 [s].

The following maximum design accelerations in the center of gravity of the cargo have been computed using the environmental conditions mentioned in paragraph 4.2:

	Maximum Acceleration		
	Longitudinal [g]	Transverse [g]	Vertical [g]
USS Fitzgerald CoG	0.073	0.492	0.182

Table 4-1: Maximum accelerations

Maximum roll angle	20.8 deg	Maximum roll acceleration	0.1414 rad / s²
Maximum pitch angle	5.1 deg	Maximum pitch acceleration	0.0342 rad / s²

- The accelerations above are derived from four sea-states. These are maximum values and thus do not necessarily occur at the same time.
- It is the responsibility of the client/cargo owner to ensure that the cargo is capable of withstanding these accelerations and that those items within or connected to the cargo are properly secured.

4.7 Support pressure

Dockwise accepts a maximum support pressure for soft wood of 20 [kg/cm^2], as described in [ref. 1]. The results of the support pressure calculations are given in Attachment 2.

	Maximum Support Pressure [kg/cm^2]
Static	4.61
Static + Dynamic	19.71

Table 4-2: Support pressures

4.8 Seafastening

Seafastening will be installed as per DW-0030270-003. The results of the seafastening calculations are given in Attachment 2. The design load for each type of seafastening is:

- Bracing capacity = 200 [ton]
- Strongbox (Push) capacity = 200 [ton]

The extreme design forces and total capacity available are summarized below:

	PS [ton]	SB [ton]	Aft [ton]	Forward [ton]
Total capacity available	3979	3979	400	400
Extreme design force	3959	3959	283	283

Table 4-3: Extreme design force and seafastening capacity

4.9 Overturning moment calculation

The overturning moment of the cargo as a result of inertia- and wind loads acting on the cargo is calculated. The results of this calculation is given in Attachment 2 and shows that uplift will not occur.

5. DISCHARGE OPERATION

This chapter describes the preparation required before the discharge operation commences and how the discharge operation will be carried out.

5.1 Description of the proposed discharge location

The USS Fitzgerald to be discharged in Pascagoula (USA). Details of the discharge location are given in Attachment 3.

5.2 Preparation of the HTV

The HTV preparations include, but are not limited to;

- All equipment that is necessary for the discharge operation to be prepared and checked before the HTV's arrival in Pascagoula (USA).
- All seafastenings to be cut loose from the HTV's deck and moved sufficient distance away from the USS Fitzgerald .

5.3 Weather conditions and limitations for discharge operation

For the discharge operation, favorable weather conditions are required. The operational limits are not strict limits and are subject to the interpretation of the Superintendent and the Master of the HTV. Also, the actual relative motion of the cargo with respect to the HTV has to be considered before the actual discharge commences.

Guidelines for the limiting criteria are:

• Maximum wave height	0.5	[m]
• Maximum swell	0.3	[m]
• Maximum wave/swell period	5 – 7	[s]
• Maximum wind speed	15	[kn]

5.4 Discharge procedure

Discharging of the USS Fitzgerald will be carried out by means of the float-off method.

5.4.1 Discharge meeting

Prior to the discharge operation, a meeting with all relevant parties, if available, to be held in which at least the following must be discussed:

- Discharging schedule & sequence;
- Responsibilities;
- Communication lines;
- Discharging specific issues;
- Safety issues.

5.4.2 Submerging of the HTV

The HTV will ballast down until discharge draft, which is the same as the loading draft, as defined in paragraph 3.5.2.

5.4.3 Go / No Go moment

Final assessment of the environmental condition is to be performed by the Superintendent, the Master of the HTV and US Navy representative, after which is decided whether or not the cargo will be discharged.

5.4.4 Discharge of the cargo

The following describes the discharging steps, as shown in drawing DW-0030270-006:

1. Tugger-lines/wires to be connected by the crew members before arrival. HTV ballasted to float-off draft. The stability of the HTV during submerging/emerging to be positive at all times.
2. Tugs connected to the cargo, just prior to the floating draft has been reached.
3. USS Fitzgerald shifted towards aft of HTV by HTV's tugger-lines/wires and with assistance of tugs.
4. All HTV's tugger-lines/wires disconnected from the cargo by USS Navy's crew at the command of the Master of the HTV and/or attending Superintendent, cargo clear off HTV. The connection of tugs, use of extra tugs or the use of tugs on standby to be at the discretion of the master of the HTV and/or Superintendent, depending on local circumstances.

6. ATTACHMENTS

ATTACHMENT 1.	PROPOSED LOADING LOCATION	REV 0
ATTACHMENT 2.	VOYAGE CALCULATIONS	REV 0
ATTACHMENT 3.	PROPOSED DISCHARGE LOCATION	REV 0
ATTACHMENT 4.	OVERVIEW OF RESOURCES (HOLD)	REV 0

ATTACHMENT 1. PROPOSED LOADING LOCATION REV 0

The attached page shows information for a proposed loading location near Yokosuka (Japan).

by Yokosuka Ko Oki-no-Ne Lt Buoy
Mo(D) R.8s
Oki-no-Ne
by Uraga Suido Traffic Route No 7 Lt Buoy
by Uraga Suido Traffic Route Center No.6 Lt Buoy
Fl(2)G.6s
Iso.W.4s
Yokosuka Ko East Bkw North
Fl(2)G.8s 10 m 4 M
E Bkw
N Bkw
NE Bkw
Yokosuka Ko North East Bkw East
Fl R.3s 20 m 7 M
Tenjin Dashi
Public Quay
Nr 6
Nr 5
Nr UW
Fl.G.3s 4 M
Ota Ne
Azuma Shima

ATTACHMENT 2. VOYAGE CALCULATIONS REV 0

The attached pages show the voyage calculations, which contain the following:

- Loading condition
- Ballast tanks
- Stability curve
- Stability rules assessment
- Longitudinal strength
- Cargo information
- Vessel route
- Environmental conditions
- Wind loads and moments
- Radii of gyration
- Motion response calculation
- Support pressure calculation
- Extreme design forces
- Seafastening calculation

- Strongbox design calculation
- Overturning moment calculation

Loading Condition

Vessel	Transshelf
Description	USS Fitzgerald from Japan to USA
Condition	Sailing
Hydrostatic model	Voyage3 [Enquiry Model]

Condition summary

Draught APP	7.39 m	KMt	23.39 m	Sea Water	1.025 t/m3
Draught MID	7.38 m	KG	10.48 m	Weight/cm	60.11 t/cm
Draught FPP	7.38 m	F.S. Corr	0.23 m	MCT	657.29 t.m/cm
Trim	0.00/167.00 m	KG-Fluid	10.71 m		
Heel Angle	0.00	GM-Fluid	12.64 m		

Condition details

Item	Weight (t)	LCG (m)	TCG (m)	VCG (m)	FSM (t.m)
Light Ship+	14559.89	88.261	0.074	10.514	
Crew	10.00	147.000	0.000	24.300	
Stores	50.00	147.000	0.000	22.000	
Seafastening	110.00	81.000	0.000	12.500	
Dead Water	500.00	81.000	0.000	0.100	
Grillage	27.00	-2.838	0.000	12.239	
Casings					
Port Casing	140.00	1.000	15.600	20.150	
Starboard Casing	140.00	1.000	-15.600	20.150	
Cargo					
USS Fitzgerald	8100.00	48.133	0.000	20.295	
Tank Summary					
Sea Water	12776.84	72.539	-0.065	5.562	5593
Fuel Oil	2065.35	119.961	-0.233	2.739	2831
Gasoline	192.39	122.069	5.441	8.188	235
Lube Oil	55.91	85.848	4.176	8.527	17
Fresh Water	160.60	135.069	-6.920	17.551	84
Drain Water	2.00	24.817	4.700	0.803	2
Bilge Water	34.00	64.651	-1.839	4.534	150
Sewage	12.55	18.682	6.391	2.292	194
Totals	38936.53	76.032	-0.001	10.478	9105

Ballast Tanks

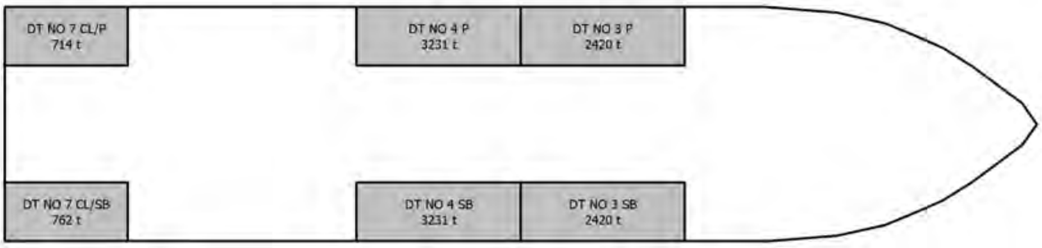
Vessel	Transshelf
Description	USS Fitzgerald from Japan to USA
Condition	Sailing
Hydrostatic model	Voyage3 [Enquiry Model]

Item Transshelf	Sound (m)	Fill %	Density (t/m)	Weight (t)	LCG (m)	TCG (m)	VCG (m)	FSM (t.m)
DT NO 3 SB	8.768	75.9	1.025	2419.7	96.866	-15.086	4.684	2082
DT NO 3 P	8.768	75.9	1.025	2419.7	96.866	15.086	4.684	2082
DT NO 4 SB	12.000	100.0	1.025	3230.9	69.000	-15.165	6.044	0
DT NO 4 P	24.300	100.0	1.025	3230.9	69.000	15.165	6.044	0
DT NO 7 CL/SB	8.553	71.6	1.025	761.8	8.173	-15.174	6.430	648
DT NO 7 CL/P	8.098	62.5	1.025	713.7	8.339	15.031	6.229	781
Totals				12776.9	72.540	-0.065	5.562	5593

Ballast Tanks

Upper Tanks

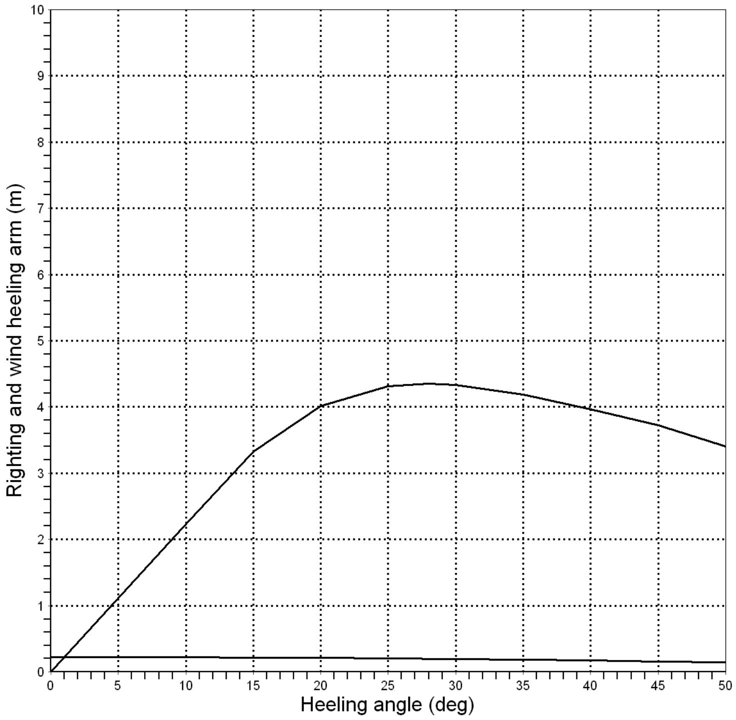
Main Deck Tanks



Stability Curve

Vessel	Transshelf
Description	USS Fitzgerald from Japan to USA
Condition	Sailing
Hydrostatic model	Voyage3 [Enquiry Model]

Stability curve (heel to starboard)



Angle of heel (deg)	Wind arm (m)	GZ (m)
0.0	0.222	0.001
5.0	0.221	1.115
10.0	0.219	2.230
15.0	0.214	3.328
20.0	0.209	4.009
25.0	0.201	4.314
30.0	0.192	4.331
35.0	0.182	4.187
40.0	0.170	3.969
45.0	0.157	3.722
50.0	0.143	3.406

Note: The Center of Gravity shown above is for the Fixed Weight of 23636.88 MT. As the tank load centers shift with heel and trim, the total Center of Gravity varies. The righting arms shown above include the effect of the C.G. variation.

The calculation uses a standard vessel model and cargo bouyancy.

DOCKWISE STABILITY (INTACT)

Description		Min/Max		Attained	
GM Upright	>	1.000	m.	12.677	P
Angle from abs 0 deg to RAzero	>	35.00	deg	90.58	P

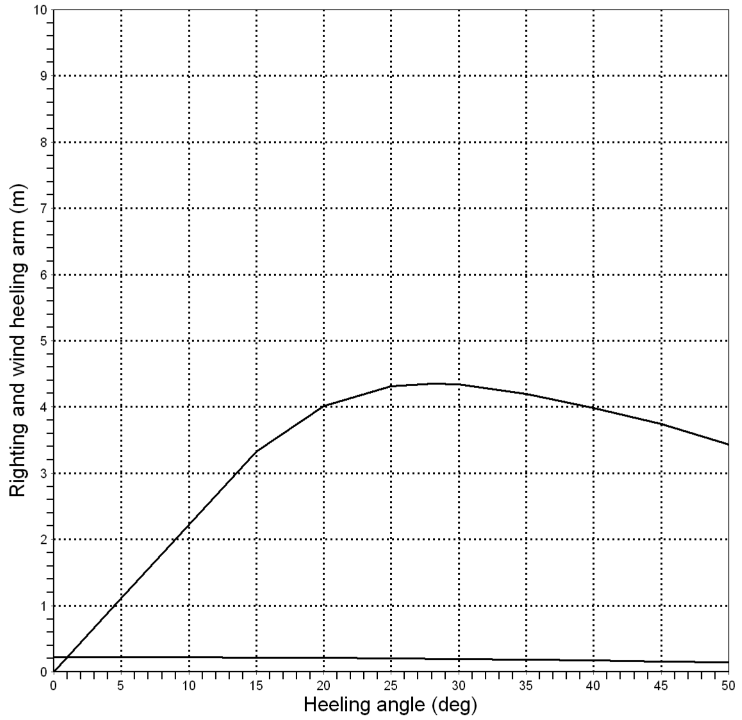
WINDARM CURVE TYPE: STANDARD
HEEL TO STARBOARD, EXTREME WIND SPEED 72.6KT, HEELING ARM@0 DEG 0.22M
DOCKWISE STABILITY (DYNAMIC)

Description		Min/Max		Attained	
GM Upright	>	1.000	m.	12.677	P
Absolute Angle at Equilibrium	<	10.00	deg	1.00	P
Angle from abs 0 deg to RAzero	>	10.00	deg	90.58	P
Absolute Area Ratio from abs 0 deg to RAzero	>	1.400		18.715	P

Stability Curve

Vessel	Transshelf
Description	USS Fitzgerald from Japan to USA
Condition	Sailing
Hydrostatic model	Voyage3 [Enquiry Model]

Stability curve (heel to portside)



Angle of heel (deg)	Wind arm (m)	GZ (m)
0.0	0.222	-0.001
5.0	0.221	1.112
10.0	0.219	2.228
15.0	0.214	3.326
20.0	0.209	4.009
25.0	0.201	4.318
30.0	0.192	4.338
35.0	0.182	4.198
40.0	0.170	3.982
45.0	0.157	3.740
50.0	0.143	3.430

Note: The Center of Gravity shown above is for the Fixed Weight of 23636.88 MT. As the tank load centers shift with heel and trim, the total Center of Gravity varies. The righting arms shown above include the effect of the C.G. variation.

The calculation uses a standard vessel model and cargo bouyancy.

DOCKWISE STABILITY (INTACT)

Description		Min/Max		Attained	
GM Upright	>	1.000	m.	12.677	P
Angle from abs 0 deg to RAzero	>	35.00	deg	90.75	P

WINDARM CURVE TYPE: STANDARD
HEEL TO PORTSIDE, EXTREME WIND SPEED 72.6KT, HEELING ARM@0 DEG 0.22M
DOCKWISE STABILITY (DYNAMIC)

Description		Min/Max		Attained	
GM Upright	>	1.000	m.	12.677	P
Absolute Angle at Equilibrium	<	10.00	deg	1.00	P
Angle from abs 0 deg to RAzero	>	10.00	deg	90.75	P
Absolute Area Ratio from abs 0 deg to RAzero	>	1.400		18.836	P

Stability Rules Assessment

Vessel	Transshelf
Description	USS Fitzgerald from Japan to USA
Condition	Sailing
Hydrostatic model	Voyage3 [Enquiry Model]

The calculation uses a standard vessel model and cargo bouyancy.

RULE EVALUATION - HEEL TO STARBOARD SIDE

IMO A.749 CH 4.5.6 INTACT STABILITY

Description		Min/Max		Attained	
Area from abs 0 deg to MaxRA (27.8)	>	0.0572	m.-Rad	1.3388	P
Area from abs 0 deg to abs 30 or RAzero	>	0.0550	m.-Rad	1.5057	P
Area from abs 30 deg to abs 40 or RAzero	>	0.0300	m.-Rad	0.7287	P
Area from abs 30 deg to Flood or RAzero	>	0.0300	m.-Rad	2.4360	P
Righting Arm at abs 30 deg or MaxRA	>	0.200	m.	4.331	P
Absolute Angle at MaxRA	>	15.00	deg	27.80	P
GM Upright	>	0.150	m.	12.677	P

IMO A749 CH.3.2 (WIND-STATIC)

Description		Min/Max		Attained	
Absolute Angle at Equilibrium	<	16.00	deg	0.38	P

IMO A749 CH.3.2 (WIND-GUST)

Description		Min/Max		Attained	
Res. Area Ratio from Roll to Flood or RAzero	>	1.000		3.360	P
Res. Ratio from Roll to abs 50 deg or RAzero	>	1.000		2.465	P

Stability Rules Assessment

Vessel	Transshelf
Description	USS Fitzgerald from Japan to USA
Condition	Sailing
Hydrostatic model	Voyage3 [Enquiry Model]

The calculation uses a standard vessel model and cargo bouyancy.

RULE EVALUATION - HEEL TO PORTSIDE

IMO A.749 CH 4.5.6 INTACT STABILITY

Description		Min/Max		Attained	
Area from abs 0 deg to MaxRA (-28.3)	>	0.0567	m.-Rad	1.3778	P
Area from abs 0 deg to abs 30 or RAzero	>	0.0550	m.-Rad	1.5057	P
Area from abs 30 deg to abs 40 or RAzero	>	0.0300	m.-Rad	0.7305	P
Area from abs 30 deg to Flood or RAzero	>	0.0300	m.-Rad	2.4613	P
Righting Arm at abs 30 deg or MaxRA	>	0.200	m.	4.338	P
Absolute Angle at MaxRA	>	15.00	deg	28.32	P
GM Upright	>	0.150	m.	12.677	P

IMO A749 CH.3.2 (WIND-STATIC)

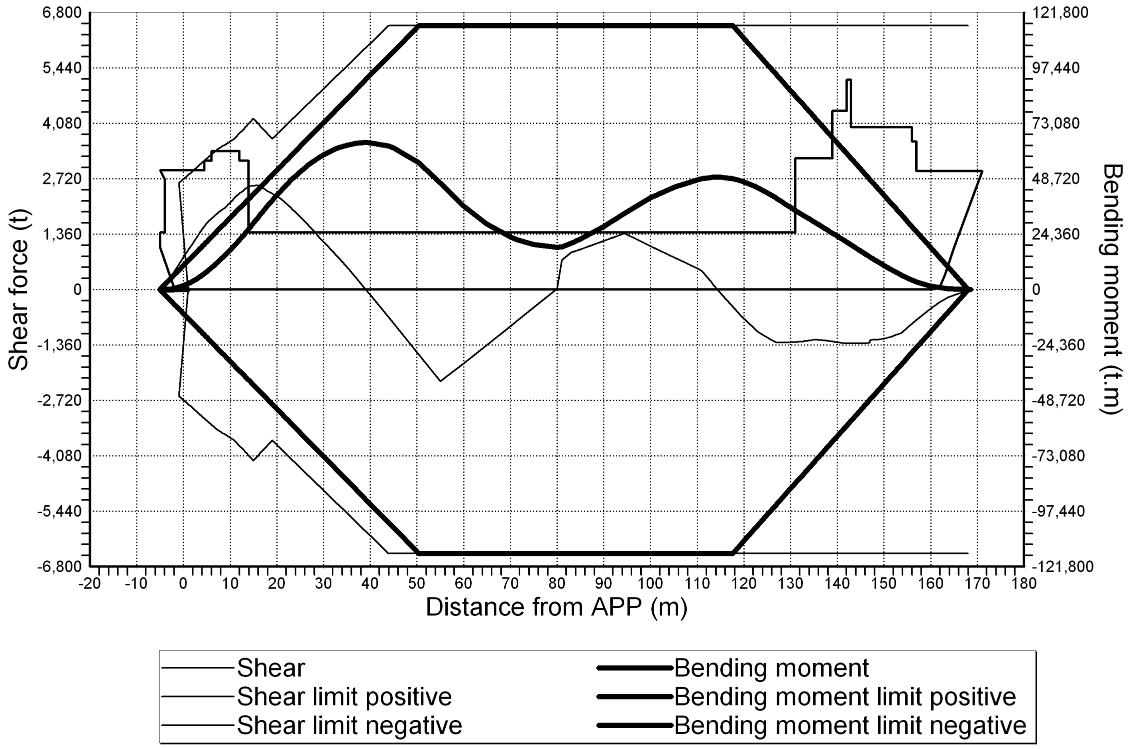
Description		Min/Max		Attained	
Absolute Angle at Equilibrium	<	16.00	deg	0.38	P

IMO A749 CH.3.2 (WIND-GUST)

Description		Min/Max		Attained	
Res. Area Ratio from Roll to Flood or RAzero	>	1.000		3.381	P
Res. Ratio from Roll to abs 50 deg or RAzero	>	1.000		2.469	P

Longitudinal Strength

Vessel Transshelf
Description USS Fitzgerald from Japan to USA
Condition Sailing



Frame	Location	Shear force			Bending moment		
	(m)	Actual (t)	Per %	Limit (t)	Actual (t.m)	Per %	Limit (t.m)
Fr 5	0.00	796	29	2709	1766	17	10560
Fr 15	10.00	2137	59	3637	17300	55	31481
Fr 25	20.00	2298	60	3810	41480	79	52402
Fr 35	30.00	1172	24	4926	59165	81	73322
Fr 45	40.00	-129	2	-6041	64577	69	94243
Fr 55	50.00	-1536	24	-6476	56275	49	115163
Fr 65	60.00	-1806	28	-6476	36672	32	116000
Fr 75	70.00	-904	14	-6476	23100	20	116000
Fr 85	80.00	20	0	6476	18664	16	116000
Fr 95	90.00	1194	18	6476	27733	24	116000
Fr 105	100.00	1070	17	6476	40248	35	116000
Fr 115	110.00	514	8	6476	48177	42	116000
Fr 125	120.00	-716	11	-6476	47349	43	110481
Fr 135	130.00	-1296	20	-6476	36145	41	87485

Longitudinal strength summary

Limits applied SAILING CONDITION

Largest shear 63.8 % at 19.000
Largest bending moment 82.3 % at 26.000
Largest stress 46.1 N/mm^2 at 32.400 (Tension)

Cargo Information

Cargo Number	64354
Revision	1
Name	USS Fitzgerald
Description	
Design	AEGIS DDG-67
Yard	Ingalls shipbuilding

Cargo description

Length	142.00 m	Hull No.	
Width	20.30 m	Built	
Height	11.10 m	Draught	6.10 m
Total height	52.00 m	Protrusion	3.029 m

Weight 8100.0 t

LCG	-70.720 m	Longitudinal axis	Fr. 0	K_{xx}	7.20 m
TCG	0.000 m	Transverse axis	Centerline	K_{yy}	41.30 m
VCG	7.720 m	Vertical axis	Baseline	K_{zz}	41.30 m

All values refer to the local axis of the cargo

Support definition

Description	Type	Weight (t)	LCG (m)	Begin (m)	End (m)
support	Line	8100.00	70.720	18.48	117.00

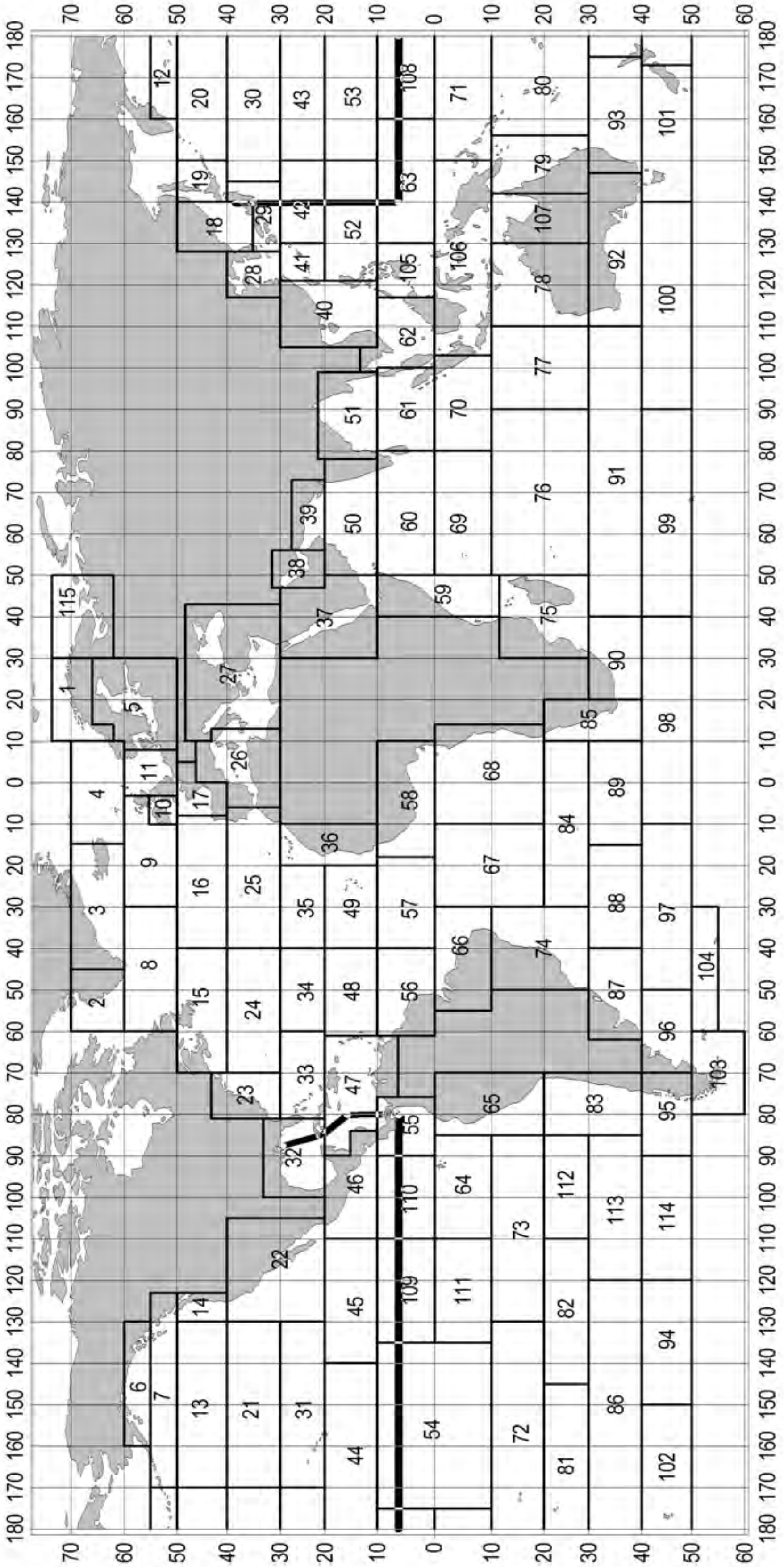
The cargo supports are given with respect to the cargo origin in the vessel coordinate system assuming a cargo rotation of 180.00 degrees.

Wind area definition

Description	Length (m)	Width (m)	Height (m)	Start at (m)	C_s
hull	153.77	20.27	16.71	0.00	1.00
accommodation-1	63.40	20.27	7.42	16.71	1.00
accommodation-2	46.50	11.00	2.20	24.13	1.00
mast	7.95	5.00	23.20	26.33	1.00

Total wind area: LxHxCs 3326.7 m², WxHxCs 629.3 m²

Vessel Route



Vessel	Transshelf
Description	USS Fitzgerald from Japan to USA
Condition	Sailing
Data source	GWS Enhanced 2.0
Port of departure	Yokosuka (Japan)
Via	Panama canal
Port of destination	Pascagoula (USA)

Environmental Conditions

Vessel	Transshelf
Description	USS Fitzgerald from Japan to USA
Condition	Sailing

Route description

Departure from	Yokosuka (Japan)	Departure date	25 Nov 2017
Via	Panama canal	Transit speed	12.0 kn
Arrival at	Pascagoula (USA)	Route No	4016
Data source	GWS Enhanced 2.0		

Environmental data

Area	Season	Transit time (hours)	Hsig (m)	Wind speed (kn)	Weather routing	Remarks
18	November-December	16.8	5.32	29.2		Typhoon season
29	November-March	25.0	5.46	26.1	Yes	Typhoon season
42	October-December	50.0	5.58	25.2	Yes	Typhoon season
52	October-January	50.0	5.47	27.7	Yes	Typhoon season
63	December-February	115.1	4.85	21.9		
108	December-February	124.1	5.99	24.2	Yes	
54	December-February	198.5	5.83	26.4		
109	December-February	124.1	5.77	21.8	Yes	
110	December-February	99.3	3.96	18.2		
55	October-December	66.8	3.89	17.2		Liability of low swell
47	December-February	56.2	5.47	26.8		
32	December-February	58.6	4.71	25.5		
Summary		984.4	5.99	29.2		

1-hour mean wind speed	15.0 m/s (29.2 kn)
1-minute sustained wind speed	18.2 m/s (35.3 kn)

Environmental Conditions

Wave scatter diagram

The following scatter diagram presents the number of observed wave period combinations for the most severe area of the route.

Area	108	Wave direction	E (Predominant)
Season	December-February	Wave note	

Hsig	Observations (All directions)											Total	P(Hsig)
(m)	0	8	57	175	264	240	149	68	26	7	3	997	
15	0	0	0	0	0	0	0	0	0	0	0	0	0.9995
14	0	0	0	0	0	0	0	0	0	0	0	0	0.9995
13	0	0	0	0	0	0	0	0	0	0	0	0	0.9995
12	0	0	0	0	0	0	0	0	0	0	0	0	0.9995
11	0	0	0	0	0	0	0	0	0	0	0	0	0.9995
10	0	0	0	0	0	0	0	0	0	0	0	0	0.9995
9	0	0	0	0	0	0	0	0	0	0	0	0	0.9995
8	0	0	0	0	0	0	1	0	0	0	0	1	0.9990
7	0	0	0	0	1	1	2	1	1	0	0	6	0.9955
6	0	0	0	1	3	6	7	5	3	1	0	26	0.9794
5	0	0	0	4	14	24	22	14	6	2	0	86	0.9224
4	0	0	2	18	48	62	46	23	9	3	0	211	0.7674
3	0	0	10	54	102	94	52	20	6	1	1	340	0.4687
2	0	3	29	81	88	51	19	5	1	0	1	278	0.1281
1	0	5	16	17	8	2	0	0	0	0	1	49	0.0070
	<4	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	>13		

Zero crossing periods (s)

Design sea states

P(Hsig) $= \sqrt[n]{(1 - Pdesign)}$

Where

n	= is the number of 3 hour periods, corrected for calm periods
Pdesign	= 0.10
Design wave height	= 5.99 m
P(Hsig)	= 0.9789

Sea state	$H_{Extreme}$ (m)	H_{Sig} (m)	T_z (sec)	T_m (sec)	Wave Slope
1	11.4	5.99	7.7	8.4	1/18
2	11.3	5.99	8.7	9.5	1/23
3	11.2	5.99	9.7	10.5	1/29
4	11.1	5.99	10.7	11.6	1/35

Wind Loads and Moments

Vessel	Transshelf
Description	USS Fitzgerald from Japan to USA
Condition	Sailing

Vessel wind area definition

Item	Length (m)	Breadth (m)	Height (m)	Start at (m)	Cs
Hull	164.00	40.00	12.00	0.00	1.00
Casing Port	8.00	7.20	12.30	12.00	1.00
Casing SB	12.00	8.00	12.30	12.00	1.00
Funnel Aft	5.50	6.20	5.40	24.30	1.00
Fore Castle	38.40	40.00	12.30	12.00	1.00
Live Boat	8.20	2.65	2.90	28.30	0.50
Deck House Low	27.10	40.00	2.90	24.30	1.00
Deck House High	18.20	40.00	4.00	27.20	1.00
Bridge House	13.80	20.80	3.00	31.20	1.00
Funnel Forward	3.70	2.00	6.20	31.20	1.00
Radar Mast	2.10	4.80	10.20	34.20	0.75
Satcom Mast	0.50	1.00	4.70	34.20	0.75

Total wind loads (Longitudinal)

Item	Force	Vessel overturning moment		Cargo support moment		
	(t)	Vertical center of pressure (m)	Overturning moment (t.m)	Support height (m)	Vertical center of pressure (m)	Overturning moment (t.m)
Transshelf	79.9	21.10	1686	0.00	0.00	0
USS Fitzgerald	40.9	30.82	1260	-0.58	18.82	769
Totals	120.8	24.39	2946			

Total wind loads (Transverse)

Item	Force	Vessel overturning moment		Cargo support moment		
	(t)	Vertical center of pressure (m)	Overturning moment (t.m)	Support height (m)	Vertical center of pressure (m)	Overturning moment (t.m)
Transshelf	106.2	16.55	1757	0.00	0.00	0
USS Fitzgerald	209.8	25.33	5313	-0.58	13.33	2796
Totals	315.9	22.38	7069			

Wind loads summary

Results using mean wind speed 60.0 kn

Total wind overturning moment mean	5903 t.m	Total wind lever mean	0.15 m
Total wind overturning moment extreme	8643 t.m	Total wind lever extreme	0.22 m

Radii of Gyration

Vessel Transshelf
Description USS Fitzgerald from Japan to USA
Condition Sailing

Roll

Item	Weight (t)	Steiner term (m)	Radius of gyration (m)	Moment of inertia (t.m²)
USS Fitzgerald	8100	9.82	7.20	1200467
Transshelf	30837	2.58	14.64	6813438
Total	38937		14.35	8013904

Pitch

Item	Weight (t)	Steiner term (m)	Radius of gyration (m)	Moment of inertia (t.m²)
USS Fitzgerald	8100	29.58	41.30	20901405
Transshelf	30837	7.77	42.53	57634989
Total	38937		44.91	78536394

Yaw

Item	Weight (t)	Steiner term (m)	Radius of gyration (m)	Moment of inertia (t.m²)
USS Fitzgerald	8100	27.90	41.30	20120842
Transshelf	30837	7.33	44.33	62264927
Total	38937		46.00	82385769

Motion Response Calculation

Vessel	Transshelf
Description	USS Fitzgerald from Japan to USA
Condition	Sailing

Condition Data

Draught FPP	7.38 m	System LCG	76.032 m	System Kxx	14.35 m
Draught APP	7.39 m	System VCG	10.478 m	System Kyy	44.91 m
GM Fluid	12.64 m	Displacement	38937 t	System Kzz	46.00 m

Nat. roll period 8.88 s

Defined sea-states

Heading (deg)	HSig (m)	Tz1 (sec)	Tz2 (sec)	Tz3 (sec)	Tz4 (sec)	Calculation Type
0	6.00	7.97	8.97	9.97	10.97	Custom (Hsig)
15	6.00	7.97	8.97	9.97	10.97	Custom (Hsig)
30	6.00	7.97	8.97	9.97	10.97	Custom (Hsig)
45	6.00	7.97	8.97	9.97	10.97	Custom (Hsig)
60	6.00	7.97	8.97	9.97	10.97	Custom (Hsig)
75	6.00	7.97	8.97	9.97	10.97	Custom (Hsig)
90	6.00	7.97	8.97	9.97	10.97	Custom (Hsig)
105	6.00	7.97	8.97	9.97	10.97	Custom (Hsig)
120	6.00	7.97	8.97	9.97	10.97	Custom (Hsig)
135	6.00	7.97	8.97	9.97	10.97	Custom (Hsig)
150	6.00	7.97	8.97	9.97	10.97	Custom (Hsig)
165	6.00	7.97	8.97	9.97	10.97	Custom (Hsig)
180	6.00	7.97	8.97	9.97	10.97	Custom (Hsig)
195	6.00	7.97	8.97	9.97	10.97	Custom (Hsig)
210	6.00	7.97	8.97	9.97	10.97	Custom (Hsig)
225	6.00	7.97	8.97	9.97	10.97	Custom (Hsig)
240	6.00	7.97	8.97	9.97	10.97	Custom (Hsig)
255	6.00	7.97	8.97	9.97	10.97	Custom (Hsig)
270	6.00	7.97	8.97	9.97	10.97	Custom (Hsig)
285	6.00	7.97	8.97	9.97	10.97	Custom (Hsig)
300	6.00	7.97	8.97	9.97	10.97	Custom (Hsig)
315	6.00	7.97	8.97	9.97	10.97	Custom (Hsig)
330	6.00	7.97	8.97	9.97	10.97	Custom (Hsig)
345	6.00	7.97	8.97	9.97	10.97	Custom (Hsig)

Response summary

No	Location	Position			Acceleration		
		Long (m)	Trans (m)	Vert (m)	Long (g)	Trans (g)	Vert (g)
1	USS Fitzgerald	48.13	0.00	20.30	0.073	0.492	0.182

All values refer to the global axis of the vessel

Maximum roll angle	20.8 deg	Maximum roll acceleration	0.1414 rad / s²
Maximum pitch angle	5.1 deg	Maximum pitch acceleration	0.0342 rad / s²

- The presented angles and accelerations are single extreme values. For each point these are maximum values for all the calculated wave headings and speeds. These maximums do not necessarily occur simultaneously.
- All values refer to the global axis of the vessel.

Motion Response Calculation

Point 1 : USS Fitzgerald

Sea State		Roll		Pitch		Longitudinal	Transverse	Vertical
HSig	Tz (1-4)	Angle (deg)	Accel. (rad/s2)	Angle (deg)	Accel. (rad/s2)	(g)	(g)	(g)
Heading 0 deg, speed 0 knots								
6.00	7.97	0.0	0.0000	4.5	0.0260	0.070	0.000	0.092
6.00	8.97	0.0	0.0000	4.9	0.0259	0.068	0.000	0.093
6.00	9.97	0.0	0.0000	5.1	0.0245	0.064	0.000	0.092
6.00	10.97	0.0	0.0000	5.1	0.0226	0.059	0.000	0.090
Heading 15 deg, speed 0 knots								
6.00	7.97	1.9	0.0137	4.5	0.0265	0.069	0.042	0.093
6.00	8.97	1.9	0.0125	5.0	0.0262	0.068	0.038	0.095
6.00	9.97	1.8	0.0113	5.1	0.0248	0.063	0.033	0.094
6.00	10.97	1.8	0.0099	5.0	0.0229	0.058	0.029	0.091
Heading 30 deg, speed 0 knots								
6.00	7.97	4.1	0.0269	4.7	0.0284	0.071	0.078	0.098
6.00	8.97	4.2	0.0253	5.0	0.0276	0.068	0.072	0.101
6.00	9.97	4.1	0.0231	5.0	0.0259	0.063	0.065	0.100
6.00	10.97	3.9	0.0207	4.9	0.0235	0.057	0.058	0.096
Heading 45 deg, speed 0 knots								
6.00	7.97	9.0	0.0567	4.8	0.0313	0.073	0.181	0.109
6.00	8.97	9.0	0.0539	4.9	0.0296	0.068	0.170	0.112
6.00	9.97	8.5	0.0495	4.8	0.0269	0.062	0.155	0.110
6.00	10.97	7.9	0.0445	4.6	0.0241	0.056	0.139	0.106
Heading 60 deg, speed 3 knots								
6.00	7.97	15.6	0.1027	4.3	0.0342	0.073	0.352	0.138
6.00	8.97	15.5	0.0991	4.3	0.0312	0.066	0.335	0.140
6.00	9.97	14.7	0.0919	4.1	0.0277	0.059	0.309	0.135
6.00	10.97	13.7	0.0836	3.8	0.0245	0.052	0.280	0.128
Heading 75 deg, speed 3 knots								
6.00	7.97	20.7	0.1414	2.7	0.0231	0.046	0.492	0.174
6.00	8.97	20.3	0.1337	2.6	0.0204	0.041	0.460	0.168
6.00	9.97	19.1	0.1228	2.4	0.0178	0.035	0.420	0.158
6.00	10.97	17.6	0.1113	2.2	0.0156	0.031	0.379	0.146
Heading 90 deg, speed 6 knots								
6.00	7.97	19.0	0.1347	0.2	0.0027	0.006	0.473	0.182
6.00	8.97	18.5	0.1241	0.2	0.0022	0.005	0.432	0.174
6.00	9.97	17.2	0.1116	0.2	0.0019	0.005	0.386	0.162
6.00	10.97	15.8	0.0993	0.1	0.0015	0.004	0.342	0.149
Heading 105 deg, speed 3 knots								
6.00	7.97	20.8	0.1371	2.7	0.0212	0.038	0.487	0.149
6.00	8.97	19.9	0.1277	2.6	0.0188	0.033	0.448	0.146
6.00	9.97	18.5	0.1161	2.4	0.0163	0.029	0.405	0.138
6.00	10.97	17.0	0.1044	2.2	0.0142	0.026	0.363	0.129
Heading 120 deg, speed 3 knots								
6.00	7.97	14.0	0.0865	3.8	0.0243	0.044	0.297	0.109
6.00	8.97	13.5	0.0806	3.8	0.0224	0.041	0.274	0.111
6.00	9.97	12.6	0.0731	3.7	0.0200	0.037	0.247	0.109
6.00	10.97	11.5	0.0654	3.5	0.0178	0.033	0.220	0.104
Heading 135 deg, speed 0 knots								
6.00	7.97	8.8	0.0551	4.1	0.0257	0.051	0.179	0.101
6.00	8.97	8.8	0.0526	4.3	0.0247	0.049	0.169	0.106
6.00	9.97	8.3	0.0481	4.3	0.0228	0.046	0.155	0.105
6.00	10.97	7.8	0.0435	4.2	0.0207	0.042	0.139	0.102

Motion Response Calculation

Point 1 : USS Fitzgerald

Sea State		Roll		Pitch		Longitudinal	Transverse	Vertical
HSig	Tz (1-4)	Angle (deg)	Accel. (rad/s2)	Angle (deg)	Accel. (rad/s2)	(g)	(g)	(g)
Heading 150 deg, speed 0 knots								
6.00	7.97	4.1	0.0269	4.0	0.0235	0.049	0.066	0.087
6.00	8.97	4.2	0.0253	4.4	0.0233	0.049	0.062	0.092
6.00	9.97	4.1	0.0229	4.5	0.0219	0.046	0.057	0.093
6.00	10.97	3.9	0.0205	4.5	0.0202	0.043	0.051	0.091
Heading 165 deg, speed 0 knots								
6.00	7.97	2.1	0.0151	3.9	0.0219	0.047	0.036	0.081
6.00	8.97	2.0	0.0137	4.4	0.0221	0.048	0.032	0.085
6.00	9.97	1.9	0.0122	4.6	0.0212	0.046	0.029	0.086
6.00	10.97	1.8	0.0108	4.6	0.0199	0.043	0.025	0.085
Heading 180 deg, speed 0 knots								
6.00	7.97	0.0	0.0000	3.8	0.0216	0.048	0.000	0.080
6.00	8.97	0.0	0.0000	4.3	0.0217	0.048	0.000	0.084
6.00	9.97	0.0	0.0000	4.6	0.0211	0.046	0.000	0.085
6.00	10.97	0.0	0.0000	4.6	0.0197	0.043	0.000	0.084
Heading 195 deg, speed 0 knots								
6.00	7.97	2.1	0.0151	3.9	0.0219	0.047	0.036	0.081
6.00	8.97	2.0	0.0137	4.4	0.0221	0.048	0.032	0.085
6.00	9.97	1.9	0.0122	4.6	0.0212	0.046	0.029	0.086
6.00	10.97	1.8	0.0108	4.6	0.0199	0.043	0.025	0.085
Heading 210 deg, speed 0 knots								
6.00	7.97	4.1	0.0269	4.0	0.0235	0.049	0.066	0.087
6.00	8.97	4.2	0.0253	4.4	0.0233	0.049	0.062	0.092
6.00	9.97	4.1	0.0229	4.5	0.0219	0.046	0.057	0.093
6.00	10.97	3.9	0.0205	4.5	0.0202	0.043	0.051	0.091
Heading 225 deg, speed 0 knots								
6.00	7.97	8.8	0.0551	4.1	0.0257	0.051	0.179	0.101
6.00	8.97	8.8	0.0526	4.3	0.0247	0.049	0.169	0.106
6.00	9.97	8.3	0.0481	4.3	0.0228	0.046	0.155	0.105
6.00	10.97	7.8	0.0435	4.2	0.0207	0.042	0.139	0.102
Heading 240 deg, speed 3 knots								
6.00	7.97	14.0	0.0865	3.8	0.0243	0.044	0.297	0.109
6.00	8.97	13.5	0.0806	3.8	0.0224	0.041	0.274	0.111
6.00	9.97	12.6	0.0731	3.7	0.0200	0.037	0.247	0.109
6.00	10.97	11.5	0.0654	3.5	0.0178	0.033	0.220	0.104
Heading 255 deg, speed 3 knots								
6.00	7.97	20.8	0.1371	2.7	0.0212	0.038	0.487	0.149
6.00	8.97	19.9	0.1277	2.6	0.0188	0.033	0.448	0.146
6.00	9.97	18.5	0.1161	2.4	0.0163	0.029	0.405	0.138
6.00	10.97	17.0	0.1044	2.2	0.0142	0.026	0.363	0.129
Heading 270 deg, speed 6 knots								
6.00	7.97	19.0	0.1347	0.2	0.0027	0.006	0.473	0.182
6.00	8.97	18.5	0.1241	0.2	0.0022	0.005	0.432	0.174
6.00	9.97	17.2	0.1116	0.2	0.0019	0.005	0.386	0.162
6.00	10.97	15.8	0.0993	0.1	0.0015	0.004	0.342	0.149
Heading 285 deg, speed 3 knots								
6.00	7.97	20.7	0.1414	2.7	0.0231	0.046	0.492	0.174
6.00	8.97	20.3	0.1337	2.6	0.0204	0.041	0.460	0.168
6.00	9.97	19.1	0.1228	2.4	0.0178	0.035	0.420	0.158
6.00	10.97	17.6	0.1113	2.2	0.0156	0.031	0.379	0.146

Motion Response Calculation

Point 1 : USS Fitzgerald

Sea State		Roll		Pitch		Longitudinal	Transverse	Vertical
HSig	Tz (1-4)	Angle (deg)	Accel. (rad/s2)	Angle (deg)	Accel. (rad/s2)	(g)	(g)	(g)
Heading 300 deg, speed 3 knots								
6.00	7.97	15.6	0.1027	4.3	0.0342	0.073	0.352	0.138
6.00	8.97	15.5	0.0991	4.3	0.0312	0.066	0.335	0.140
6.00	9.97	14.7	0.0919	4.1	0.0277	0.059	0.309	0.135
6.00	10.97	13.7	0.0836	3.8	0.0245	0.052	0.280	0.128
Heading 315 deg, speed 0 knots								
6.00	7.97	9.0	0.0567	4.8	0.0313	0.073	0.181	0.109
6.00	8.97	9.0	0.0539	4.9	0.0296	0.068	0.170	0.112
6.00	9.97	8.5	0.0495	4.8	0.0269	0.062	0.155	0.110
6.00	10.97	7.9	0.0445	4.6	0.0241	0.056	0.139	0.106
Heading 330 deg, speed 0 knots								
6.00	7.97	4.1	0.0269	4.7	0.0284	0.071	0.078	0.098
6.00	8.97	4.2	0.0253	5.0	0.0276	0.068	0.072	0.101
6.00	9.97	4.1	0.0231	5.0	0.0259	0.063	0.065	0.100
6.00	10.97	3.9	0.0207	4.9	0.0235	0.057	0.058	0.096
Heading 345 deg, speed 0 knots								
6.00	7.97	1.9	0.0137	4.5	0.0265	0.069	0.042	0.093
6.00	8.97	1.9	0.0125	5.0	0.0262	0.068	0.038	0.095
6.00	9.97	1.8	0.0113	5.1	0.0248	0.063	0.033	0.094
6.00	10.97	1.8	0.0099	5.0	0.0229	0.058	0.029	0.091

Support Pressure Calculation

Vessel	Transshelf
Description	USS Fitzgerald from Japan to USA
Condition	Sailing

Cargo USS Fitzgerald

Support properties			Cargo properties		
Area	177.81	m^2	Weight	8100	t
COG.Long	-0.12	m	LCG	70.720	m
COG.Trans	0.00	m	TCG	0.000	m
			VCG	7.720	m
Ixx	1643	m^4	Support	-0.58	m
Extreme to Port	6.51	m	Support.Lever	8.30	m
Extreme to Sb	-6.51	m	Kxx	7.20	m
Wx-port	252	m^3	Kyy	41.30	m
Wx-sb	-252	m^3			
			Wind heel and moments		
Iyy	85130	m^4	Long.wind	769	t.m
Extreme to Forward	46.84	m	Trans.wind	2796	t.m
Extreme to Aft	-53.01	m	Mean loll	0.68	deg
Wy-forward	1818	m^3	Extreme loll	0.99	deg
Wy-aft	-1606	m^3			
			Design accelerations		
			Longitudinal	0.073	g
			Transverse	0.492	g
			Vertical	0.182	g
			Roll	0.1414	rad/s²
			Pitch	0.0342	rad/s²

Loads or moments due to			Moment about		
Long.eccentric moment	961	t.m	Longitudinal axis	53132	t.m
Trans.eccentric moment	-13	t.m	Transverse axis	39111	t.m
Static weight	8100	t	Vertical axis	1474	t

Wind loads and moments					
Wind heel moment.mean	796	t.m	Wind heel moment.extreme	1162	t.m
Long.windforce.mean	769	t.m	Long.windforce.extreme	1126	t.m
Trans.windforce.mean	2796	t.m	Trans.windforce.extreme	4093	t.m

Support Pressure Calculation

Vessel Transshelf
Description USS Fitzgerald from Japan to USA
Condition Sailing

	Max. static pressure (kg/cm2)	Longitudinal coordinate (m)	Transverse coordinate (m)
	4.61	114.44	-0.30
Heading (deg)	Max. static + dynamic pressure (kg/cm2)	Longitudinal coordinate (m)	Transverse coordinate (m)
0	7.16	20.59	-0.30
15	7.50	84.88	-6.06
30	8.43	84.88	-6.06
45	11.20	84.88	-6.06
60	15.87	84.88	-6.06
75	19.71	84.88	-6.06
90	19.16	84.88	-6.06
105	19.51	84.88	-6.06
120	14.31	84.88	-6.06
135	11.11	84.88	-6.06
150	8.14	84.88	-6.06
165	7.35	84.88	-6.06
180	6.81	84.88	-6.06
195	7.35	84.88	-6.06
210	8.14	84.88	-6.06
225	11.11	84.88	-6.06
240	14.31	84.88	-6.06
255	19.51	84.88	-6.06
270	19.16	84.88	-6.06
285	19.71	84.88	-6.06
300	15.87	84.88	-6.06
315	11.20	84.88	-6.06
330	8.43	84.88	-6.06
345	7.50	84.88	-6.06

Extreme Design Forces

Vessel Transshelf
Description USS Fitzgerald from Japan to USA
Condition Sailing

Longitudinal Forces

Item	Inertia	Wind			Friction		Total	Req'
		Mean	Extreme		$F_{Friction}$		F_{Total}	F_{Long}
	(t)	(t)	(t)		Coef	(t)	(t)	(t)
USS Fitzgerald	591	41	60		0.04	349	283	283

Transverse Forces

Item	Inertia	Wind		Loll		Friction		Total	Req'
		Mean	Extreme	Mean	Extreme	$F_{Friction}$		F_{Total}	F_{Trans}
	(t)	(t)	(t)	(t)	(t)	Coef	(t)	(t)	(t)
USS Fitzgerald	3985	210	307	96	140	0.04	335	3959	3959

*) The calculated value has been replaced by the minimum required force

Item	Weight	Minimum force as % of cargo weight	
		long	trans
	(t)	%	%
USS Fitzgerald	8100	2.5	10.0

Seafastening Calculation

Vessel Transshelf
Description USS Fitzgerald from Japan to USA
Condition Sailing
Cargo **USS Fitzgerald**

Seafastening description

No	Type	Capacity (t)	Force applied	Weld	
				Length (mm)	Type
1	BRACING	200	Push	1000	Double Fillet
2	STRONGBOX	200	Push	2000	Full.Pen

Seafastening arrangement

No	Type	Capacity (t)	Angle (deg)	Seafastening acting to				Lever (mm)	Weld	
				PS (t)	SB (t)	Aft (t)	Fwd (t)		Length (mm)	Leg (mm)
1	BRACING	200	90	0	173	0	0	0	1000	11.0
2	BRACING	200	90	0	173	0	0	0	1000	11.0
3	BRACING	200	90	0	173	0	0	0	1000	11.0
4	BRACING	200	90	0	173	0	0	0	1000	11.0
5	BRACING	200	90	0	173	0	0	0	1000	11.0
6	BRACING	200	90	0	173	0	0	0	1000	11.0
7	BRACING	200	90	0	173	0	0	0	1000	11.0
8	BRACING	200	90	0	173	0	0	0	1000	11.0
9	BRACING	200	90	0	173	0	0	0	1000	11.0
10	BRACING	200	90	0	173	0	0	0	1000	11.0
11	BRACING	200	90	0	173	0	0	0	1000	11.0
12	BRACING	200	90	0	173	0	0	0	1000	11.0
13	BRACING	200	90	0	173	0	0	0	1000	11.0
14	BRACING	200	90	0	173	0	0	0	1000	11.0
15	BRACING	200	90	0	173	0	0	0	1000	11.0
16	BRACING	200	90	0	173	0	0	0	1000	11.0
17	BRACING	200	90	0	173	0	0	0	1000	11.0
18	BRACING	200	90	0	173	0	0	0	1000	11.0
19	BRACING	200	90	0	173	0	0	0	1000	11.0
20	BRACING	200	90	0	173	0	0	0	1000	11.0
21	BRACING	200	90	0	173	0	0	0	1000	11.0
22	BRACING	200	90	0	173	0	0	0	1000	11.0
23	BRACING	200	90	0	173	0	0	0	1000	11.0
24	BRACING	200	270	173	0	0	0	0	1000	11.0
25	BRACING	200	270	173	0	0	0	0	1000	11.0
26	BRACING	200	270	173	0	0	0	0	1000	11.0
27	BRACING	200	270	173	0	0	0	0	1000	11.0
28	BRACING	200	270	173	0	0	0	0	1000	11.0
29	BRACING	200	270	173	0	0	0	0	1000	11.0
30	BRACING	200	270	173	0	0	0	0	1000	11.0
31	BRACING	200	270	173	0	0	0	0	1000	11.0
32	BRACING	200	270	173	0	0	0	0	1000	11.0
33	BRACING	200	269	173	0	0	0	0	1000	11.0
34	BRACING	200	270	173	0	0	0	0	1000	11.0
35	BRACING	200	270	173	0	0	0	0	1000	11.0
36	BRACING	200	270	173	0	0	0	0	1000	11.0
37	BRACING	200	270	173	0	0	0	0	1000	11.0
38	BRACING	200	270	173	0	0	0	0	1000	11.0
39	BRACING	200	270	173	0	0	0	0	1000	11.0
40	BRACING	200	270	173	0	0	0	0	1000	11.0
41	BRACING	200	270	173	0	0	0	0	1000	11.0
42	BRACING	200	270	173	0	0	0	0	1000	11.0
43	BRACING	200	270	173	0	0	0	0	1000	11.0
44	BRACING	200	270	173	0	0	0	0	1000	11.0

Voyage Calculation

No	Type	Capacity (t)	Angle (deg)	Seafastening acting to PS (t)	SB (t)	Aft (t)	Fwd (t)	Lever (mm)	Weld Length (mm)	Leg (mm)
45	BRACING	200	270	173	0	0	0	0	1000	11.0
46	BRACING	200	270	173	0	0	0	0	1000	11.0
47	STRONGBOX	200	178	0	0	0	200	422	2000	-
48	STRONGBOX	200	0	0	0	200	0	422	2000	-
49	STRONGBOX	200	181	0	0	0	200	422	2000	-
50	STRONGBOX	200	0	0	0	200	0	422	2000	-
			Total capacity available	3979	3979	400	400	(t)		
			Extreme design forces	3959	3959	283	283	(t)		
			Excess	20	20	117	117	(t)		

- The calculated weld leg only applies to a continuous weld over the weld length. In other cases the weld length will be calculated manually.
- Welds calculated to be smaller than 6mm will be welded on site at 6mm.

Standard Calculation
Cargo overturning moment

DOCKWISE

Introduction

This calculation provides a indication of the tendency of the cargo to overturn (tip) and is subjected to uplift based on comparison of the sum of the external moments acting on the cargo and the moment generated by cargo weight around a pre-defined tipping point. Cargo will have the tendency to tip if the resulting moment is positive.

Cargo particulars

Cargo weight	W	8100	[t]	
Vertical center of gravity wrt. top of support	VCG	7.72	[m]	
Distance COG to tipping point	L1	6.51	[m]	*SB*
Inertia	k_{xx}	7.20	[m]	

External Components

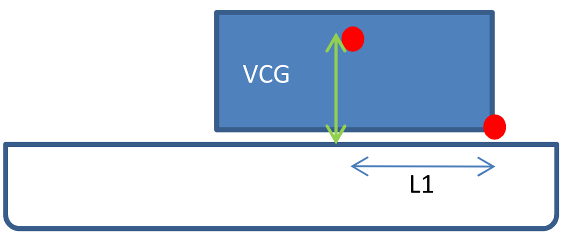
Wind (mean)	$M_{wind,mean}$	2796.00	[ton.m]
Wind (extreme)	$M_{wind,extr.}$	4093.62	[ton.m]
Mean loll	$Loll_{mean}$	0.68	[deg]
Extreme loll	$Loll_{extr}$	0.99	[deg]
Sway	a_{yy}	0.492	[g]
Heave	a_{zz}	0.182	[g]
Roll	φ	0.1414	[rad/s^2]
Gravity constant	g	9.81	[m/s^2]

Summary of moments

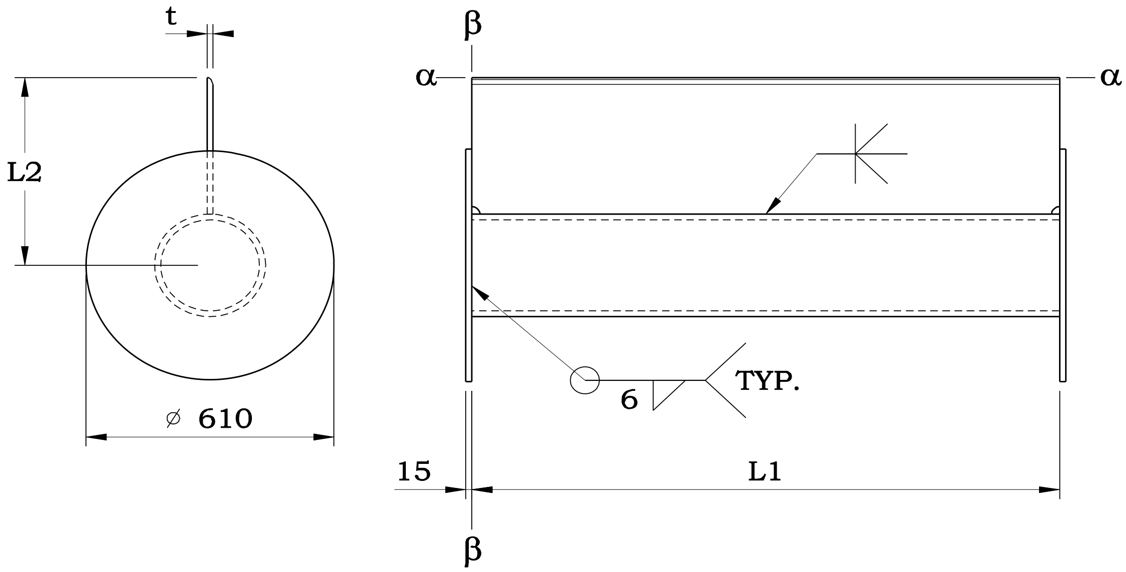
Weight	F_{weight}	6626	[ton]
Sway	M_{sway}	30766	[ton.m]
Rotation	$M_{rotation}$	6052	[ton.m]
Mean loll	$M_{mean\ loll}$	742	[ton.m]
Extreme loll	$M_{extr.\ loll}$	1080	[ton.m]
Total	M_{total}	40393	[ton.m]
Moment arm	$L2=M_{total} / F_{weight}$	6.10	[m]
	L2/L1 ✓	94%	

Result

Cargo does not have tendency to tip / is not subject to uplift



Strongbox Calculation

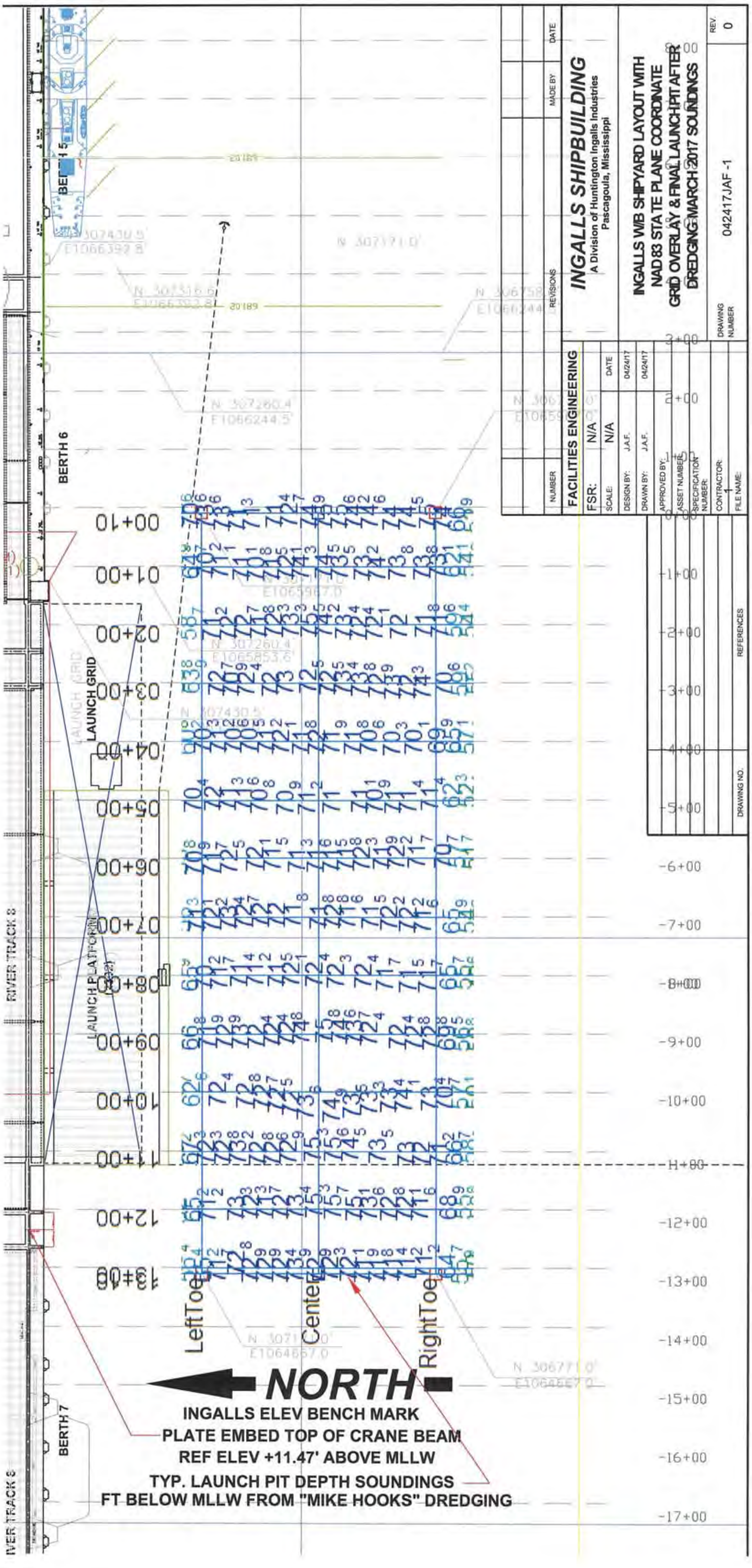


Design Properties		
Member i.d.	1	
Force	200	Ton
Plate length, L1	2000	mm
Plate plate thickness, t	15	mm
Lever, L2	620	mm
Pipe section	273x15.1	
Pipe section area	12234	mm^2
Pipe section outside diameter	273	mm
Poisson's ratio	0.3	
Yield stress	235	N/mm^2
Youngs modulus	210000	N/mm^2

Calculation & Results			
Force applied	1962000	N	
Plane alpha-alpha			
Section modulus plate	1.000E+07	mm^3	
Plate area	30000	mm^2	
Moment	1.216E+09	Nmm	
Shear (max = 0.53 Sigma y)	65.40	N/mm^2	UC= 0.53
Tension (max = 0.8 Sigma y)	121.64	N/mm^2	UC= 0.65
Combined stress (max = 0.88 Sigma y)	166.22	N/mm^2	UC= 0.80
Plate buckling (DNV Class. Notes-No.30.1 chapter 3.3)			
Buckling coeff. c. (table 3.2)	9.47858		
sigma E (Euler stress)	1053.03	N/mm^2	
Plane bèta-bèta, area required for pipe			
Max allowable stress (0.8 Sigma y)	188.00	N/mm^2	
Minimum required cross section area	10436	mm^2	
Actual pipe section area	12234	mm^2	UC= 0.85
Total weight of strongbox	374.76	kg	

ATTACHMENT 3. PROPOSED DISCHARGE LOCATION REV 0

The attached page shows information for a proposed discharge location near Pascagoula (USA).


INGALLS SHIPBUILDING
A Division of Huntington Ingalls Industries
Pascagoula, Mississippi
INGALLS W/B SHIPYARD LAYOUT WITH
NAD 83 STATE PLANE COORDINATE
GRID OVERLAY & FINAL LAUNCH PIT AFTER
DREDGING MARCH 2017 SOUNDINGS
DRAWING NUMBER 042417JAF-1
REV. 0
FACILITIES ENGINEERING
FSR: N/A
SCALE: N/A
DESIGN BY: J.A.F. 04/24/17
DRAWN BY: J.A.F. 04/24/17
BERTH 5
BERTH 6
BERTH 7
RIVER TRACK 8
LAUNCH GRID
LAUNCH PLATFORM
LeftToe
Center
RightToe
NORTH
INGALLS ELEV BENCH MARK
PLATE EMBED TOP OF CRANE BEAM
REF ELEV +11.47' ABOVE MLLW
TYP. LAUNCH PIT DEPTH SOUNDINGS
FT BELOW MLLW FROM "MIKE HOOKS" DREDGING

ATTACHMENT 4. OVERVIEW OF RESOURCES (HOLD) REV 0

The attached page summarizes the required resources mentioned elsewhere in this manual for the transport of the USS Fitzgerald . Smit Salvage is responsible for the installation/delivering of the items in the client's column.

Item		DWG No.	Required No.	Responsibility	
				DW	Client
Cribbing wood 300x300	L= 6000 [mm]	-		X	
Cribbing wood 300x300	L= 5000 [mm]	-		X	
Cribbing wood 300x300	L= 4000 [mm]	-		X	
Cribbing wood 300x300	L= 3000 [mm]	-		X	
Cribbing wood 300x300	L= 2000 [mm]	-		X	
Cribbing wood 300x300	L= 1000 [mm]	-		X	
Angle Bar 100x100x10	L= 6000 [mm]	-		X	
Lag bolt 10x100 DIN 571		-		X	
Nail chip		EQUIP02-030-02		X	
Seafastening SF-1250		EQUIP03-001-04		X	
Seafastening SF-1250 plus rubber pad		EQUIP03-001-04		X	
Paint mark on hull		EQUIP04-031-01			X
Guidepost (with bumper)	H=8000 [mm]	EQUIP04-028-01	2	X	

REFERENCE 0030270, STEP 5

FLOAT-ON BALLAST PLAN YOKOSUKA

REFERENCE NUMBER : 0030270

DRAFTS SUMMARY

DRAFT @ PERPENDICULARS		DRAFT @ MARKS	
18.94M @ FPP	162.00f FROM APP	18.94M @ BOW	162.00f FROM APP
18.35M @ MID	81.00f FROM APP	18.35M @ MIDSHIPS	81.00f FROM APP
17.76M @ APP	0.00a FROM APP	17.72M @ STERN	5.00a FROM APP
		18.68M @ ACCOM.BULKHEAD	127.00f FROM APP
		17.81M @ CASING	7.00f FROM APP

CLASS AND FLAG STATE REQUIREMENTS

RULE/REQUIREMENT	REQUIRED	OBTAINED	P/F
DRAFT AT LOADLINE (B)	<= 8.80M	18.35M	WARN
DRAFT SUBMERGED AT FPP	<= 22.00M	18.94M	PASS
DRAFT SUBMERGED AT APP	<= 22.00M	17.76M	PASS

HYDROSTATIC PROPERTIES

Trim: Fwd 1.18/162.00, No Heel, VCG = 8.050

LCF Draft	Displacement Weight(MT)	Buoyancy-Ctr. LCB	VCB	Weight/ cm	LCF	Moment/ cm trim	GML	GMT
18.722	76,933.24	81.805f	7.460	15.18	132.243f	139.70	29.42	1.411

Distances in METERS.-----Specific Gravity = 1.025.-----------Moment in m.-MT.
Trim is per 162.00m.
Draft is from Baseline. Free Surface included. GMT is from RA curve.
Caution: Standard GMT is 1.407

WEIGHT STATUS

Trim: Fwd 1.18/162.00, Heel: zero

Part	Weight(MT)	LCG	TCG	VCG	FSM
Total Fixed--------->	15,509.89	86.627f	0.070p	10.412	
Total Tanks--------->	61,423.02	80.581f	0.009s	7.453	28767.28
Total Weight-------->	76,932.91	81.800f	0.007p	8.050	
Free Surface Adjustment---------->				0.374	
Adjusted CG---------------------->		81.798f	0.007p	8.424	

Distances in METERS.---------------------------------------Moments in m.-MT.

DISPLACEMENT STATUS

Baseline draft: 18.938 @ 162.00f, 18.350 @ 81.00f, 17.762 @ 0.00

Trim: Fwd 1.18/162.00, Heel: zero

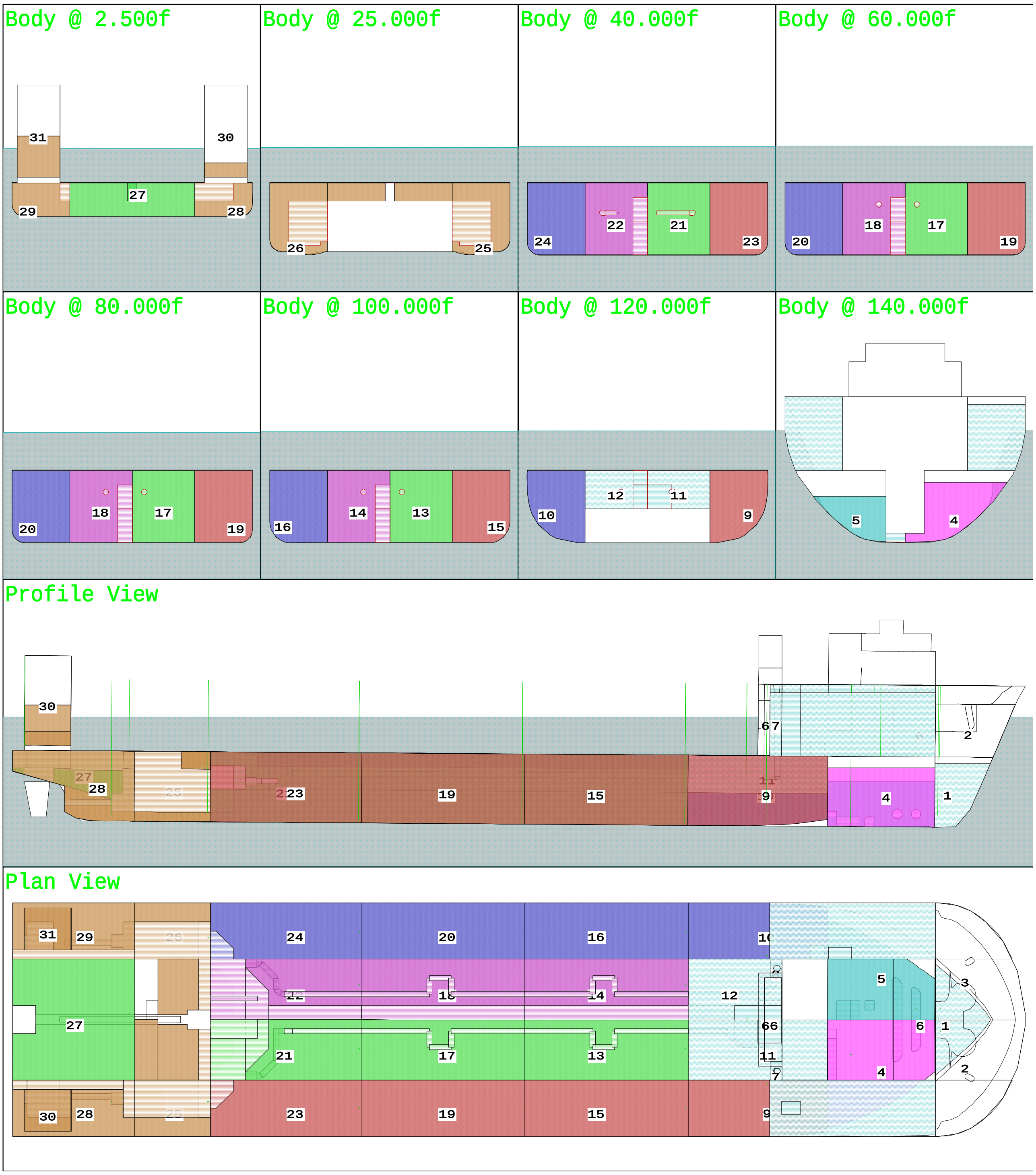
Part	SpGr	Displ(MT)	LCB	TCB	VCB
HULL	1.025	76,253.23	82.526f	0.007p	7.394
PSCASING	1.025	340.01	1.000f	15.600p	14.885
SBCASING	1.025	340.01	1.000f	15.600s	14.885
Total Displacement-->	1.025	76,933.24	81.805f	0.007p	7.460

Distances in METERS.

REFERENCE 0030270, STEP 5

FLOAT-ON BALLAST PLAN YOKOSUKA

Condition Graphic - Draft: 18.938 @ 162.000f, 17.762 @ 0.000 Heel: zero



Tanks

	5 WBT202.P	10 WBT304.P	15 WBT403.S	20 WBT504.P	25 WBT703.S	30 WBT811.S
1 WBT100.C	6 WBT210.C	11 WBT311.S	16 WBT404.P	21 WBT601.S	26 WBT704.P	31 WBT812.P
2 WBT111.S	7 WBT211.S	12 WBT312.P	17 WBT501.S	22 WBT602.P	27 WBT800.C	66 WBT320.C
3 WBT112.P	8 WBT212.P	13 WBT401.S	18 WBT502.P	23 WBT603.S	28 WBT801.S	
4 WBT201.S	9 WBT303.S	14 WBT402.P	19 WBT503.S	24 WBT604.P	29 WBT802.P	

M.V. TRANSSHELF - IMO 8512279

REFERENCE 0030270, STEP 13

FLOAT-ON BALLAST PLAN YOKOSUKA

REFERENCE NUMBER : 0030270

DRAFTS SUMMARY

DRAFT @ PERPENDICULARS		DRAFT @ MARKS	
17.67M @ FPP	162.00f FROM APP	17.67M @ BOW	162.00f FROM APP
16.67M @ MID	81.00f FROM APP	16.67M @ MIDSHIPS	81.00f FROM APP
15.66M @ APP	0.00a FROM APP	15.60M @ STERN	5.00a FROM APP
		17.24M @ ACCOM.BULKHEAD	127.00f FROM APP
		15.75M @ CASING	7.00f FROM APP

CLASS AND FLAG STATE REQUIREMENTS

- RULE/REQUIREMENT	REQUIRED	OBTAINED	P/F
DRAFT AT LOADLINE (B)	<= 8.80M :	16.67M	WARN
DRAFT SUBMERGED AT FPP	<= 22.00M :	17.67M	PASS
DRAFT SUBMERGED AT APP	<= 22.00M :	15.66M	PASS

HYDROSTATIC PROPERTIES

Trim: Fwd 2.00/162.00, No Heel, VCG = 8.789

Draft	Displacement Weight(MT)	Buoyancy-Ctr. LCB	VCB	Weight/ cm	LCF	Moment/ cm trim	GML	GMT
16.785	78,605.21	78.956f	7.526	29.97	90.515f	509.96	105.10	1.023

Distances in METERS.-----Specific Gravity = 1.025.-----------Moment in m.-MT.
Trim is per 162.00m.
Draft is from Baseline. Free Surface included. GMT is from RA curve.
Caution: Standard GMT is 1.019

WEIGHT STATUS

Trim: Fwd 2.00/162.00, Heel: zero

Part	Weight(MT)	LCG	TCG	VCG	FSM
Total Fixed--------->	23,609.89	71.705f	0.046p	13.803	
Total Tanks--------->	54,996.97	82.045f	0.013s	6.637	19030.4
Total Weight-------->	78,606.86	78.939f	0.005p	8.789	
Free Surface Adjustment---------->				0.242	
Adjusted CG---------------------->		78.936f	0.005p	9.031	

Distances in METERS.--Moments in m.-MT.

DISPLACEMENT STATUS

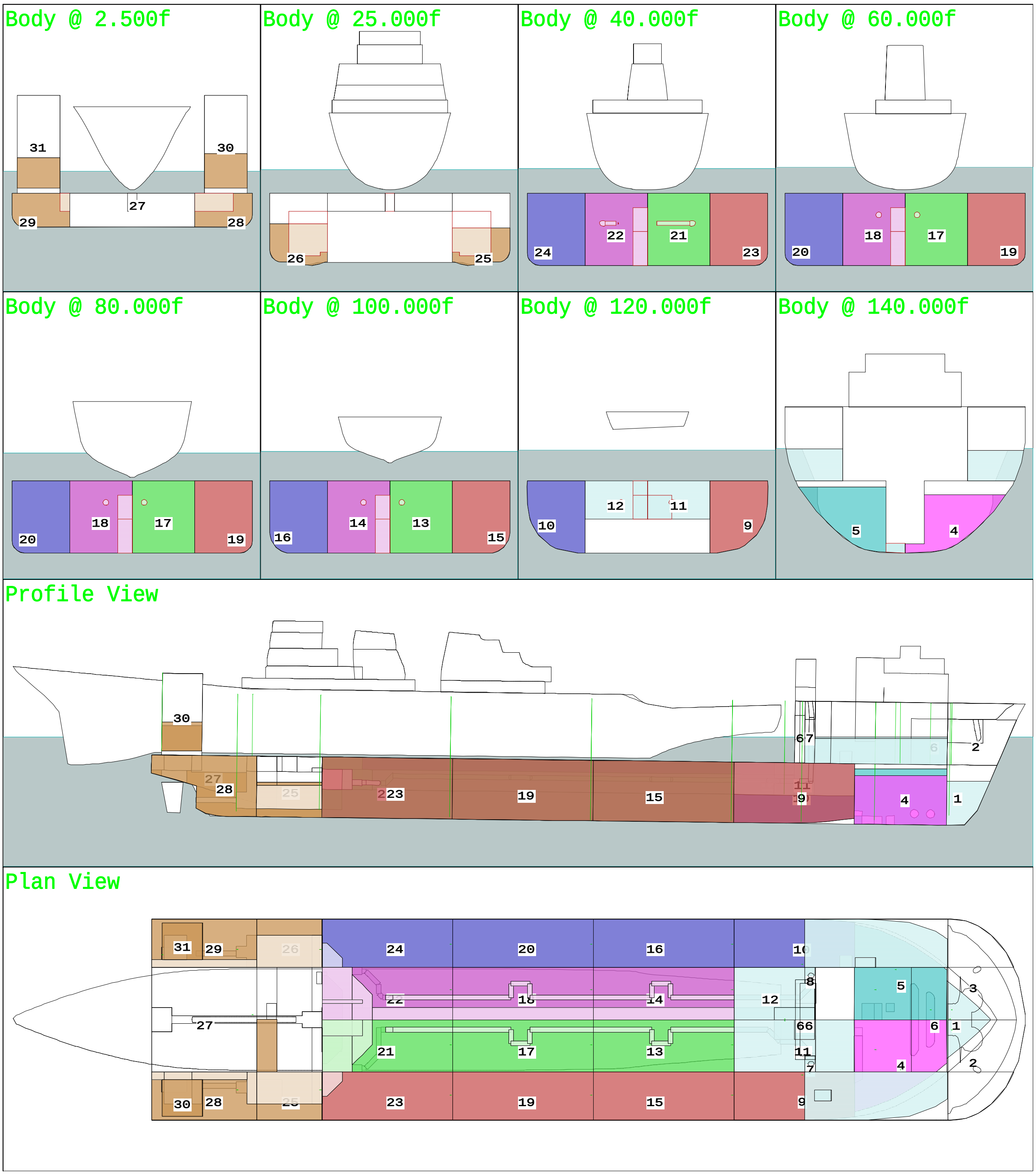
Baseline draft: 17.670 @ 162.00f, 16.668 @ 81.00f, 15.666 @ 0.00

Trim: Fwd 2.00/162.00, Heel: zero

Part	SpGr	Displ(MT)	LCB	TCB	VCB
64354000	1.025	3,786.83	47.448f	0.003s	14.711
HULL	1.025	74,384.85	81.014f	0.005p	7.124
PSCASING	1.025	216.76	1.011f	15.600p	13.839
SBCASING	1.025	216.76	1.011f	15.600s	13.839
Total Displacement-->	1.025	78,605.21	78.956f	0.005p	7.526

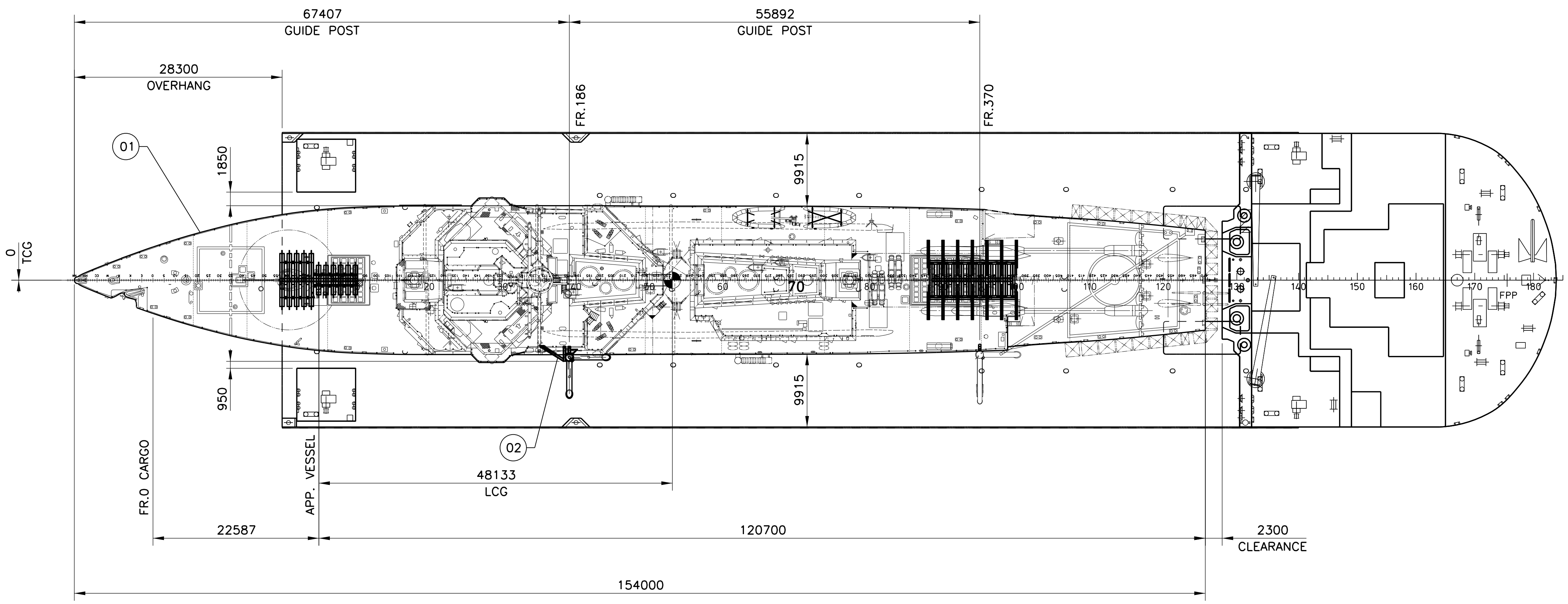
Distances in METERS.

Condition Graphic - Draft: 17.670 @ 162.000f, 15.666 @ 0.000 Heel: zero



Tanks

	5 WBT202.P	10 WBT304.P	15 WBT403.S	20 WBT504.P	25 WBT703.S	30 WBT811.S
1 WBT100.C	6 WBT210.C	11 WBT311.S	16 WBT404.P	21 WBT601.S	26 WBT704.P	31 WBT812.P
2 WBT111.S	7 WBT211.S	12 WBT312.P	17 WBT501.S	22 WBT602.P	27 WBT800.C	66 WBT320.C
3 WBT112.P	8 WBT212.P	13 WBT401.S	18 WBT502.P	23 WBT603.S	28 WBT801.S	
4 WBT201.S	9 WBT303.S	14 WBT402.P	19 WBT503.S	24 WBT604.P	29 WBT802.P	



ITEM	REQ.	DESCRIPTION	DIMENSIONS/DRAWING REFERENCE	WEIGHT
01	1	USS FITZGERALD	154.00x20.30x52.00	8500
02	1	RIG CATCHER	SEE DWG 0030270-004-02	–
			TOTAL WEIGHT (MT)	8500

NOTES

REFERENCE LIST

REV.	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
0	11/03/2017	ISSUED FOR TRANSPORT MANUAL
A	10/13/2017	PRELIMINARY ISSUE

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED – TRANSPORT ENGINEERING	YNVE
CHECKED – TRANSPORT ENGINEERING	YASO
CHECKED – DISCIPLINE	YJPA
CHECKED – ORIGINATOR	YHHO

CLIENT
MSC

CLIENT 2 REF: REV.

CLIENT 1 REF: REV.

DEVELOPMENT

PROJECT
USS FITZGERALD

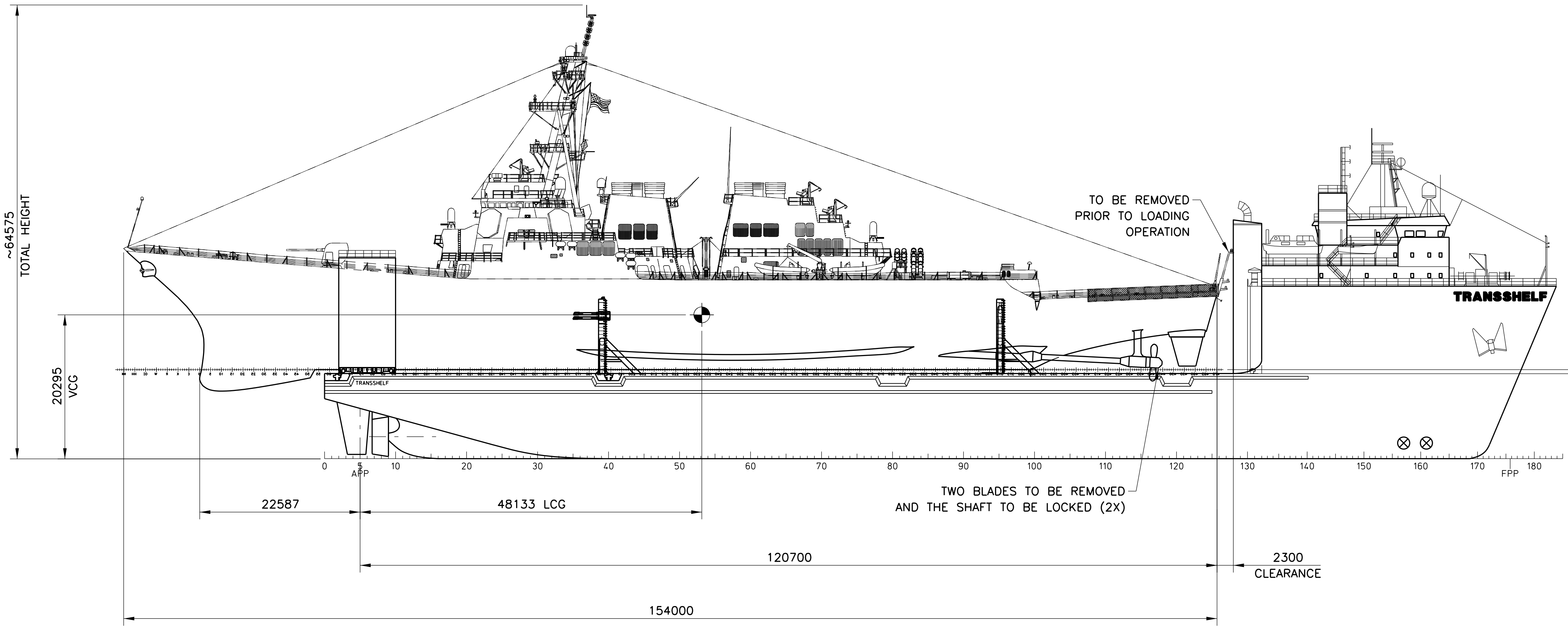
SUBJECT
STOWAGE PLAN
TOP VIEW

Dockwise Shipping B.V.

DOCKWISE

SCALE	DOCKWISE DRAWING NO.	SHT.	REV.
1:750	DW–0030270–001–01		0

PREPARED USING DOCKWISE MICROSTATION CAD SYSTEM FORMAT:A3 TEMPLATE [DOCKWISE_2011] SEARCH KEYS (1)M.V. TRANSSHELF (2) CARGO (3) 64354 03/Nov/2017 11:29 DW–0030270–001–01–0.DGN [PROJECTWISE SERVER]



NOTES	REFERENCE LIST		REV.	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
			0	11/03/2017	ISSUED FOR TRANSPORT MANUAL
			A	10/13/2017	PRELIMINARY ISSUE

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED – TRANSPORT ENGINEERING	YNVE
CHECKED – TRANSPORT ENGINEERING	YASO
CHECKED – DISCIPLINE	YJPA
CHECKED – ORIGINATOR	YHHO

CLIENT
MSC

CLIENT 2 REF: REV.

CLIENT 1 REF: REV.

DEVELOPMENT

PROJECT
USS FITZGERALD

SUBJECT
STOWAGE PLAN
SIDE VIEW

Dockwise Shipping B.V.

DOCKWISE

SCALE	DOCKWISE DRAWING NO. SHT.	REV.
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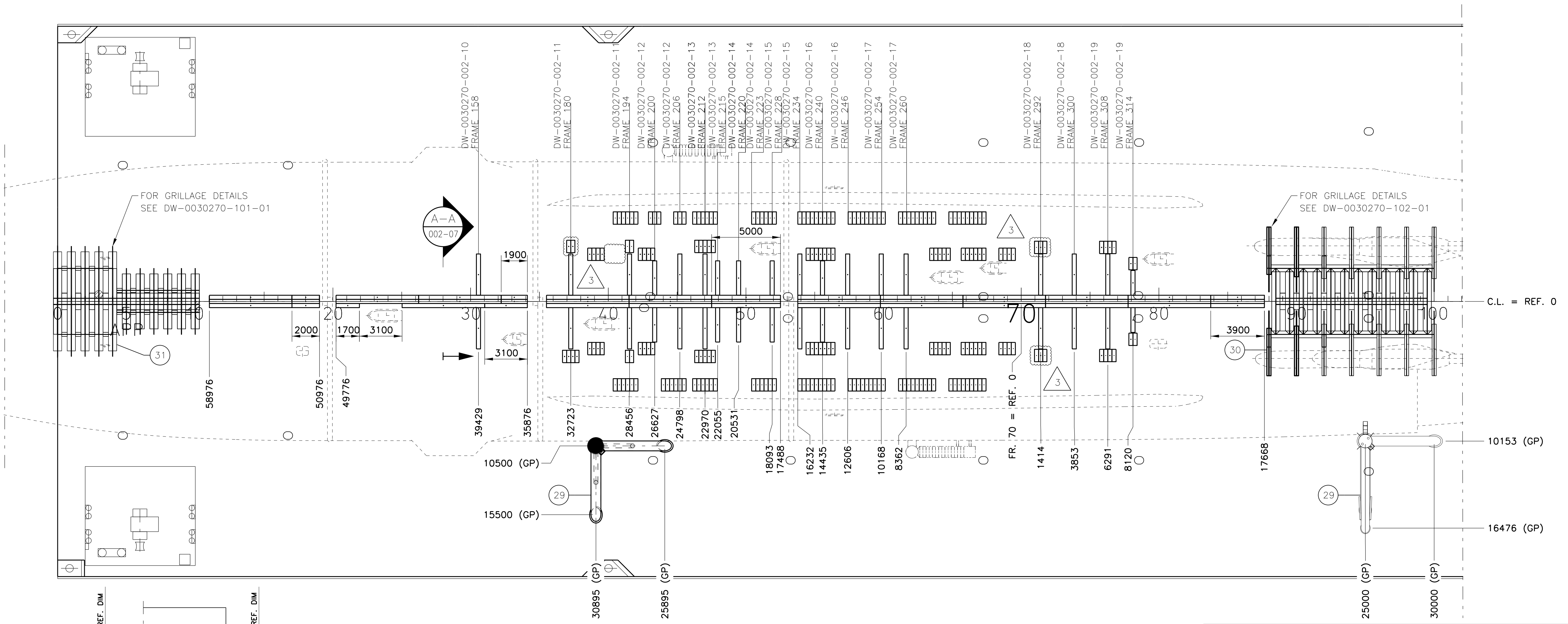
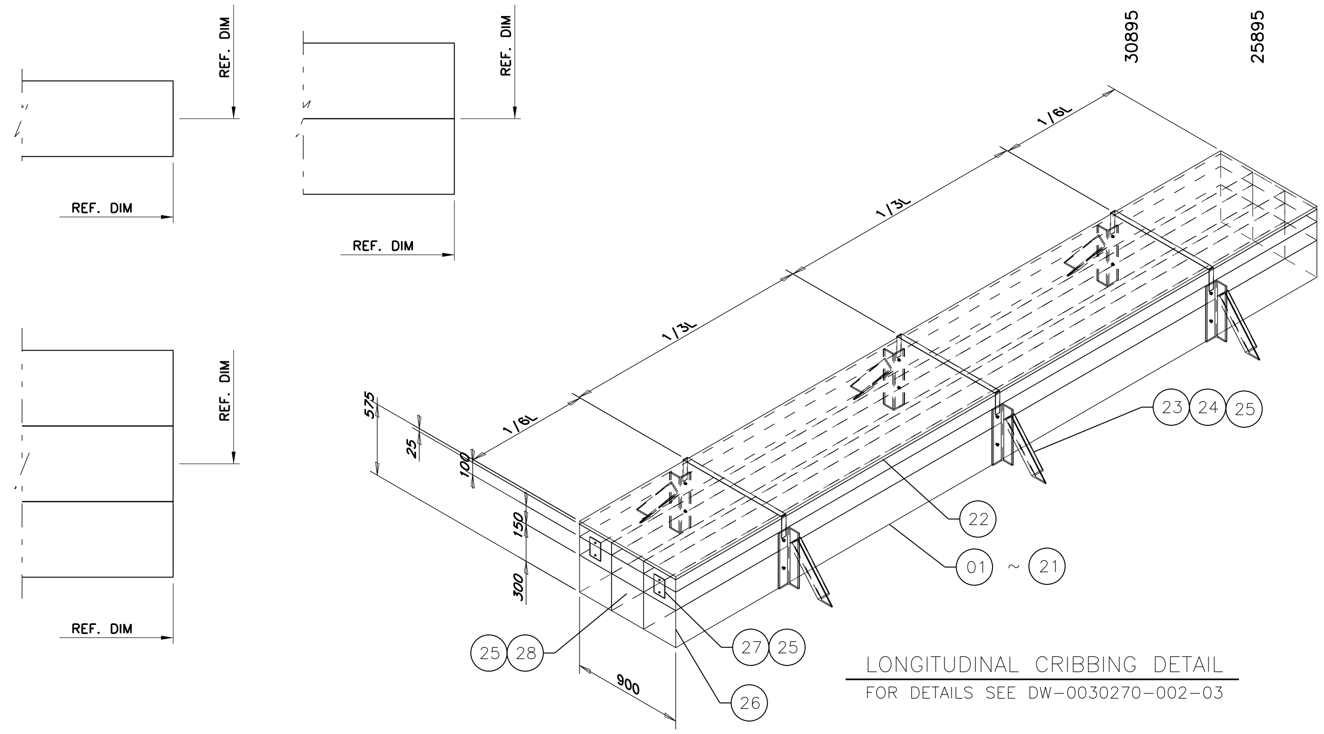




LONGITUDINAL CRIBBING DETAIL

FOR DETAILS SEE DW-0030270-002-03

ITEM	REQ.	DESCRIPTION	DIMENSIONS/DRAWING REFERENCE	WEIGHT
01	29	HARD WOOD	300x300 L=6000	–
02	3	HARD WOOD	300x300 L=5000	–
03	3	HARD WOOD	300x300 L=3900	–
04	1	HARD WOOD	300x300 L=3100	–
05	3	HARD WOOD	300x300 L=2000	–
06	2	HARD WOOD	300x300 L=1900	–
07	1	HARD WOOD	300x300 L=1700	–
08	29	HARD WOOD	150x300 L=6000	–
09	3	HARD WOOD	150x300 L=5000	–
10	3	HARD WOOD	150x300 L=3900	–
11	1	HARD WOOD	300x300 L=3100	–
12	3	HARD WOOD	150x300 L=2000	–
13	2	HARD WOOD	150x300 L=1900	–
14	1	HARD WOOD	150x300 L=1700	–
15	29	SOFT WOOD	100x300 L=6000	–
16	3	SOFT WOOD	100x300 L=5000	–
17	3	SOFT WOOD	100x300 L=3900	–
18	1	SOFT WOOD	100x300 L=3100	–
19	3	SOFT WOOD	100x300 L=2000	–
20	2	SOFT WOOD	100x300 L=1900	–
21	1	SOFT WOOD	100x300 L=1700	–
22	30	PLYWOOD	25x900 L=2440	–
23	84	CRIBBING SUPPORT	DW-0030270-002-04	–
24	42	FLAT BAR	3x40 L=1275	–
25	216	LAG BOLT	DIA. 10x100 (DIN 571)	–
26	16	ANGLE BAR	100x100x10 L=450	–
27	16	NAIL CHIP 5x100 L=150	DW-0030270-002-05	–
28	8	NAIL CHIP 5x100 L=500	DW-0030270-002-06	–
29	2	GUIDE POST	DW-0030270-004-03	–
30	1	GRILLAGE FWD	DW-0030270-102-01	–
31	1	GRILLAGE AFT	DW-0030270-101-01	–
			TOTAL WEIGHT (KG)	–

NOTES

REFERENCE LIST	
DW-0030270-002-02	CRIBBING PLAN TOP VIEW CRIBBING BLOCK SETS

REV.	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
3	12/01/2017	ISSUED FOR TRANSPORT MANUAL REVISED AS INDICATED
2	11/30/2017	ISSUED FOR TRANSPORT MANUAL REVISED AS INDICATED
1	11/16/2017	ISSUED FOR TRANSPORT MANUAL REVISED AS INDICATED
0	11/03/2017	ISSUED FOR TRANSPORT MANUAL REVISED AS INDICATED
A	10/13/2017	PRELIMINARY ISSUE

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED – TRANSPORT ENGINEERING	YRPO
CHECKED – TRANSPORT ENGINEERING	YASO
CHECKED – DISCIPLINE	YJPA
CHECKED – ORIGINATOR	DBMN

CLIENT: MSC

CLIENT 2 REF: REV.

CLIENT 1 REF: REV.

DEVELOPMENT

PROJECT: USS FITZGERALD

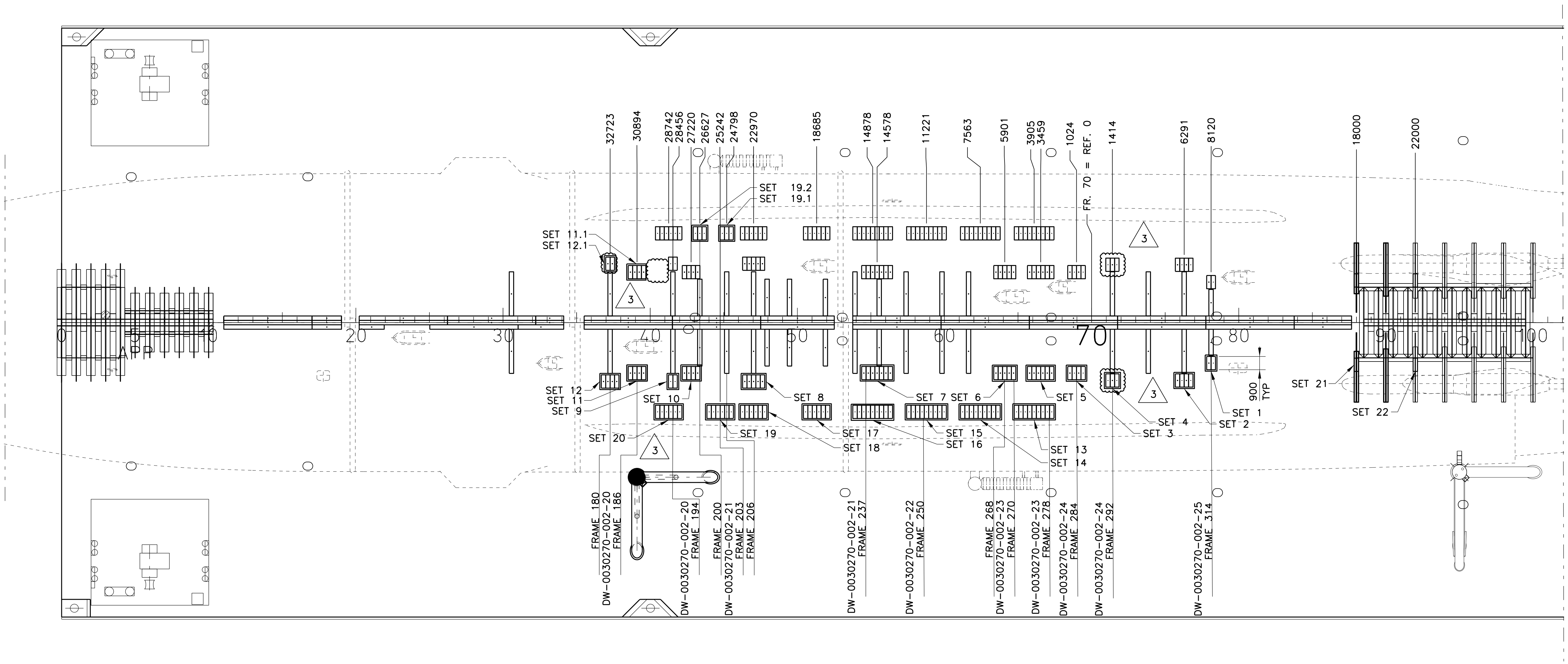
SUBJECT: CRIBBING PLAN
TOP VIEW
LONGITUDINAL & TRANSVERSE CRIBBING

Dockwise Shipping B.V.

DOCKWISE

SCALE	DOCKWISE DRAWING NO.	SHT.	REV.
1:300	DW-0030270-002-01		3

PREPARED USING DOCKWISE MICROSTATION CAD SYSTEM FORMAT:A3 TEMPLATE [DOCKWISE_2011] SEARCH KEYS (1)M.V. TRANSSHELF (2) CARGO (3) 64354 01/Dec/2017 11:39 DW-0030270-002-01-3.DGN [PROJECTWISE SERVER]



NOTES	REFERENCE LIST		REV.	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
	DW-0030270-002-01	CRIBBING PLAN TOP VIEW LONGITUDINAL & TRANSVERSE CRIBBING	3	12/01/2017	ISSUED FOR TRANSPORT MANUAL UPDATED AS INDICATED
			2	11/30/2017	ISSUED FOR TRANSPORT MANUAL UPDATED AS INDICATED
			1	11/16/2017	ISSUED FOR TRANSPORT MANUAL UPDATED AS INDICATED
			0	11/03/2017	ISSUED FOR TRANSPORT MANUAL

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED – TRANSPORT ENGINEERING	YRPO
CHECKED – TRANSPORT ENGINEERING	YASD
CHECKED – DISCIPLINE	YJPA
CHECKED – ORIGINATOR	DBMN

CLIENT: MSC

CLIENT 2 REF: REV.

CLIENT 1 REF: REV.

DEVELOPMENT

PROJECT: USS FITZGERALD

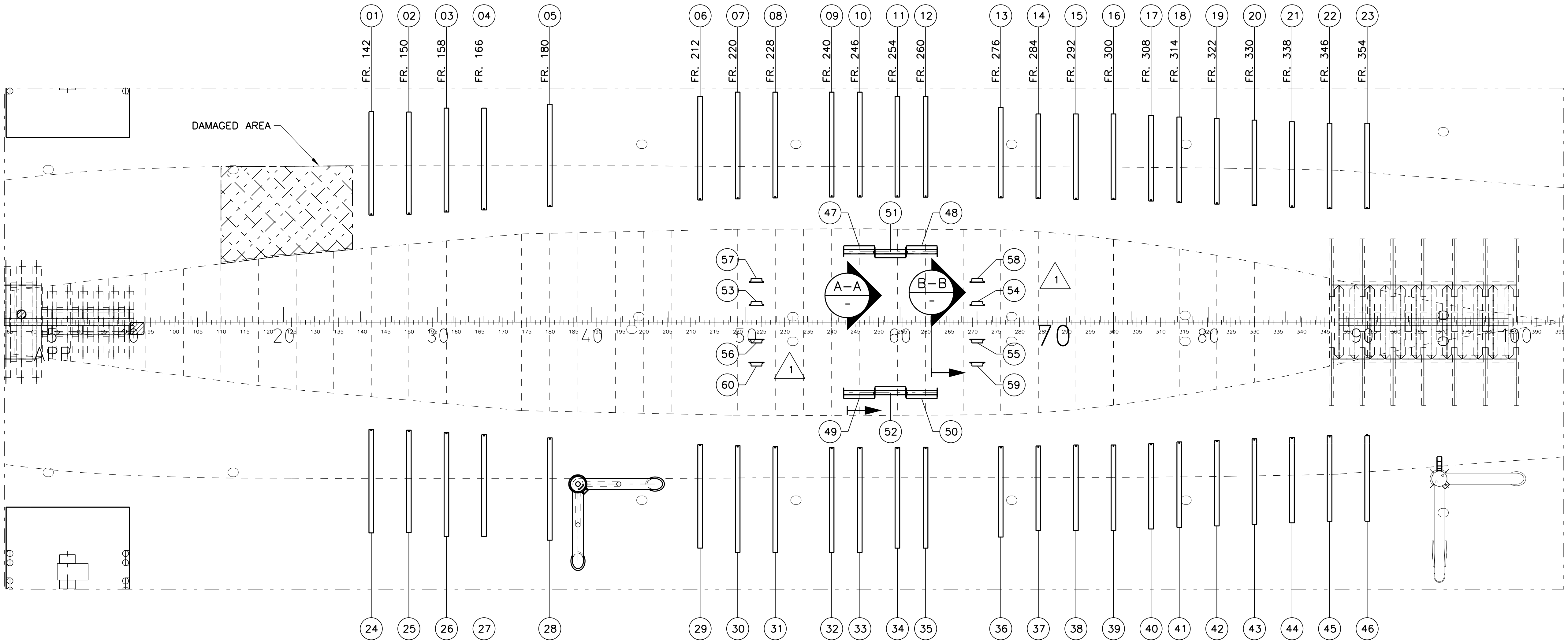
SUBJECT: CRIBBING PLAN
TOP VIEW
CRIBBING BLOCK SETS

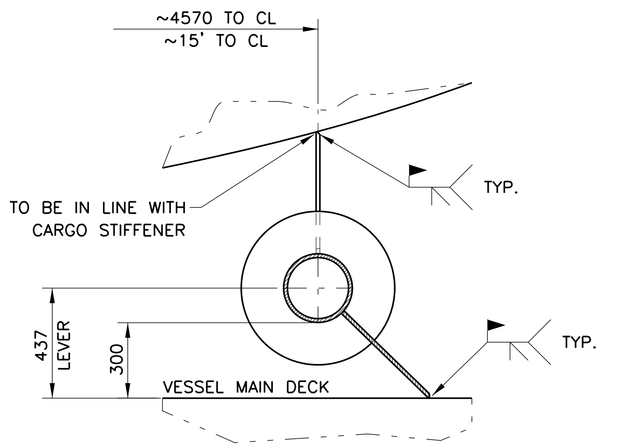
Dockwise Shipping B.V.

DOCKWISE

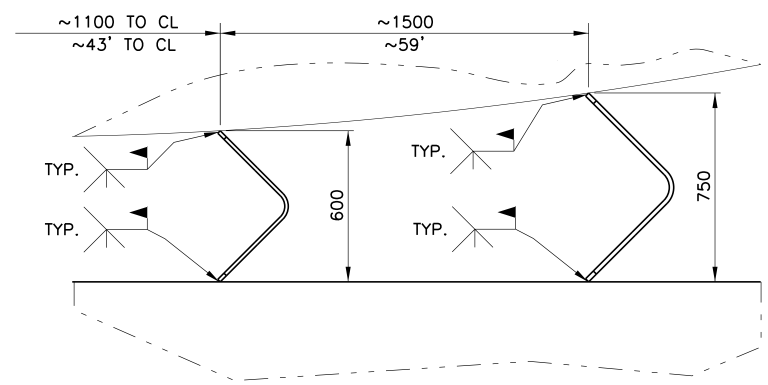
SCALE	DOCKWISE DRAWING NO. SHT.	REV.
1:300	DW-0030270-002-02	3

PREPARED USING DOCKWISE MICROSTATION CAD SYSTEM FORMAT:A3 TEMPLATE [DOCKWISE_2011] SEARCH KEYS (1)M.V. TRANSSHELF (2) CARGO (3) 64354 01/Dec/2017 11:39 DW-0030270-002-02-3.DGN [PROJECTWISE SERVER]





SECTION A–A
1:30



SECTION B–B
1:30

ITEM	REQ.	DESCRIPTION	DIMENSIONS/DRAWING REFERENCE	WEIGHT
01–46	46	TRV SEAFASTENING	DW–0030270–003–03	–
47–52	6	STRONG BOX	DW–0030270–003–02	–
53–56	4	BEND PLATE 600	DW–0030270–003–06	–
57–60	4	BEND PLATE 750	DW–0030270–003–06	–
			TOTAL WEIGHT (KG)	–

NOTES

WELDING [UNLESS NOTED OTHERWISE]
TO BE IN ACCORDANCE AMERICAN WELDING SOCIETY CODES
ALL WELDING PREPARATIONS TO BE MADE BY FABRICATOR
TO BE FULLY PENETRATED UNLESS NOTED OTHERWISE

REFERENCE LIST

DW–0030270–003–02	SEAFASTENING PLAN STRONG BOX (PIPE) CONSTRUCTION
DW–0030270–003–03	SEAFASTENING PLAN TRANSVERSE SEAFASTENINGS TABLE
DW–0030270–003–06	SEAFASTENING PLAN BEND PLATES DETAILS

REV.	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
1	11/17/2017	ISSUED FOR TRANSPORT MANUAL REVISED AS INDICATED
0	11/03/2017	ISSUED FOR TRANSPORT MANUAL
A	10/13/2017	PRELIMINARY ISSUE

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED – TRANSPORT ENGINEERING	YRPO
CHECKED – TRANSPORT ENGINEERING	YASO
CHECKED – DISCIPLINE	YJPA
CHECKED – ORIGINATOR	DBMN

CLIENT
MSC

CLIENT 2 REF: REV.
CLIENT 1 REF: REV.

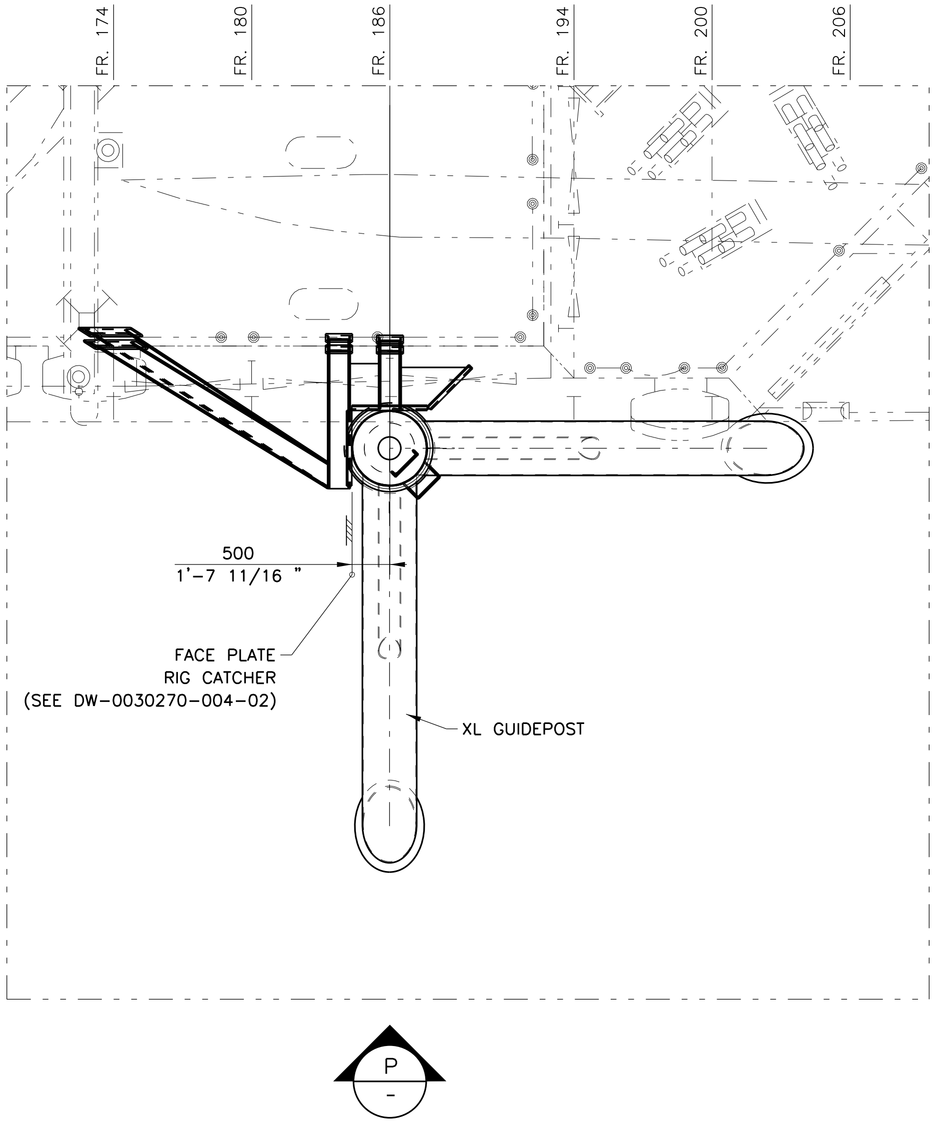
DEVELOPMENT

PROJECT
USS FITZGERALD

SUBJECT
SEAFASTENING PLAN
TOP VIEW

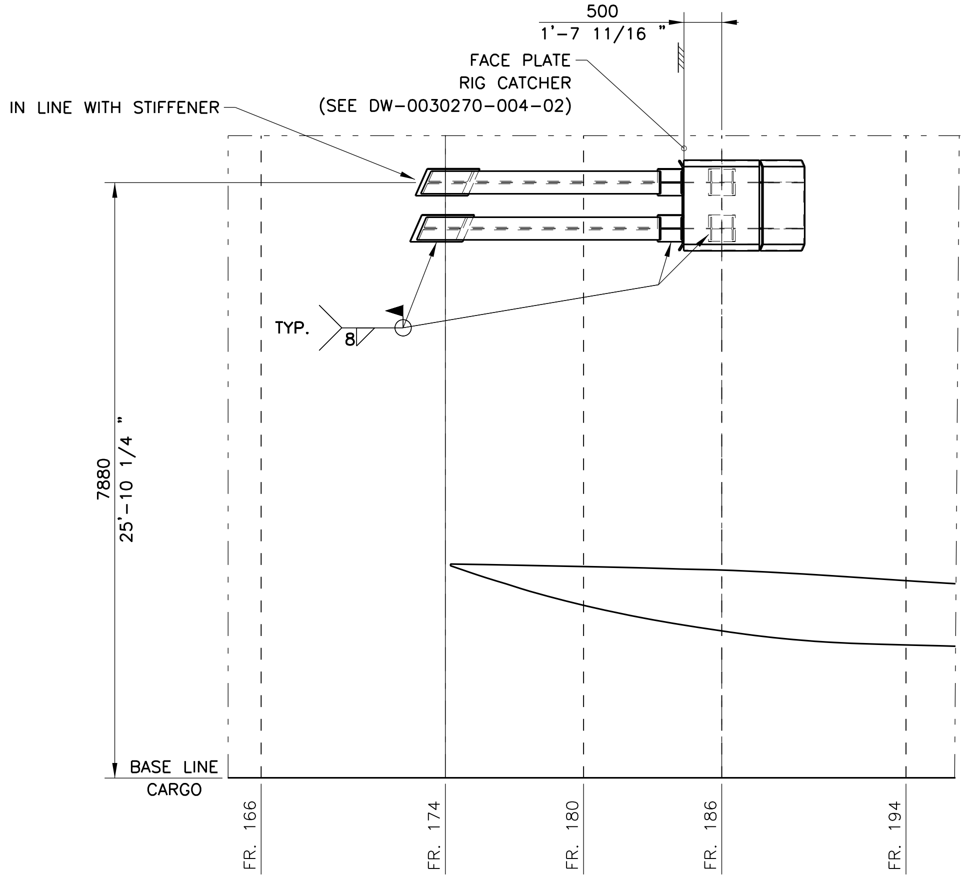
Dockwise Shipping B.V.
DOCKWISE

SCALE	DOCKWISE DRAWING NO. SHT.	REV.
1:300	DW–0030270–003–01	1



DETAIL 1 / -

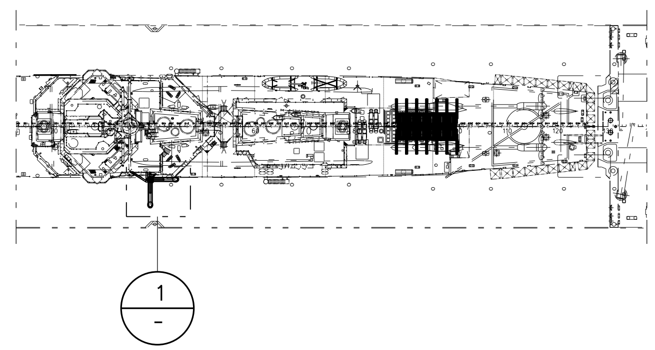
0



VIEW P / - XL GUIDEPOST
OMITTED FOR CLARITY

0

KEY PLAN



NOTES	REFERENCE LIST		REV.	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
MATERIALS [UNLESS NOTED OTHERWISE] ALL STEEL YIELD STRESS 235 N/MM2 OR EQUIVALENT WELDING [UNLESS NOTED OTHERWISE] TO BE IN ACCORDANCE AMERICAN WELDING SOCIETY CODES ALL WELDING PREPARATIONS TO BE MADE BY FABRICATOR TO BE FULLY PENETRATED UNLESS NOTED OTHERWISE			0	11/03/2017	ISSUED FOR CONSTRUCTION UPDATED DESIGN
			B	10/19/2017	PRELIMINARY ISSUE UPDATED DESIGN
			A	10/13/2017	PRELIMINARY ISSUE

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED - TRANSPORT ENGINEERING	YNVE
CHECKED - TRANSPORT ENGINEERING	YASO
CHECKED - DISCIPLINE	YJPA
CHECKED - ORIGINATOR	YHHO

CLIENT: MSC

CLIENT 2 REF: REV.

CLIENT 1 REF: REV.

DEVELOPMENT

PROJECT: USS FITZGERALD

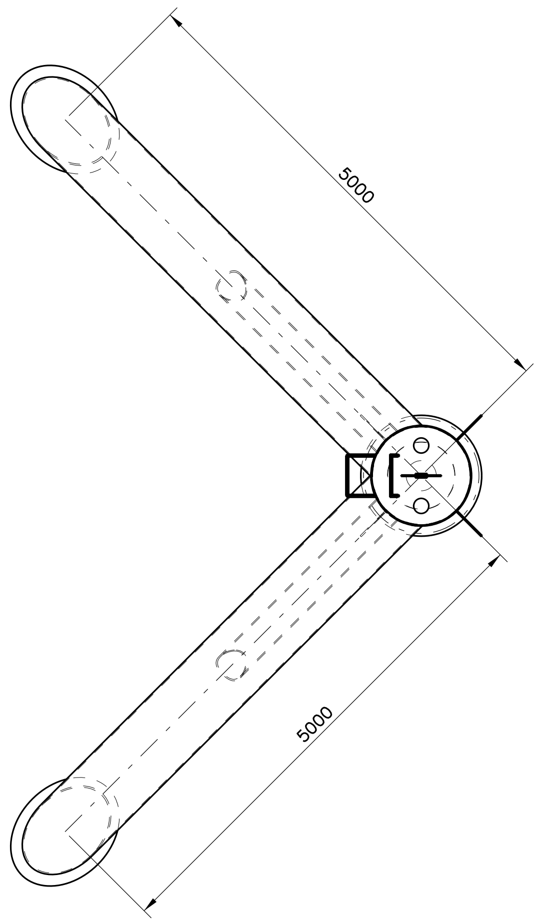
SUBJECT: RIG CATCHER
INSTALLATION PLAN

Dockwise Shipping B.V.

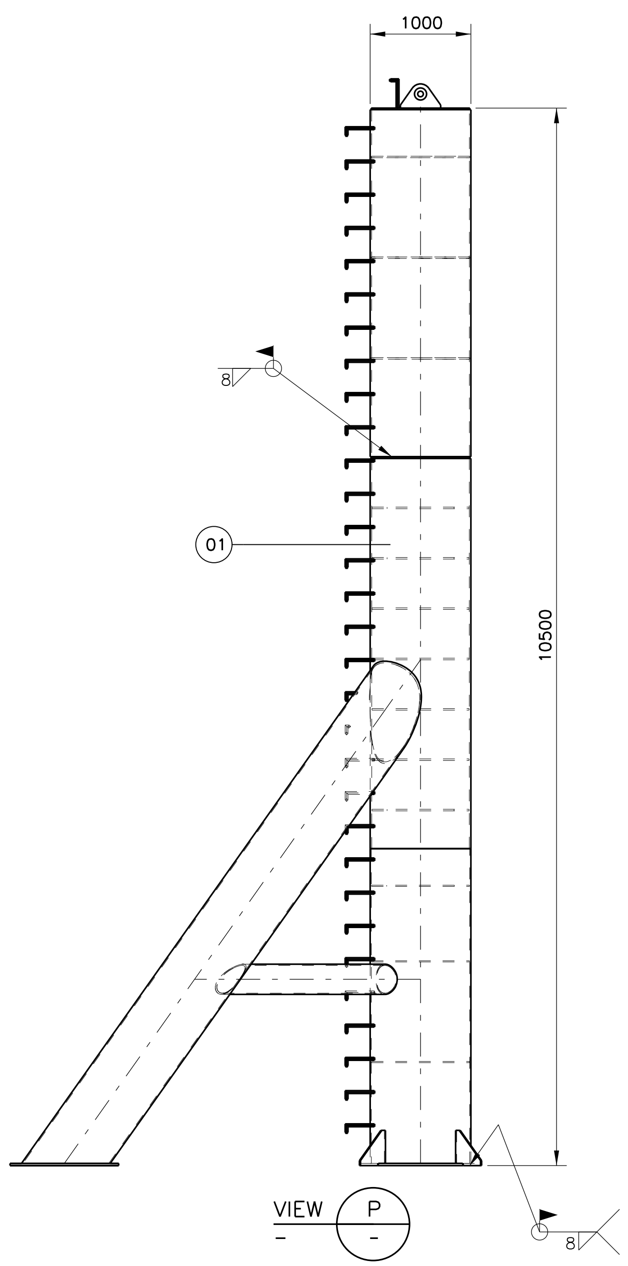
DOCKWISE

SCALE	DOCKWISE DRAWING NO. SHT.	REV.
1:100	DW-0030270-004-01	0

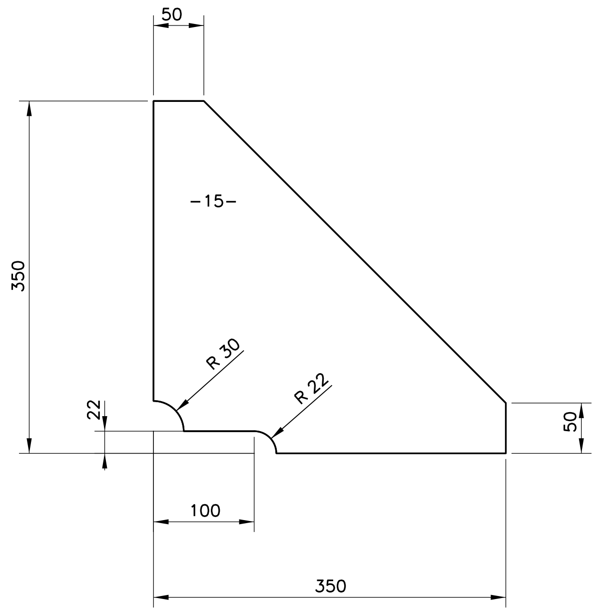
PREPARED USING DOCKWISE MICROSTATION CAD SYSTEM FORMAT:A3 TEMPLATE [DOCKWISE_2011] SEARCH KEYS (1)M.V. TRANSSHELF (2) CARGO (3) 64354 03/Nov/2017 13:37 DW-0030270-004-01-0.DGN [PROJECTWISE SERVER]



P
-



VIEW P
- -



ITEM 04
1:10 -

ITEM	REQ.	DESCRIPTION	DIMENSIONS/DRAWING REFERENCE	WEIGHT
01	1	GUIDEPOST EXTRA LARGE	REF. DWG. EQUIP04-010-01	7203
02	4	BRACKET	350x350x15	35
			TOTAL WEIGHT (KG)	8849

NOTES

MATERIALS [UNLESS NOTED OTHERWISE]
ALL STEEL YIELD STRESS 235 N/MM2 OR EQUIVALENT

WELDING [UNLESS NOTED OTHERWISE]
TO BE IN ACCORDANCE AMERICAN WELDING SOCIETY CODES
ALL WELDING PREPARATIONS TO BE MADE BY FABRICATOR
TO BE FULLY PENETRATED UNLESS NOTED OTHERWISE

REFERENCE LIST

REV.	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
0	11/03/2017	ISSUED FOR TRANSPORT MANUAL

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED - TRANSPORT ENGINEERING	YNVE
CHECKED - TRANSPORT ENGINEERING	YASO
CHECKED - DISCIPLINE	YJPA
CHECKED - ORIGINATOR	YHHO

CLIENT
MSC

CLIENT 2 REF: REV.
CLIENT 1 REF: REV.

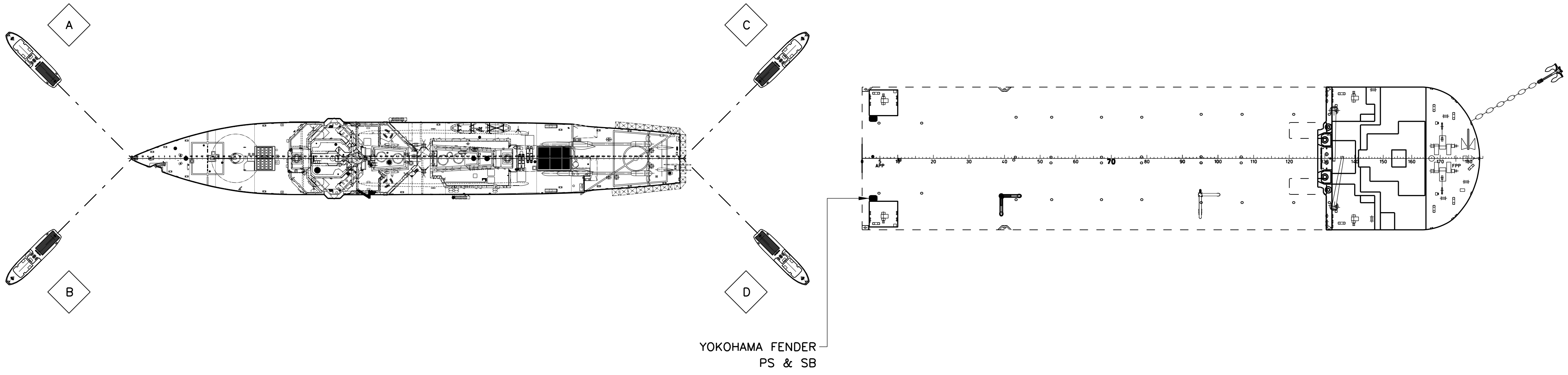
DEVELOPMENT

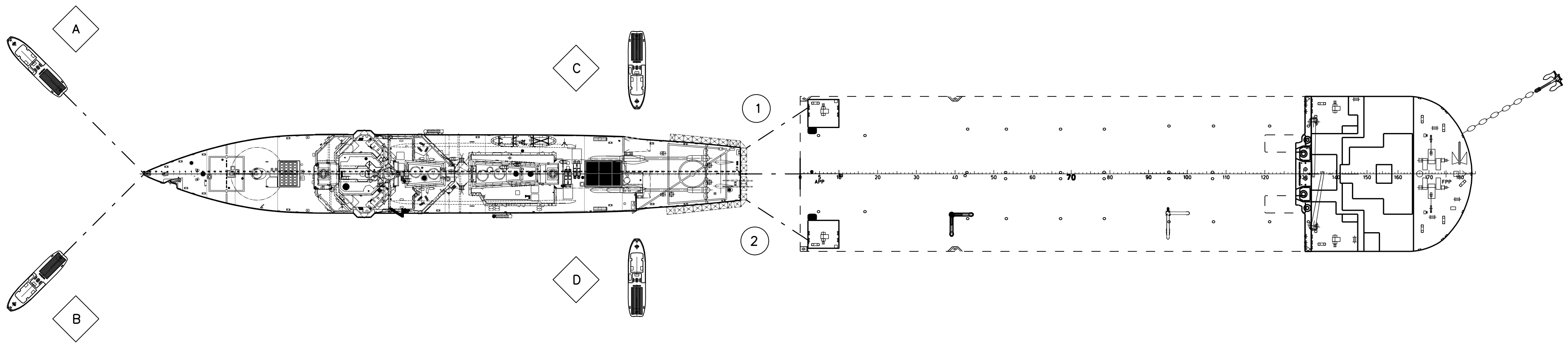
PROJECT
USS FITZGERALD

SUBJECT
GUIDEPOST EXTRA LARGE
CONSTRUCTION
MARLIN CLASS

DOCKWISE
Dockwise Shipping B.V.

SCALE	DOCKWISE DRAWING NO. SHT.	REV.
1:75	DW-0030270-004-06	0





NOTES	REFERENCE LIST		REV.	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
THE STEPS IN THIS DRAWING ARE FOR GUIDANCE ONLY			0	11/03/2017	ISSUED FOR TRANSPORT MANUAL
			A	10/13/2017	PRELIMINARY ISSUE

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED – TRANSPORT ENGINEERING	YNVE
CHECKED – TRANSPORT ENGINEERING	YASD
CHECKED – DISCIPLINE	YJPA
CHECKED – ORIGINATOR	DBMN

CLIENT: MSC

CLIENT 2 REF: REV.

CLIENT 1 REF: REV.

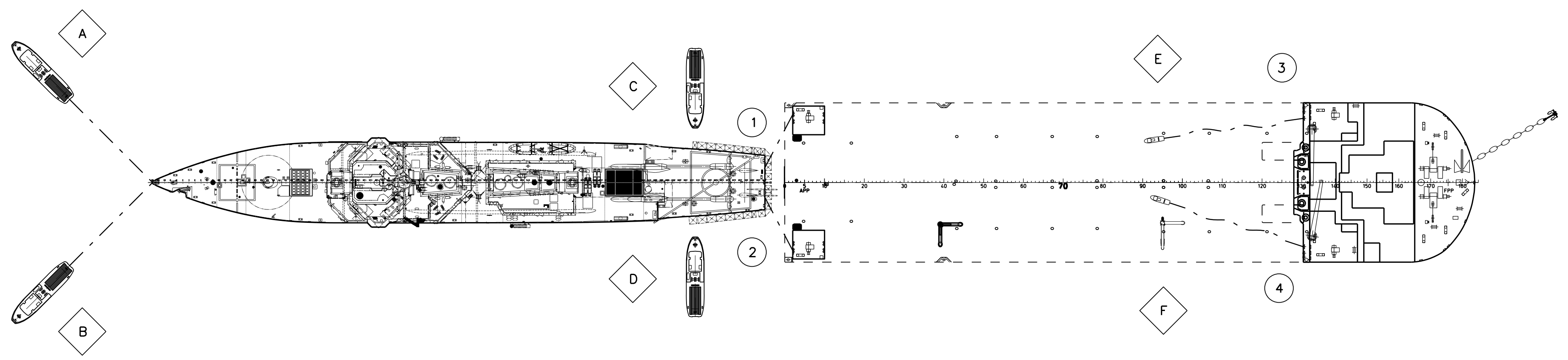
DEVELOPMENT

PROJECT: USS FITZGERALD

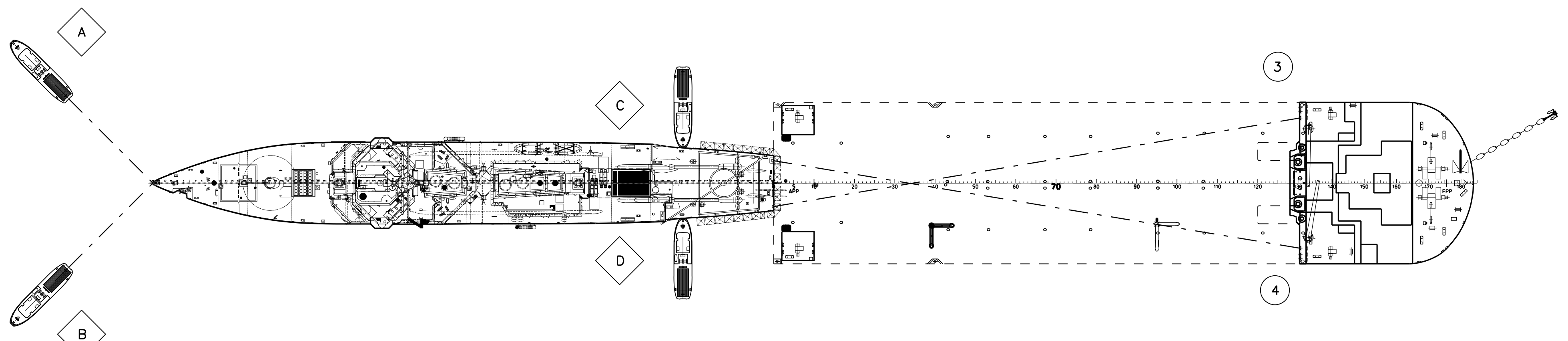
SUBJECT: LOADING SEQUENCE
TOP VIEW
STEP 1 – 2

Dockwise Shipping B.V.

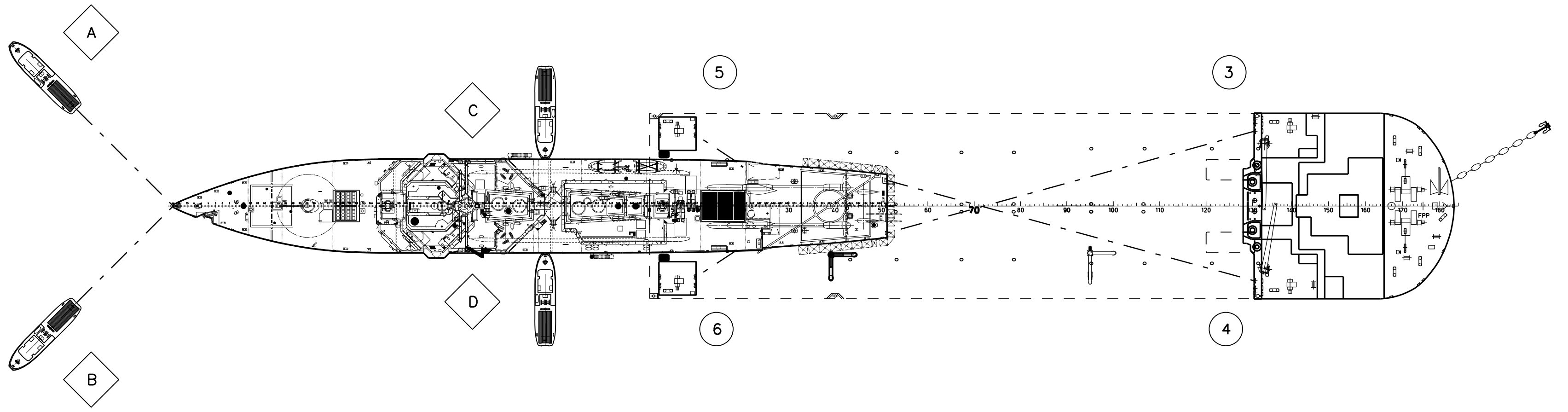
SCALE	DOCKWISE DRAWING NO. SHT.	REV.
1:1,500	DW–0030270–005–01	0



STEP 3



STEP 4



STEP 5

NOTES	REFERENCE LIST	REV.	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
THE STEPS IN THIS DRAWING ARE FOR GUIDANCE ONLY		0	11/03/2017	ISSUED FOR TRANSPORT MANUAL
		A	10/13/2017	PRELIMINARY ISSUE

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED – TRANSPORT ENGINEERING	YNVE
CHECKED – TRANSPORT ENGINEERING	YASD
CHECKED – DISCIPLINE	YJPA
CHECKED – ORIGINATOR	DBMN

CLIENT
MSC

CLIENT 2 REF: REV.

CLIENT 1 REF: REV.

DEVELOPMENT

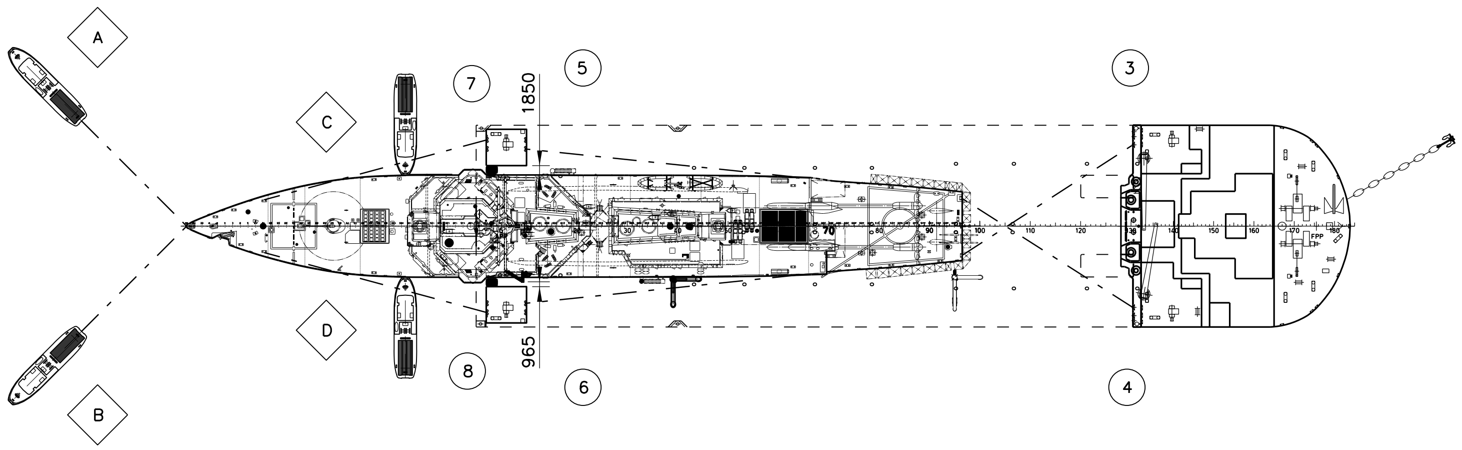
PROJECT
USS FITZGERALD

SUBJECT
LOADING SEQUENCE
TOP VIEW
STEP 3 – 4 – 5

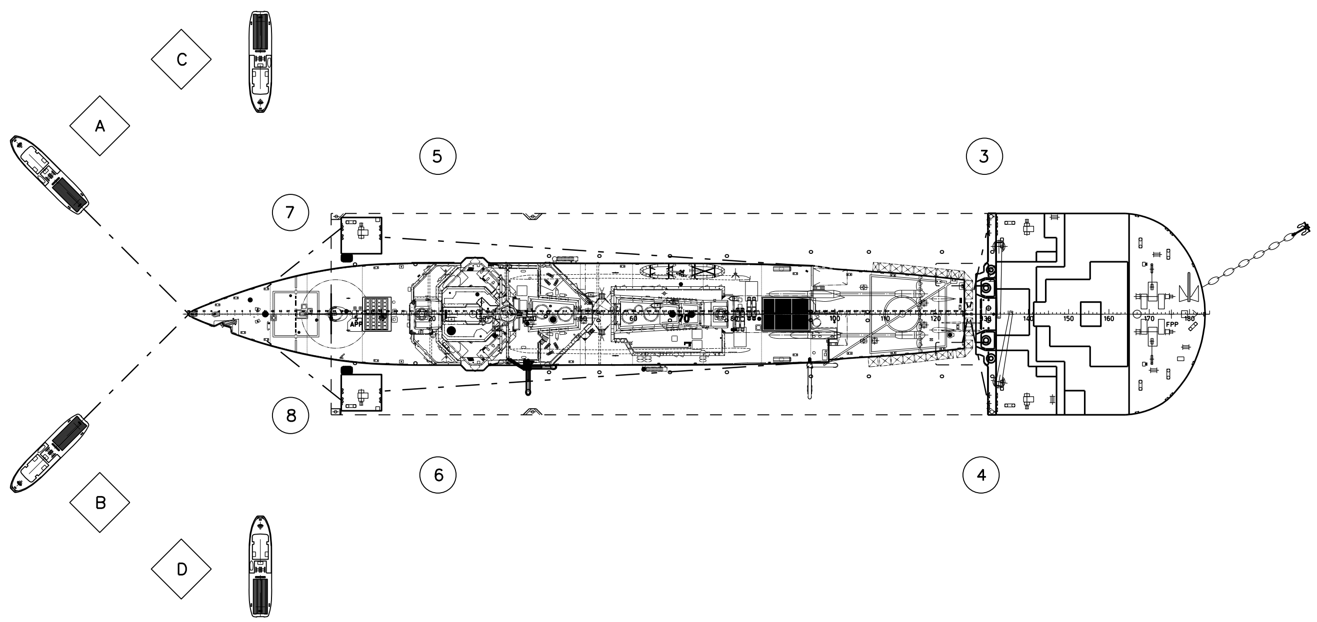
DOCKWISE
Dockwise Shipping B.V.

SCALE	DOCKWISE DRAWING NO. SHT.	REV.
1:1,500	DW-0030270-005-02	0

PREPARED USING DOCKWISE MICROSTATION CAD SYSTEM FORMAT:A3 TEMPLATE [DOCKWISE_2011] SEARCH KEYS (1)M.V. TRANSSHELF (2) CARGO (3) 64354 03/Nov/2017 13:39 DW-0030270-005-02-0.DGN [PROJECTWISE SERVER]



STEP 6



STEP 7

NOTES	REFERENCE LIST	REV.	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
THE STEPS IN THIS DRAWING ARE FOR GUIDANCE ONLY		0	11/03/2017	ISSUED FOR TRANSPORT MANUAL
		A	10/13/2017	PRELIMINARY ISSUE

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED – TRANSPORT ENGINEERING	YNVE
CHECKED – TRANSPORT ENGINEERING	YASD
CHECKED – DISCIPLINE	YJPA
CHECKED – ORIGINATOR	DBMN

CLIENT: MSC

CLIENT 2 REF: REV.

CLIENT 1 REF: REV.

DEVELOPMENT

PROJECT: USS FITZGERALD

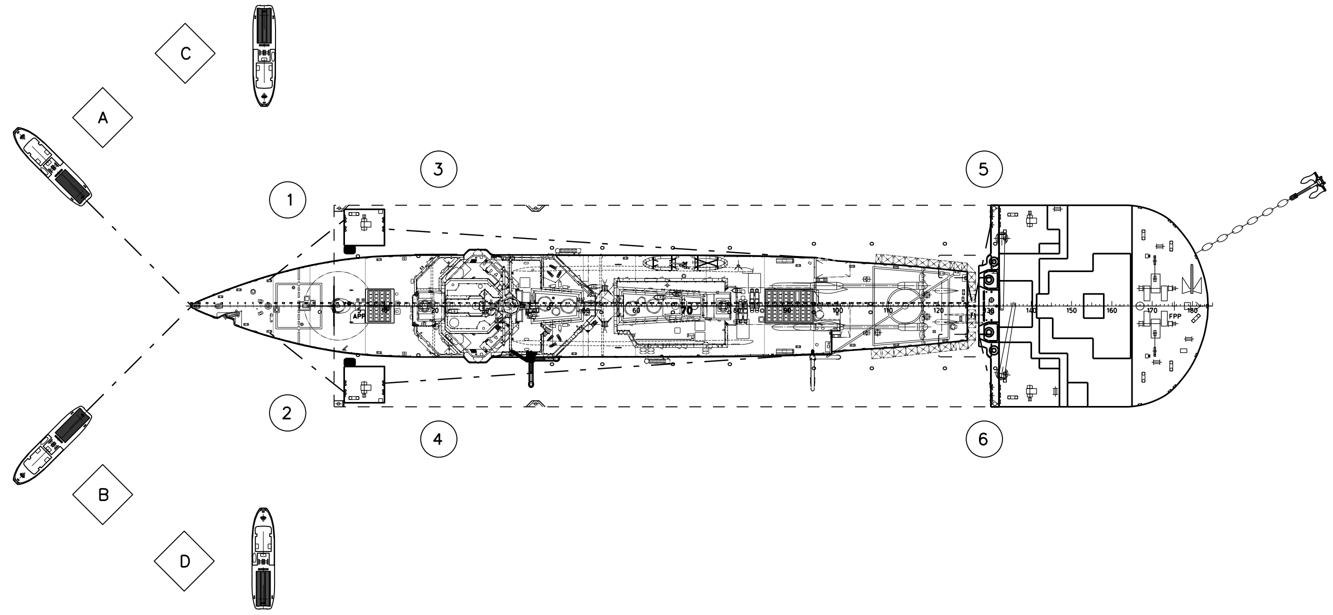
SUBJECT: LOADING SEQUENCE
TOP VIEW
STEP 6 – 7

Dockwise Shipping B.V.

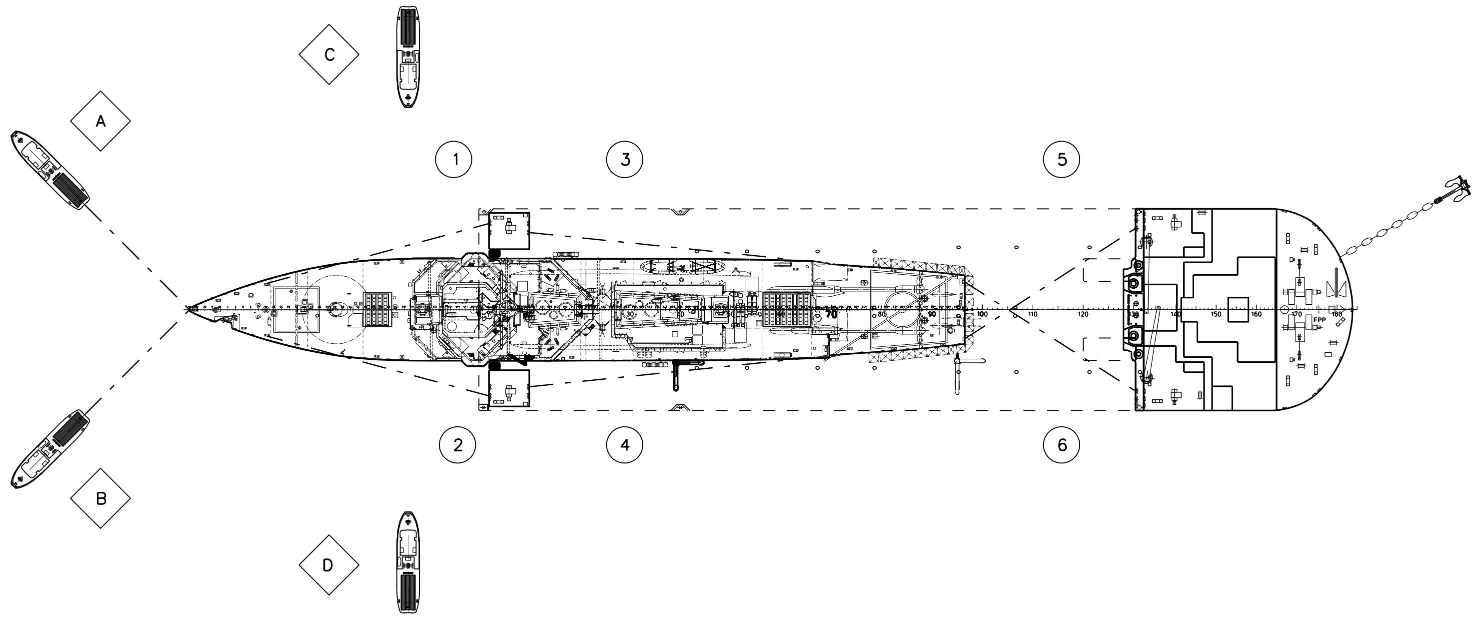
DOCKWISE

SCALE	DOCKWISE DRAWING NO. SHT.	REV.
1:1,500	DW-0030270-005-03	0

PREPARED USING DOCKWISE MICROSTATION CAD SYSTEM FORMAT:A3 TEMPLATE [DOCKWISE_2011] SEARCH KEYS (1)M.V. TRANSSHELF (2) CARGO (3) 64354 03/Nov/2017 13:37 DW-0030270-005-03-0.DGN [PROJECTWISE SERVER]



STEP 1



STEP 2

NOTES	REFERENCE LIST		REV.	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
THE STEPS IN THIS DRAWING ARE FOR GUIDANCE ONLY			0	11/03/2017	ISSUED FOR TRANSPORT MANUAL
			A	10/13/2017	PRELIMINARY ISSUE

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED – TRANSPORT ENGINEERING	YNVE
CHECKED – TRANSPORT ENGINEERING	YASD
CHECKED – DISCIPLINE	YJPA
CHECKED – ORIGINATOR	DBMN

CLIENT: MSC

CLIENT 2 REF: REV.

CLIENT 1 REF: REV.

DEVELOPMENT

PROJECT: USS FITZGERALD

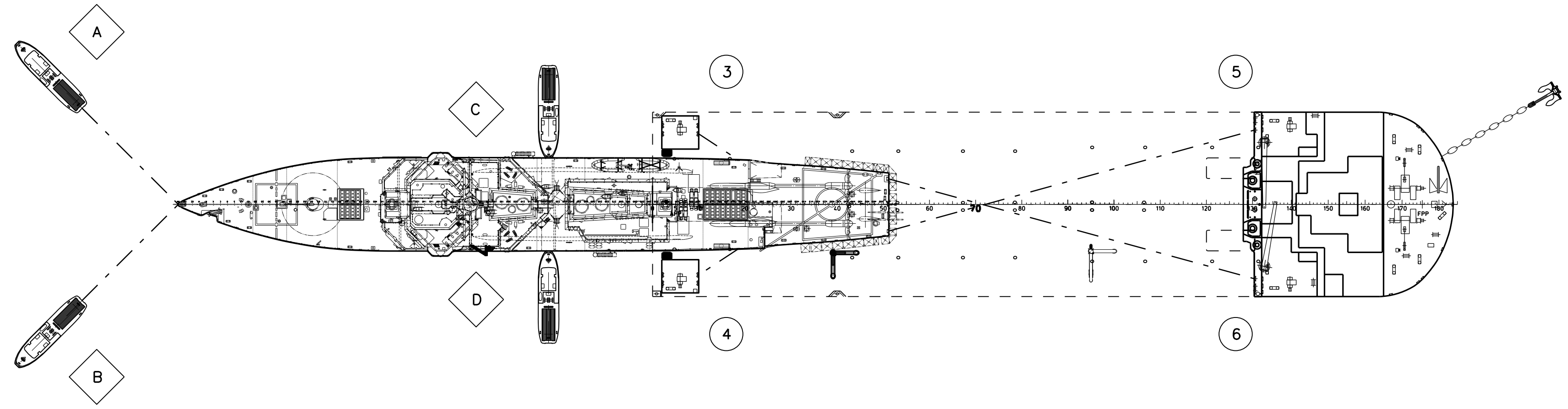
SUBJECT: DISCHARGING SEQUENCE
TOP VIEW
STEP 1 – 2

Dockwise Shipping B.V.

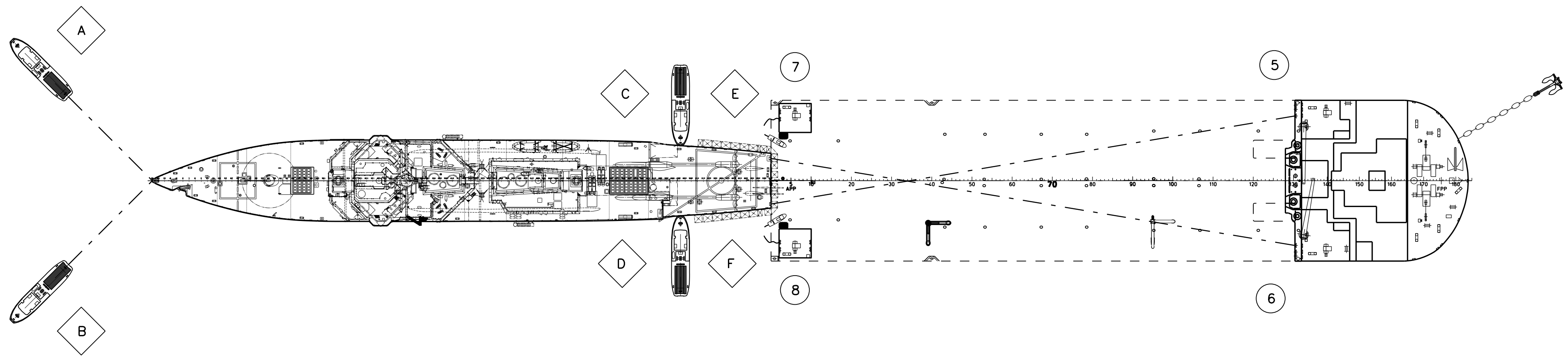
DOCKWISE

SCALE	DOCKWISE DRAWING NO.	SHT.	REV.
1:1,500	DW–0030270–006–01		0

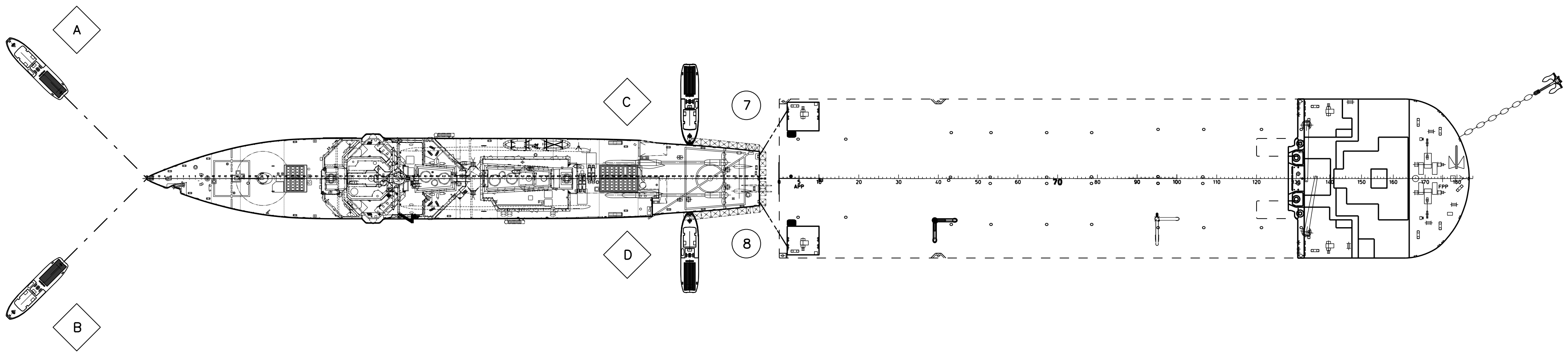
PREPARED USING DOCKWISE MICROSTATION CAD SYSTEM FORMAT:A3 TEMPLATE [DOCKWISE_2011] SEARCH KEYS (1) M.V. TRANSSHELF (2) CARGO (3) 64354 03/Nov/2017 13:38 DW–0030270–006–01–0.DGN [PROJECTWISE SERVER]



STEP 3



STEP 4



STEP 5

NOTES	REFERENCE LIST		REV.	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
THE STEPS IN THIS DRAWING ARE FOR GUIDANCE ONLY			0	11/03/2017	ISSUED FOR TRANSPORT MANUAL
			A	10/13/2017	PRELIMINARY ISSUE

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED – TRANSPORT ENGINEERING	YNVE
CHECKED – TRANSPORT ENGINEERING	YASO
CHECKED – DISCIPLINE	YJPA
CHECKED – ORIGINATOR	DBMN

CLIENT
MSC

CLIENT 2 REF: REV.
CLIENT 1 REF: REV.

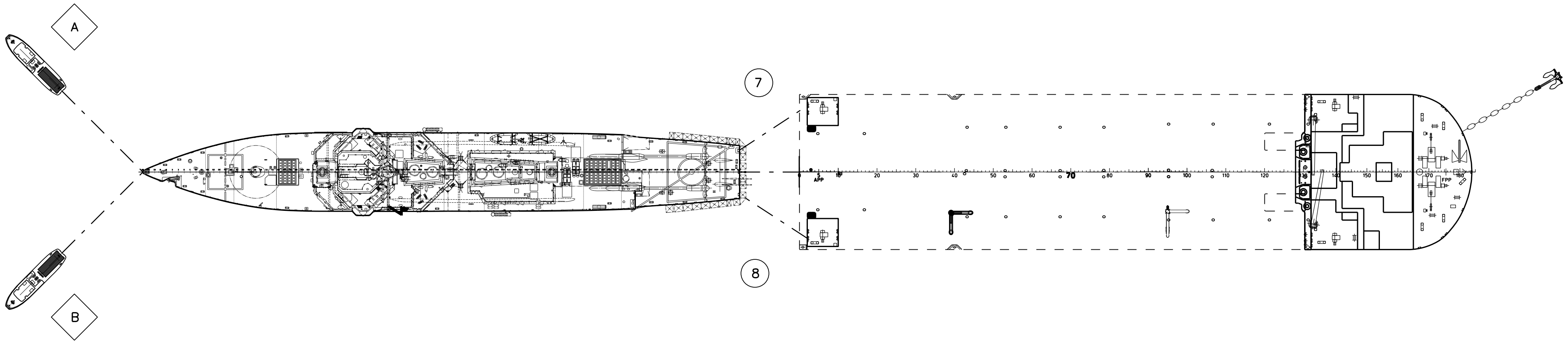
DEVELOPMENT

PROJECT
USS FITZGERALD

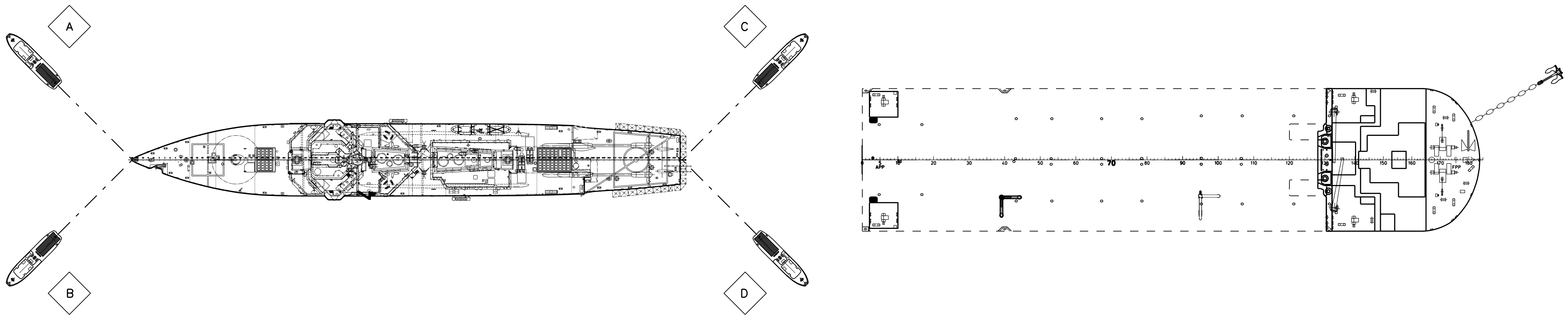
SUBJECT
DISCHARGING SEQUENCE
TOP VIEW
STEP 3 – 4 – 5

Dockwise Shipping B.V.
DOCKWISE

SCALE	DOCKWISE DRAWING NO.	SHT.	REV.
1:1,500	DW-0030270-006-02		0



STEP 6



STEP 7

NOTES	REFERENCE LIST		REV.	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
THE STEPS IN THIS DRAWING ARE FOR GUIDANCE ONLY			0	11/03/2017	ISSUED FOR TRANSPORT MANUAL
			A	10/13/2017	PRELIMINARY ISSUE

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED – TRANSPORT ENGINEERING	YNVE
CHECKED – TRANSPORT ENGINEERING	YASD
CHECKED – DISCIPLINE	YJPA
CHECKED – ORIGINATOR	DBMN

CLIENT: MSC

CLIENT 2 REF: REV.

CLIENT 1 REF: REV.

DEVELOPMENT

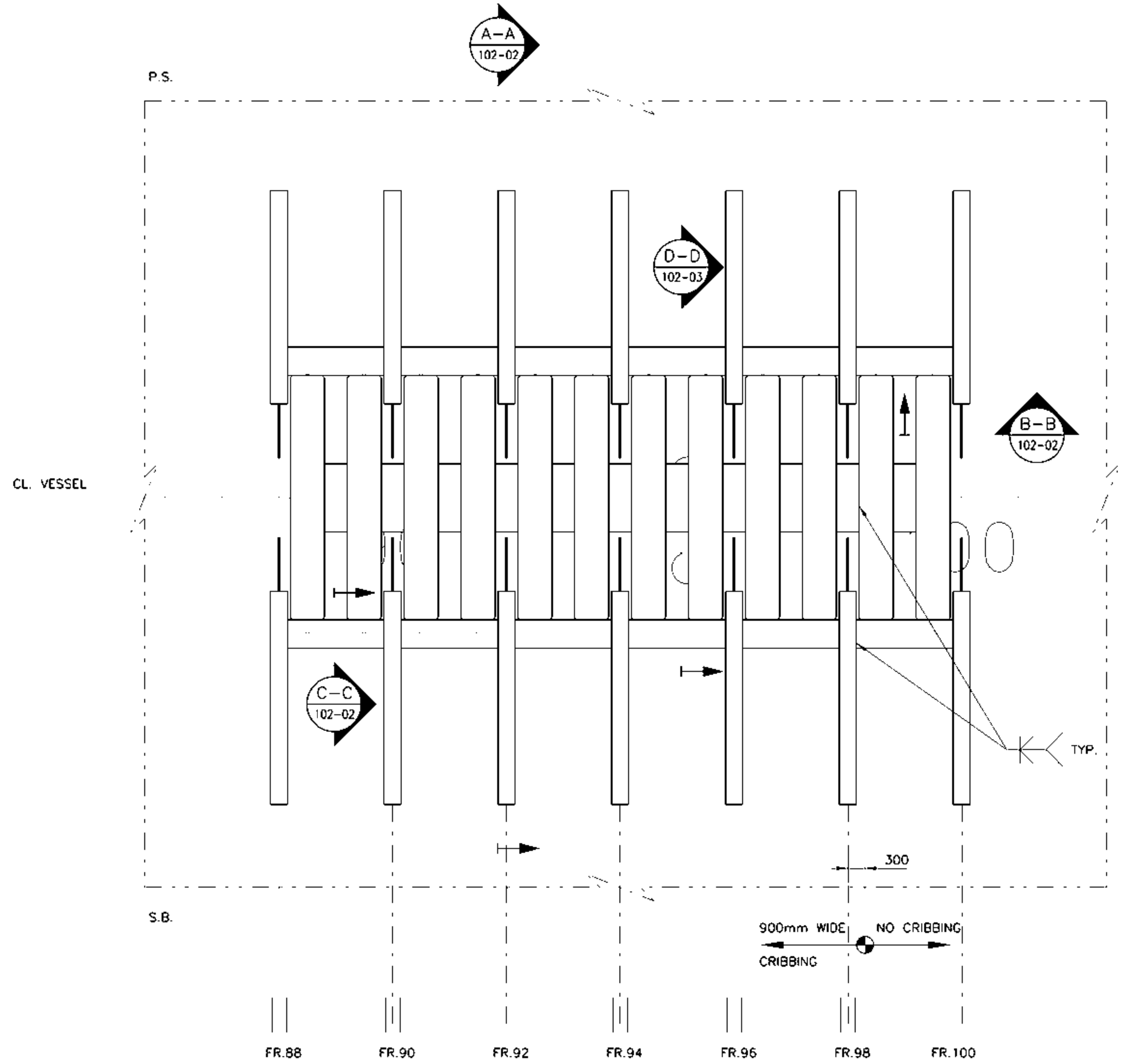
PROJECT: USS FITZGERALD

SUBJECT: DISCHARGING SEQUENCE
TOP VIEW
STEP 6 – 7

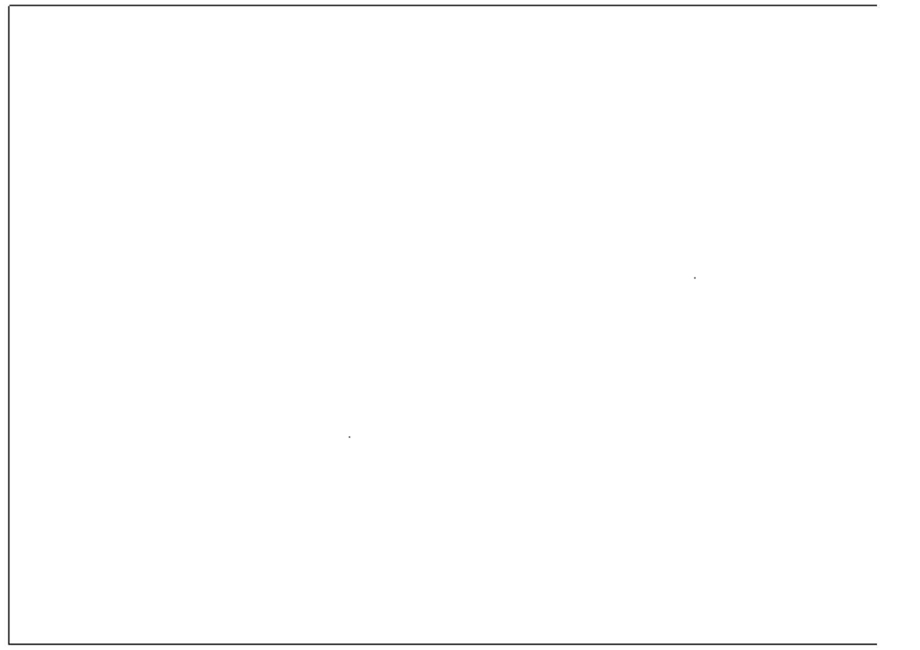
DOCKWISE **Dockwise Shipping B.V.**

SCALE	DOCKWISE DRAWING NO. SHT.	REV.
1:1,500	DW-0030270-006-03	0

PREPARED USING DOCKWISE MICROSTATION CAD SYSTEM FORMAT:A3 TEMPLATE [DOCKWISE_2011] SEARCH KEYS (1)M.V. TRANSSHELF (2) CARGO (3) 64354 03/Nov/2017 13:39 DW-0030270-006-03-0.DGN [PROJECTWISE SERVER]

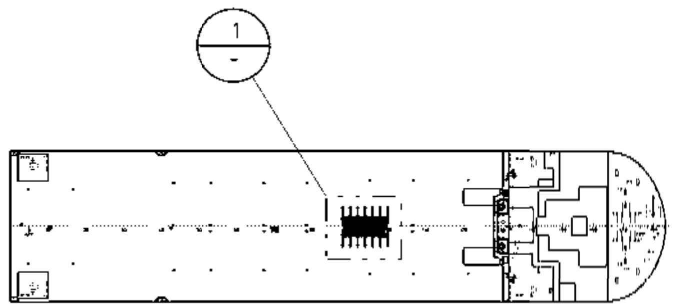


DETAIL 1 / -
1:100



ISOMETRIC VIEW

KEY PLAN



NOTES	REFERENCE LIST		REV	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
1. STEEL SHALL BE ASTM A572-50 WITH YIELD STRESS 345 MPA OR EQUIVALENT			0	11/02/2017	ISSUED FOR CONSTRUCTION
2. RELATED HTV FRAME DIMENSION SURVEY SHALL BE DONE BEFORE GRILLAGE FABRICATOIN TO ENSURE THE GRILLAGE MATCH THEM			B	11/01/2017	ISSUED FOR REVIEW
3. ALL WELDING SHOULD CONFORM WITH AWS D1.1. ALL WELDS TO BE CJP U.N.O.			A	10/20/2017	ISSUED FOR INTERNAL REVIEW
4. BASED ON MATERIAL AVAILABLE IN THE FABRICATION YARD, THE FOLLOWING MATERIAL SUBSTITUTIONS ARE ACCEPTED: SUBSTITUTE 50MM ASTM A572-50 STEEL WITH 45MM ABS AH36 STEEL SUBSTITUTE 30MM ASTM A572-50 STEEL WITH 35MM ABS AH36 STEEL					

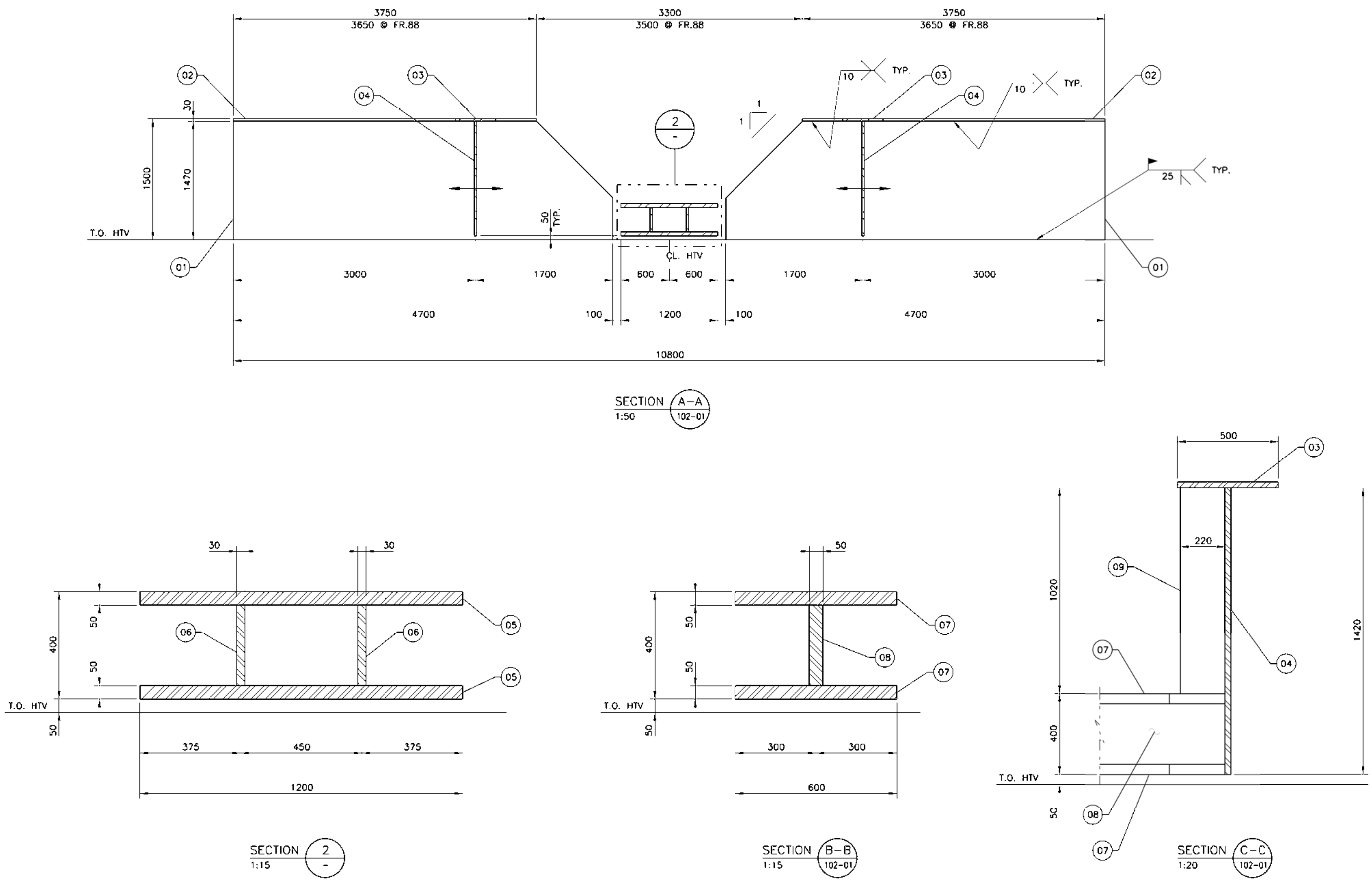
APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED - TRANSPORT ENGINEERING	YBGO
CHECKED - TRANSPORT ENGINEERING	YYWU
CHECKED - DISCIPLINE	YANG
CHECKED - ORIGINATOR	YJTO

CLIENT: MSC
CLIENT 2 REF — REV.
CLIENT 1 REF — REV.

DEVELOPMENT
PROJECT: USS FITZGERALD
SUBJECT: FWD GRILLAGE ON TRANSSHELF GENERAL ARRANGEMENT

Dockwise Shipping B.V.
DOCKWISE

SCALE	DOCKWISE DRAWING NO.	SHT.	REV.
1:100	DW-0030270-102-01		0



NOTES	REFERENCE LIST	REV	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
1. STEEL SHALL BE ASTM A572-50 WITH YIELD STRESS 345 MPA OR EQUIVALENT		0	11/02/2017	ISSUED FOR CONSTRUCTION
2. RELATED HTV FRAME DIMENSION SURVEY SHALL BE DONE BEFORE GRILLAGE FABRICATOIN TO ENSURE THE GRILLAGE MATCH THEM		B	11/01/2017	ISSUED FOR REVIEW
3. ALL WELDING SHOULD CONFORM WITH AWS D1.1. ALL WELDS TO BE CJP U.N.O.		A	10/20/2017	ISSUED FOR INTERNAL REVIEW
4. BASED ON MATERIAL AVAILABLE IN THE FABRICATION YARD, THE FOLLOWING MATERIAL SUBSTITUTIONS ARE ACCEPTED: SUBSTITUTE 50MM ASTM A572-50 STEEL WITH 45MM ABS AH36 STEEL SUBSTITUTE 30MM ASTM A572-50 STEEL WITH 35MM ABS AH36 STEEL				

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED – TRANSPORT ENGINEERING	YBGO
CHECKED – TRANSPORT ENGINEERING	YYWU
CHECKED – DISCIPLINE	YANG
CHECKED – ORIGINATOR	YJTO

CLIENT: MSC

CLIENT 2 REF — REV.

CLIENT 1 REF — REV.

DEVELOPMENT

PROJECT: USS FITZGERALD

SUBJECT: FWD GRILLAGE ON TRANSSHELF SECTIONS AND DETAILS (1 OF 2)

Dockwise Shipping B.V.

DOCKWISE

SCALE	DOCKWISE DRAWING NO. SHT.	REV.
1:50	DW-0030270-102-02	0

PREPARED USING DOCKWISE MICROSTATION SYSTEM FORMATS

Document no.	*0030270*	**DOCUMENT REVIEW SHEET**
Revision	--	
Document title	*0030270-TRS-CSM__Rev 0* *DRAWINGS - DW-0030270.pdf*	

	Sheet prepared by	Project:	Enquiry number	Contract no.	Date
	CAPT David Ferris, NAVSEA OOC	USS Fitzgerald	-	0030270	
	Document status:				

☐ 1. Approved, no comments	☐ 2. Approved with comments	☒ 3. Not Approved, resubmit	☐ 4. For Information	☐ 5. Cancelled/Superseded	☐ 6. As Built

Nr.	Reference	Contractor / Company		DW Comments Reaction	Initials	CLOSE
[1]	Cribbing Plan Top View (30270-002-0)	US Navy	8-11: No Stern Shoring. Stern shoring not required for a normal docking but given the dynamic loading associated with heavy lift stern shoring is required. 14-11: US Navy indicates requirement of stern shoring 15-11: US Navy will review their position, also concerned with the unpredictable forces	10-11:We advise against stern shoring, as this may cause unpredictable forces due to the deflection of the vessel. It is also not considered necessary, similar to the transport of the McCain. 14-11: DW does not see the need for stern shoring. Please provide further information about your requirements, as we didn't find reference in the U.S. Navy Towing Manual.		
[2]	Cribbing Plan Top View (30270-002-0)	US Navy	Need Transverse Stoppers	10-11: As the whole centerline is wood, and considerable more support blocks are installed than on the McCain transport, the friction is considered enough by our engineers. 14-11: We can supply similar as on McCain		Closed
[3]	Cribbing Plan Top View (30270-002-0) And engineering report (page 22-23)	US Navy	Provide Lever arms for all bracing. Refer to US Navy Tow Manual Table 8-13, page 8-42 and Appendix Q page Q-22.	All bracings have been designed to act through the center of gravity of the Cargo.		Closed

[4]	Cargo Securing Manual (page 12/15)	US Navy	Longitudinal acceleration is too low (0.073 g). Refer to US Navy Tow Manual Table 8-4, page 8-35 and paragraph 8-7.5.1 (Dynamic Force) page 8-55. Need to include Surge component of 0.15g and provide a sufficient number of strongboxes. CSM proposes 4 strong boxes which is insufficient.	10-11 All components are included in our values for the acceleration, calculated for the specific weather for this route. Weather routing and at 72 hour weather forecasts will be available. 14-11: DW Engineering will look into effects. Please note that we have a weather routing apply for this transport. We understood that this was applied from “GENERAL REMARK”, that means when you don’t have values of the route. In our case we have, and we calculates that the acceleration will be limited. 15-11: DW Engineering will check consequences. Please see attached Extreme design forces as per the US Navy accelerations. This means a total of ~8 strongboxes (or bend plates). Possible locations have not yet been identified. I have also attached our engineering guidelines for motion response calculations and extreme design forces, explaining how we usually determine the accelerations and forces, for your information.		
[5]	Cribbing Plan (30270-002-01 thru 76)	US Navy	8-11: US Navy review indicates numerous discrepancies associated with blocking particularly with side block and cradle shapes and heights. Provide the approach that was used to calculate. Current focus is on blocking and cradles that will be in place for on-load. 14-11: Jonathan Cies will send model soon.	10-11: Some blocking height discrepancies have been found and we are updating the drawings. Priority will be given to blocks that need to be pre-installed. 14-11: DW engineering has received the model and started review of blocks at frame 254, 194 and 200 15-11: DW Engineering will plot the differences in the models (please see attached DWG file). We think these differences can be absorbed by the wood, and our dimensions are on the safe side for the pre-installed blocks (lower).		

Document no.	*0030270*	**DOCUMENT REVIEW SHEET** DOCKWISE
Revision	--	
Document title	*0030270-TRS-CSM__Rev 0* *DRAWINGS - DW-0030270.pdf*	

[6]	Rig Catcher Installation Plan	US Navy	Some comments with respect to the rig catcher are as follows: 1. View P of Rig Catcher drawing DW-0030270-004-01 shows the upper leg of the catcher being installed 25 feet 10.25 inches above baseline with a note that states "IN LINE WITH STIFFENER". There is no shell stringer at 25 feet 10.25 inches above baseline. Port-side shell stringer 18 is located 25 feet 7 inches above baseline. Is the intent to align the upper leg of the catcher with port-side shell stringer 18? 2. Section B-B of Rig Catcher drawing DW-0030270-004-02 shows a measurement of 810mm from the outboard face of Item 04 to the inboard face of an unlabeled item. View P of Rig Catcher drawing DW-0030270-004-02 shows a measurement of 945mm from the outboard face of Item 04 to a dashed line that appears to be inside Item 01. I expect the "legs" (Items 06-09) to be of unequal lengths due to the contour of the hull however since the reference lines for these dimensions are not consistent it is difficult to determine the actual length of item 08 and Item 09. Note, using the 810mm dimension and 945mm dimension at frame 186 results in a 1/2" gap between the lower leg of the catcher and the hull. 3. The drawing for the guidepost (drawing DW-0030270-004-03) does not provide locating dimensions for the guidepost with respect to the block build so it is not possible to verify that the dimensions of the rig catcher are accurate for centering DDG 62 over the block build. Given that the rig catcher is the primary means of centering DDG 62 over the block build, the locating dimension for the guidepost should be provided to allow for independent verification of the rig catcher dimensions.	1. Location of catcher is same as used on the John S. McCain. The legs are in line with frames, which is considered strong enough. 2. Design of catcher is same as on JSM. Our expert can liaise with the Navy engineers on site for a correct installation. Can you provide a construction drawing of this area, so our expert can look in to this before arrival? 3. Locating dimensions for the guideposts can be found on drawing 003270-002-01		Closed
[7]	Rig Catcher Installation Plan	US Navy	Need a representative from DockWise that is familiar with the Catcher Installation Plan to travel to Yokosuka as soon as possible to work with the contractor that will be welding the catcher to the Fitzgerald hull.	Timo Dekoning will arrive Saturday evening.		Closed

Document no.	*0030270*	**DOCUMENT REVIEW SHEET**
Revision	--	
Document title	*0030270-TRS-CSM__Rev 0* *DRAWINGS - DW-0030270.pdf*	

[8]	CSM	US Navy	CSM uses 8100 and 8500 mT as the displacement for the Fitzgerald. Expected condition of USS Fitzgerald is as follows: 1. FWD Draft: 19 Feet 2.28 inches 2. Midship Draft: 19 Feet 1.8 inches 3. AFT Draft: 19 Feet 1.6 inches 4. List: 0.02 degrees starboard 5. Trim: 0.6 inches by the bow 6. KG: 26.08 Feet above keel 7. GM (corrected): 2.72 Feet 8. LCG: 3 Feet forward of Midship 9. TCG: 0.0 Feet 10. Displacement: 7599.13 Long Tons	Updated cargo details noted. It is noted that the figures in the CSM are more conservative. Please keep in mind that the list should be zero during the loading operation.		Closed
[9]	CSM Page 11/15	US Navy	CSM proposes to design to 60 KTS. US Navy Tow Manual paragraph 8-5.1.1 requires that a wind speed of 86.6 KTS unless better wind data along the route is available. Given the early portion of the transit may be conducted during Typhoon season use a minimum wind of 86.6 KTS.	It is our opinion that our database qualifies for "better wind data along the route" Please also note that weather routing will be active, and 72 hour weather forecasts will be available..		Closed
[10]	CSM 8/15	US Navy	Note that all propeller blades have been removed.	Noted.		Closed
[11]	CO, DDG 62	US Navy	Please verify that Dockwise intends to place a stern light on the forecastle of Fitzgerald during transit.	We did not have such intention. Can be done if deemed necessary.		
[12]	Engineering Report and DWG 30270—102-02	US Navy	Figure 2-8 and 2.22 shows a notch in the grillage by which the keel of Fitzgerald will settle. Dockwise shall ensure that there is sufficient flexibility to adjust the Fitzgerald alignment over the block build during on load. Additionally, Dockwise shall ensure that there is sufficient clearance between the hull of Fitzgerald and grillage.	There is sufficient clearance between the grillage and hull of the USS Fitzgerald		Closed
[13]	Cribbing Plan (30270-002-01 thru 76)	US Navy	14-11: Location of Soft wood in support blocks. Why so low?	14-11: This has been done to create equal flexibility in each location of the cribbing. Location of the soft wood makes the whole stack work like a spring, rather than only a flexible top.		Closed

[14]	Cribbing Plan (30270-002-01 thru 76)	US Navy	14-11: Some cradles are not on frames (eg 161, 211, maybe some more) 15-11:Cradles on fr. 211 to be repositioned to 212, fr. 161 to 158, and fr. 223 to be removed. To be checked on clashes	14-11: During Transport Manual Review Meeting in Japan, the locations of the cradles and blocks were discussed and decided (confirmed on Oct. 18th), and the cribbing plan was made accordingly. It is noted that the US Navy is now advising differently. DW Engineering has checked cradles, but cannot find available space on frames, due to clashes with protrusions. Please advise to which position the cradles need to move, or if they need to be removed. 15-11: DW Engineering is checking feasibility.		
[15]	Cribbing Plan (30270-002-01 thru 76)	US Navy	14-11: Steel plate needs to be placed on top of centerline cribbing at grillage, similar as on McCain transport.	14-11: DW Engineering will review. Please let us know if you have a requirement for the length of the steel plate, to avoid discussions later. The grillage was calculated without this plate to support the weight of the cargo. For McCain the steel plate was added to distribute better the weight on the grillage, and it was not for the cargo. 15-11: Steel plates will be installed on the wood on the grillage. Steel has been ordered and will be on board before the scheduled departure of the Transshelf from China.		Closed
[16]						

Appendix F: Modifications to the heavy transport vessel (HTV) by addition of grillage support structures for the USS FITZGERALD (DDG-62)

Initial analysis completed by Dockwise showed that some HTV structural components did not have adequate strength or buckling capacity to support the anticipated loads. In particular, the cargo deck surface and the lower bulkheads below both the bow and stern of the USS Fitzgerald (cargo) warranted strengthening.

In designing solutions to address HTV cargo deck limitations, the following are examples of relevant considerations

- Material properties of the steel used to build or strengthen HTV modifications
- Details of the meshing used for the stress analysis modeling (an analysis that is too coarse will not yield accurate results)
- Boundary conditions (known or assumed values for displacements or associated loads) used for the model
- Details of loads, forces, pressures, and accelerations considered
- Specification of weld joint designs and analysis of weld stresses
- Calculations used to address life and safety

Grillage below the USS Fitzgerald's bow:

Structural analysis completed by Dockwise showed that the installation of vertical plates in the below deck framework (Fig 1) and a steel grillage on the cargo deck were needed. The grillage on the cargo deck (Fig 2) was designed to spread loads on the cargo deck in a way that would further protect the support framework below deck. Steelwork design codes permit a 1/3 stress increase for dynamic loads (i.e., the motion-induced load that would be encountered during transport), but Dockwise did not include that additional stress increase.

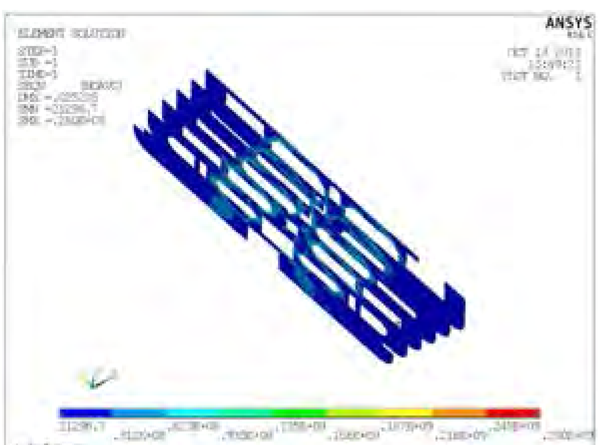


Fig 1. Preliminary analysis of stresses in the support framework under the cargo deck of the HTV where the bow of the Fitzgerald would be placed (completed by Dockwise).

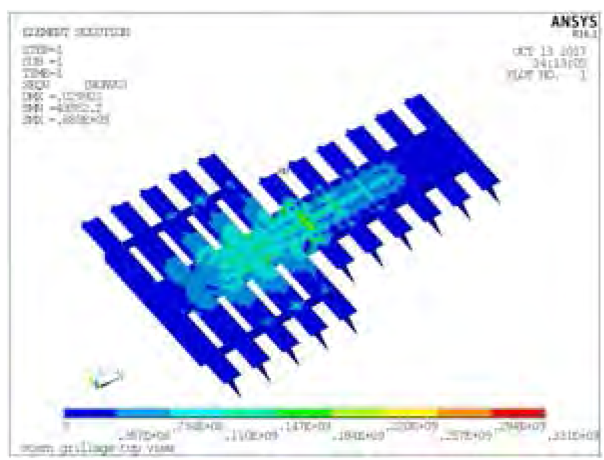


Fig 2. Preliminary analysis of stresses in the proposed bow grillage when loaded with cargo (completed by Dockwise).

The bow grillage distributing the load of the cargo was implemented successfully (Fig 3) and did not require modification from the design recommended by Dockwise.

Fig 3. Bow grillage constructed on the cargo deck of the HTV with the cargo in-place prior to installation of sea fastening for transport from SRF Yokosuka.

Grillage below the USS Fitzgerald's stern:

Structural analysis completed by Dockwise also showed that the installation of stiffeners on pillars in the below deck framework (Fig 4) and a tall steel grillage on the cargo deck were needed. As with the grillage under the bow of the cargo, the grillage at the stern of the cargo (Fig 5) was designed to spread loads on the cargo deck in a way that would further protect the support framework below.

The stern grillage was unsuccessfully implemented. The design of the stern grillage resulted in destructive contact between the cargo and the grillage involving bilateral cargo hull punctures during onloading.

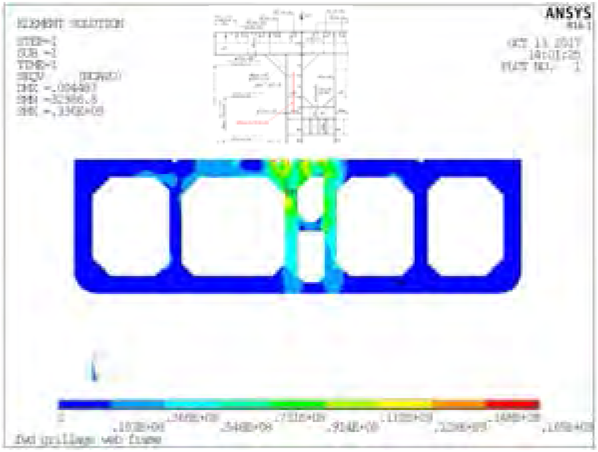


Fig 4. Preliminary analysis of stresses in the support framework under the cargo deck of the HTV where the stern of the Fitzgerald would be placed (completed by Dockwise).

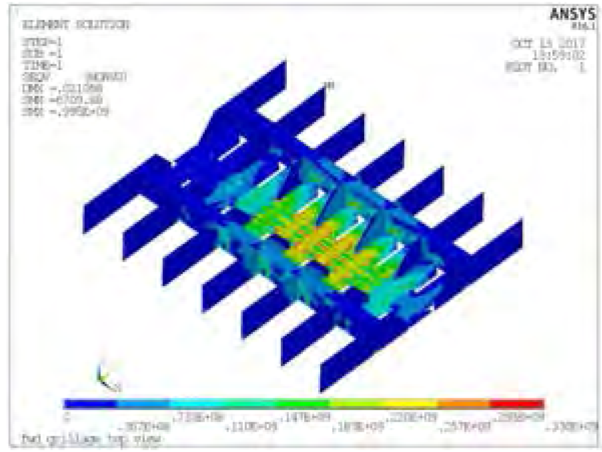


Fig 5. Preliminary analysis of stresses in the proposed stern grillage when loaded with cargo (completed by Dockwise).

Fig 6. Cargo port side hull puncture resulting from contact with grillage at HTV frame 88.

Fig 7. Cargo port side hull puncture resulting from contact with grillage at HTV frame 88.

The bilateral cargo hull punctures resulted in leaks that required urgent containment to prevent spillage of an upper layer of fuel from inside the punctured tank. Box patches to be welded to the surface of the cargo hull were selected as the optimal approach for controlling the leaks with the supporting grillage in-place. The installation of those box patches required significant cuts in the web of the grillage beam at HTV frame 88 (Figs 8 and 9). This was an area of the grillage that was not in direct contact with the hull cargo but it was an element of the support structure associated with the purpose of the grillage.

The bilateral grillage web cuts at HTV frame 88 made under the direction of Dockwise were approximately 90° cuts and were sized to accommodate the proposed box patches.

Fig 8. Cargo starboard side hull puncture box patch.

Fig 9. Cargo port side hull puncture box patch.

With these significant cuts in the structure of the cargo stern grillage and their effective shortening the height and length of the beam, the overall load distribution system that the grillage provided had been modified. It was unclear if the shape, size, and location of the cuts presented an unforeseen risk to the integrity of the grillage. In addition, the cuts were rough, imprecise, and not shaped or finished in a way that would protect the integrity of the remaining beam. For example, the cut on the cargo starboard side was overcut (Fig 10), reflecting a concerning lack of accuracy in measurement and planning.

Fig 10. Overcut of the beam under the cargo starboard side box patch.

The box patches were sized to accommodate the cargo hull punctures. Once the box patches were installed, it was found that the cuts in the grillage beam were too close to the box patches on both sides of the cargo hull, creating a risk of damage or puncture to the box patches while in transit. As the HTV underwent routine ballasting operations, the list of the cargo hull changed sufficiently for the grillage to make contact with the box patch on the cargo hull's port side (Fig 11) and to come within 2 inches of the cargo hull's starboard side (Fig 12).

Fig 11. Grillage beam in contact with the box patch on the cargo hull's port side.

Fig 12. Grillage beam in contact with the box patch on the cargo hull's starboard side.

To avoid contact between the box patches and the grillage and to prevent tearing or cracking at the sharp angles of the original cuts, the grillage beam cuts were revised by rounding the angles and removing more of the beam steel to create more space between the beam and box patch on both sides of the cargo hull.

Fig 13. Revised grillage cut on the cargo hull's port side.

Fig 14. Revised grillage cut on the cargo hull's starboard side.

In addition to reshaping the cuts, the rounded angles of the cuts were finished to further protect them from cracking (Fig 15).

Fig 15. Surface finishing on the rounded grillage cut angle on the cargo hull's port side.

A key assumption used in the design and calculations for the grillage is the dynamic load impact on structural integrity. With the significant modifications to the grillage structure, and despite revisions to the cuts, the dynamic loading characteristics of the grillage would certainly have changed. When this work was complete, we had not received any formal verification that the impact of these cuts will be negligible. Detailed information about the revised set of stress analyses was requested.

In order to fully understand and build confidence in the ability of the modified grillage structure to support the static and dynamic loads of the transit, we requested that the Dockwise engineering team present the details of their analysis, to include:

- Static and dynamic analysis
- Material properties of the steel
- Details of the meshing used for the modeling
- Boundary conditions used for the model
- Details of loads, forces, pressures, and accelerations
- Analysis of weld stresses
- Calculations used to address life and safety considerations

Additional questions about their grillage design models included:

- Are the internal edges calculated as being chamfered, filleted, or true 90° edges? How much difference does that make for this material at this scale?

- The model is pristine and does not reflect the jagged nature of the cuts. Would an "extreme case" model be more informative (i.e., a model where the ~90° cutouts in FR 88 are represented as cuts extending all the way to the HTV deck)?
- To address concerns about whether an appropriate mesh density (elements / unit area) was used, running the model with a few different mesh densities may illustrate the impact on this particular model. For the current model, does changing the mesh density show a maximum stress in a few key locations converging (not changing significantly)?
- Would using a different mesh density in the areas of greatest concern, areas where fatigue or a failure is most likely to begin, be appropriate?

A final analysis completed by Dockwise (Figs 16 and 17) involved a mesh size for the model that was varied by a factor of 2x without any significant changes. This approach demonstrated that the mesh size used was adequate for the objective of the model. Overall, the stress analysis using the revised model indicated that the modified grillage would provide the intended stress distribution in support of all life and safety considerations.

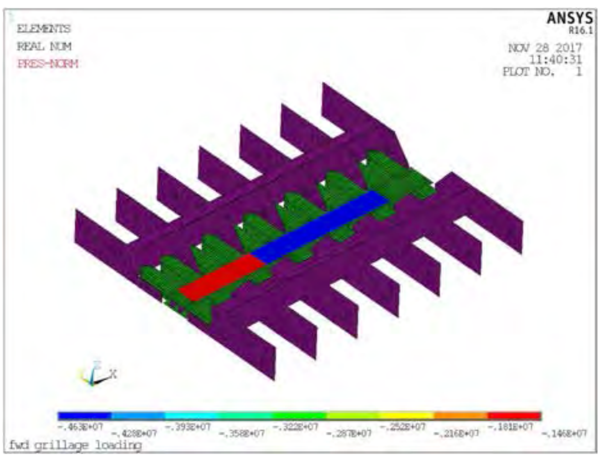


Fig 16. Preliminary analysis of stresses in the support framework under the cargo deck of the HTV where the stern of the Fitzgerald would be placed (completed by Dockwise).

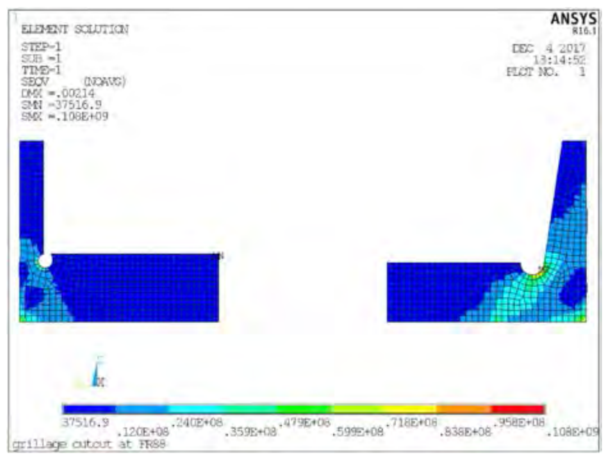


Fig 17. Detailed analysis of stresses of the revised grillage beam at HTV frame 88 (completed by Dockwise).

Data Legend:	
Input	Calculated Value

Actual ship conditions prior to HL

		FT	In	decimal	unit
Fwd Draft (Bow) =	D_{FWD}	18.00	11.00	18.9167	FT
Aft Draft (Stern) =	D_{AFT}	19.00	6.00	19.5000	FT
Mean Draft or D_M	= (HL_Dfwd + HL_Daft) / 2 =			19.20833	FT
Actual Trim = T_{TR}			0.5833	**0.5833**	FT
			7.00	**7.00**	IN

Acceleration coefficients calculated per US Navy Tow Manual:

a_x= 1.22 a_y= 0.42 a_z= 0.24

Draft at Instability and Draft at Landing per NSTM 997:

Calculated Draft at Instability: 17.27 FT Calculated Draft at Landing: 19.11 FT

Ship hydrostatics interpolated from Table of Displacement on NAVSEA Docking Drawing

d, Mean Draft:	19.21	FT
Δ, DISPL:	7635	LT
LCF (Aft)	22.71	FT
TP1"	50.13	LT
LCB (Fwd)	238.23	FT
KM	28.80	FT

Ship characteristics from NAVSEA Docking Drawing

Length between draft marks	461	FT	Length between Perps	466	FT
Deep Projection	9.93	FT	Length of Keel, Pos 1	321.5	FT

	FT	In	decimal	unit
Mid Ships)O(	237.00	4.75	237.54	FT, FWD of SRP
POS 1, First Keel Block	88.00	6.00	88.50	FT, FWD of SRP
POS 2, First Keel Block	87.00	6.00	87.50	FT, FWD of SRP
POS 3, First Keel Block	86.00	6.00	86.50	FT, FWD of SRP

∴ LCF, Forward of 1st Keel Block

$$LCF_{FWD\_1st\_KB} = r = Midships - LCF_{Aft\ of\ Midships} - Keel\ Block_{Position\ 1}$$

$LCF_{FWD\ 1st\ KB}$ = 126.3260417

∴ Knuckle Load

$$Knuckle\ \ Load\ = p\ = \frac{Trim\,(in) \times MT1"}{LCF_{FWD\_1st\_KB}}$$

Knuckle Load = 81.057 LT

Consider 1st foot of keel with 900 mm of Steel plate 35.43 Inches

A_e = 12" x 35.4" 425.20 in^2 First Foot

A_e = 42" x 35.4" 1488.19 in^{2B} Batten

Max block pressure due to knuckle load

$$Block\ \ Pressure\ = \frac{Knuckle\ Load \times LBS/LT}{A_e\ (Length)}$$

Block Pressure $_{\text{First Foot}}$ = 427.02 psi

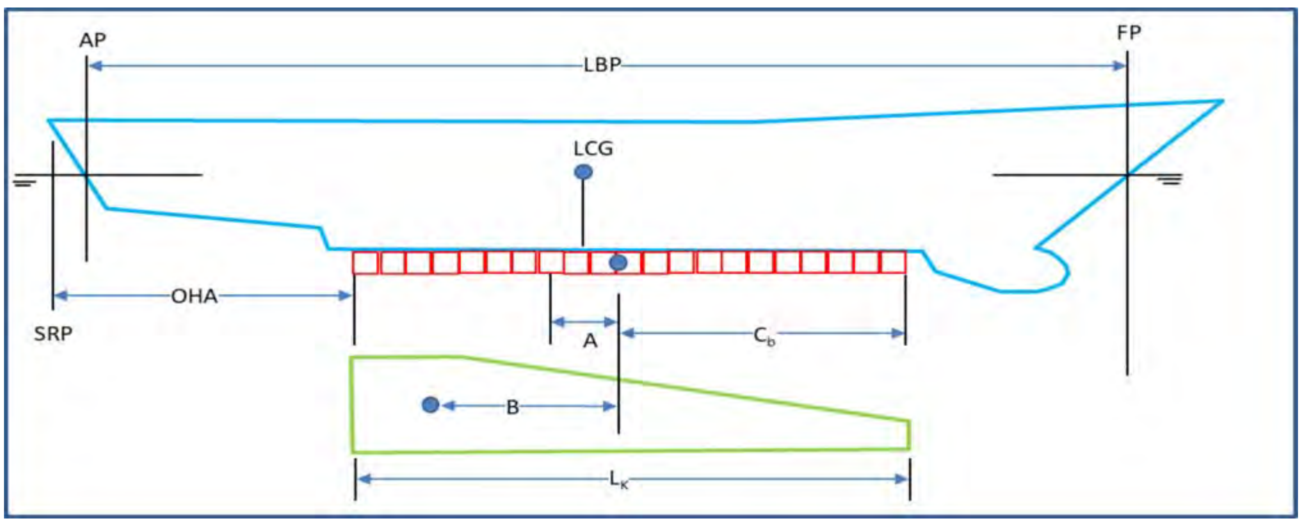
Block Pressure $_{\text{Batten}}$ = 122.01 psi

Batten load is spread over 19 inches of keel, ∴ Block pressure is less than 370 PSI.

Keel Loading

$$D_{LK}\ = \Delta \times a_x$$

D_{LK} = 9314.7 LT



LBP = 466 FT

L_K = 321.5 FT

$C_b = L_K$ / 2 = 160.75 FT

B = L_K / 6 = 53.58333 FT

OHA = 88.50 = SRP to 1st Keel Block, Pos 1

LCG1 = 1.957138 FWD of Midships, Recall MS = 238

LCG1 = 239.4936 FWD of SRP

A = (OHA + C_b) - LCG = 9.756 AFT of Midships (+)

$$Load\ Max = \frac{D_{L_K}}{L_K} \times \left(1 + \frac{A}{B}\right)$$

$$Load\ Min = \frac{D_{L_K}}{L_K} \times \left(1 - \frac{A}{B}\right)$$

Load Max = 34.248 LT / FT

Load Min = 23.697 LT / FT

$$S = \frac{Load\ Max\,(LT)}{A_{e\_First\_12"}\,(in^2)} \times \left(\frac{2240\ lb}{LT}\right)$$

S = 180.4232

Description	Distance	Size	Lever Arm (mm)	Lever Arm (in)	Lever Arm (FT)	REF Resisting Mom (SP as 370)
Onload SB	0	900	450	17.71654	1.476	38,406,513.82
Onload Craddle	450	3000	1950	76.77165	6.398	515,134,986.96
Onload Craddle	450	2500	1700	66.92913	5.577	115,151,805.11
Onload Craddle	450	1800	1350	53.14961	4.429	-
				Total Resisting Moment:		668,693,306

Description	Size (mm)	Size (Inches)	N (Qty)	Len (in)	Width (in)	A_{eC} Area (in2)	Total Area (in2)
Onload SB	300 x 900	35.4" x 11.81"	14	11.811	35.43	418.50	5,859
Onload Craddle	300 x 3000	35.4" x 118.11"	13	11.811	118.11	1395.00	18,135
Onload Craddle	300 x 2500	35.4" x 98.43"	4	11.811	98.43	1162.50	4,650
Onload Craddle	300 x 1800	35.4" x 70.87"	0	11.811	70.87	837.00	-
						Total Ae:	28,644

$$N_d = \frac{DL_S + DL_r}{S_P \times A_e} \qquad DL_S = \frac{0.15 \times \Delta}{2} = 0.075\,\Delta$$

$$DL_r = \Delta \sin R$$

(R = Roll Amplitude in Degrees)

DL_S = 572.625 LT

DL_r = 684.0169 LT

Consider Only Side Blocks

N_d = 1.2985

Ans > 1, ∴ Craddles are needed!

$$N_d = \frac{DL_S + DL_r}{S_P \times A_e}$$

Consider Side Blocks and Craddles

$$N_d(Units) = \left(\frac{LT \times lb}{psi \times in^2 \times LT}\right)$$

N_d = 0.2656

Consider Transit

Wind Area				FT	FT	FT^2
Area	Shape	Shape X	Description	height	length	Area
1	RT	1	Super Structure	40	190	7600
2	RT	1	Above Waterline	22	506	11132
3	RT	1	Below Waterline	22	466	10252
					Total Area:	28,984

$KG_A = L_3 = 35$ Per US Navy Tow Manual

Consider a 25 kt wind

$$M_{Wind} = A_S \cdot KG_A \cdot 0.004 \cdot V^2 \text{ (ft-lb)}$$

M_W = 2,536,100 FT-lbs

# of Block segments required for 25kt wind

$$N_W = \frac{M_{W25}}{A_e \times S_P \times L_2}$$

N_W = 1.387

∴ 2 Blocks are needed

Consider a 60 kt wind with a 1.21 gust factor = 72.6

$$M_{Wind} = A_S \cdot KG_A \cdot 0.004 \cdot V^2 \text{ (ft-lb)}$$

M_W = 21,387,479 FT-lbs

# of Block segments required for 72.6kt wind

$$N_W = \frac{M_{W\,72.6}}{A_e \times S_P \times L_2}$$

N_W = 7.796

∴ 8 Blocks are needed

Calculate Overturning Moment at Sea State 7

$$M_r = \Delta \times a_y \times KG \times 2240$$

Disp	Ay	KG	lbs/LT
7635	0.42	24.97	2240

M_r = 179,359,710 FT-lbs

We will use the outer side blocks for this calculation

Recall the lever arm and Ae segment

Lever arm = 17.71654 FT

Ae = 418.5008 in2

$$N_r = \frac{M_r}{A_e \times S_P \times L_2}$$

N_r = 65.38047031 → ∴ 66 Block segments are needed

Since we only have 51 segments, we will need shores

Number of Segments required:

M_W = 8

N_r = 66

Total = 74

Calculate number of shores required

$$DL = \Delta \sin R$$

$DL_r = \Delta \sin R$

Δ (LT)	R (deg)	Sin R
7635	20	0.342020143

DL_r = 2611.3 LT

$$N_r = \frac{DL_r}{A_e \times S_P \times L_2}$$

N_r = 37.78 Block Segments

$$N_S = \frac{M_r - (DL_r \times L_2)}{\sigma_S \times 2204 \times L_3}$$

σ_S = 173 Per Contractor's Securing Manual

N_S = 2204 MT/lbs (Unit consistency)

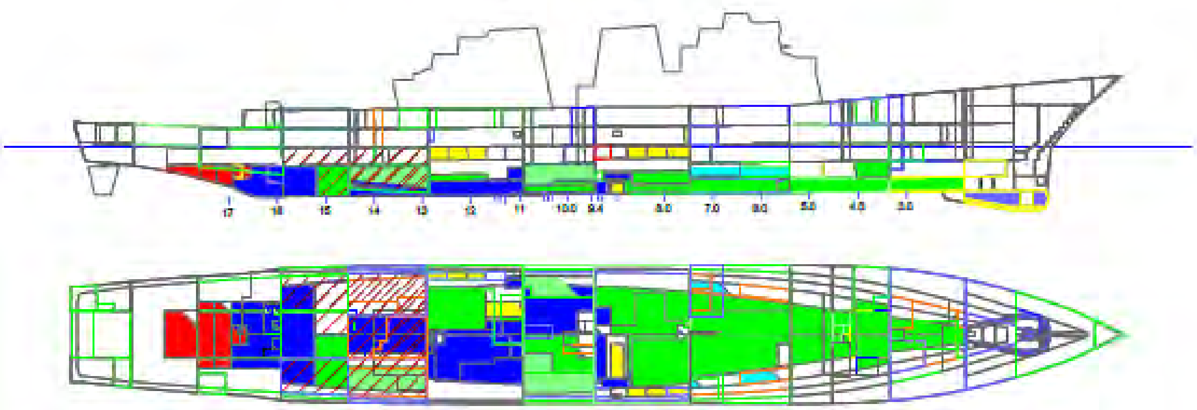
L_3 = 22.5 FT, Average for spur shores

N_S = 8.827206 → ∴ 9 Shores per side required

Dockwise proposed 23 shores.

Appendix H – MCCAIN POSSE Initial and Final Conditions

JSM Initial
Trim and Stability Summary



Loading

Intact Displacement	8,614 LT	Specific Gravity	1.025
Flooding	1,031 LT		
Outflow	0 LT		
Total Displacement	9,562 LT		

Stability		**Trim**	
GMt (Corrected)	5.56 ft	LCF Draft	22.53 ft
GMt @ Equil	5.49 ft	LCF	251.67A Ft-FP
		LCB	243.22A Ft-FP
		LCG	243.15A Ft-FP
		KB	13.41 Ft-BL
		TCB	0.00S Ft-CL
		TCG	0.00P Ft-CL
		TP1in	47.8 LT/in
		MT1in	1,442 ft-LT/in
		Trim at Perps	3.83A ft
		Heel Angle	0.00 deg

Drafts - Perps		**Drafts - Marks**	
AP	24.29 (24-3.5) ft	Aft	24.25 (24-3.0) ft
MS	22.37 (22-4.5) ft	MS	22.41 (22-4.9) ft
FP	20.46 (20-5.5) ft	Fwd	20.50 (20-6.0) ft

Strength –At Sea–

Shear (Min)	-342 LT	93.20A Ft-FP	— %
Shear (Max)	550 LT	302.90A Ft-FP	— %
Moment (Max Hog)	50,942H ft-LT	221.35A Ft-FP	— %
Moment (Max Sag)	— ft-LT	— Ft-FP	— %

Notes

Drafts from Keel
Hull from Offsets
GMt from GZ Curve Slope
Tanks from Tables

JSM Initial

Righting Arm Summary

Angle deg	GZ ft	Draft AP ft	Draft FP ft	Trim deg	Flooded LT	CDisp LT	CTrim ft	Iter	#Calcs
0.00	0.00	24.29	20.46	0.47A	1,031	0	0.00	4	4
1.00S	0.10	24.27	20.46	0.47A	1,025	0	0.00	2	2
5.00S	0.53	24.08	20.47	0.44A	978	0	0.00	3	3
10.00S	1.09	23.78	20.42	0.41A	917	0	0.00	3	3
20.00S	2.31	22.85	20.15	0.33A	796	0	0.00	3	3
30.00S	3.68	21.37	19.44	0.24A	692	0	0.00	3	3
45.00S	5.35	18.44	16.87	0.19A	571	0	0.00	4	4
60.00S	5.22	14.65	12.29	0.29A	477	0	0.00	3	3
75.00S	4.32	4.87	1.83	0.37A	416	0	0.00	9	9
								34	34

Notes

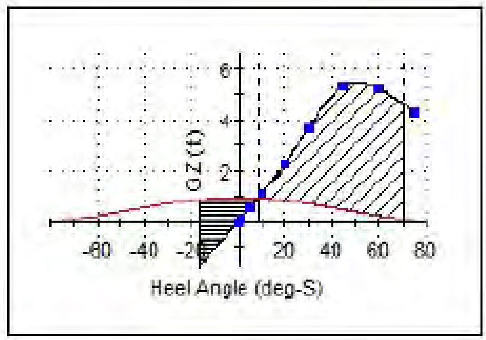
GZ Curve from Offsets

Tanks from Tables

Disp. of Remaining Intact Hull = 8,532

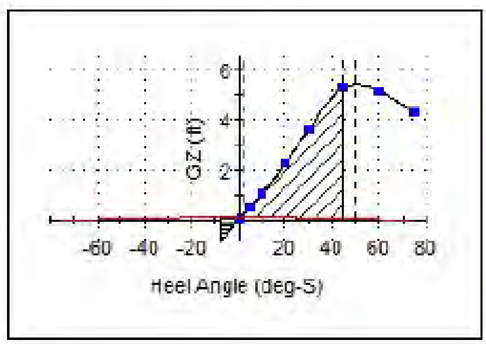
DDS079-1 2.2 USN Beam Winds Combined with Rolling

PASS	DDS079-1 2.2 USN Beam Winds Combined with		Value	Required
PASS	Maximum Righting Arm	ft	5.50	>=1.55
PASS	Reserve Area	ft-deg	214.30	>=47.89



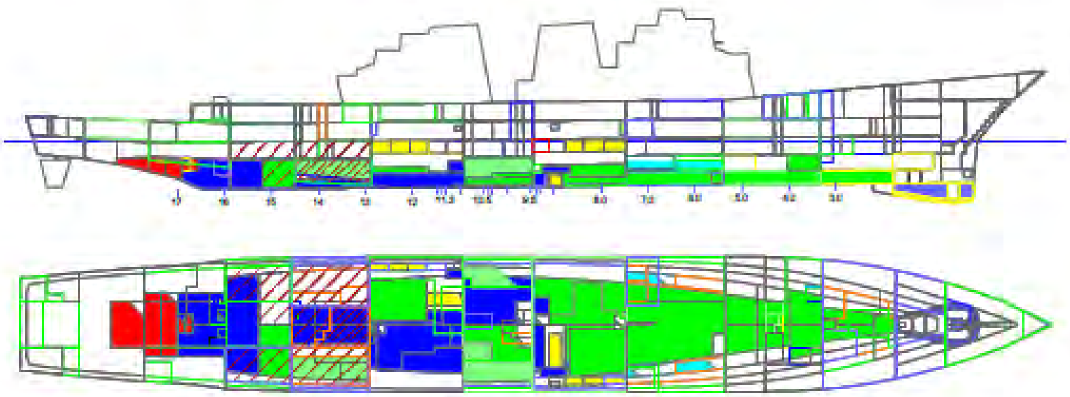
DDS079-1 3. USN Damage Stability Standards

PASS	DDS079-1 3. USN Damage Stability Standards		Value	Required
PASS	Static Angle of Heel (No Wind Moment)	deg	0.00	>=-15.00 and <=15.00
PASS	Angle to Margin Line (Static)	deg	N/A	>=0.00
PASS	Reserve Area	ft-deg	114.87	>=6.07
PASS	Maximum Righting Arm	ft	5.32	>=0.30



JSM Initial

Damage Summary



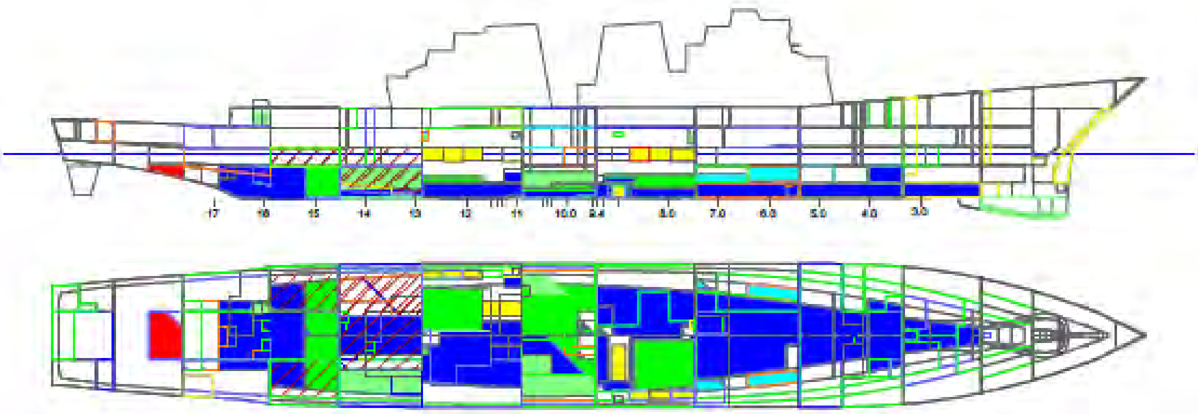
Damaged Spaces

Name	Int Weight LT	Outflow LT	Flooding LT	Net Wt LT	LCG Ft-FP	VCG Ft-BL	TCG Ft-CL	Damage Opt
5-338-2-F	83	83	85	85	345.75A	9.51	8.56P	DAMAGED-Free Flood
5-300-4-F	0	0	77	77	315.95A	10.17	18.73P	DAMAGED-Free Flood
3-300-0-C	0	0	85	85	310.71A	18.85	1.78S	DAMAGED-Free Flood
3-300-1-L	0	0	130	130	318.93A	18.98	19.81S	DAMAGED-Free Flood
3-310-2-L	0	0	148	148	318.95A	18.97	18.68P	DAMAGED-Free Flood
3-338-1-L	0	0	104	104	353.75A	19.19	19.15S	DAMAGED-Free Flood
3-338-2-L	0	0	104	104	353.75A	19.19	19.15P	DAMAGED-Free Flood
5-300-1-E	0	0	298	298	318.93A	9.65	0.22S	DAMAGED-Free Flood
Damage Totals	83	83	1,031	1,031	327.28A	14.87	2.06P	

Abbreviations:

		Free-Floating Draft / Displacement Data		
		Intact	After Outflow	Damaged
Draft AP	ft	20.64		24.29
Draft FP	ft	21.16		20.46
Trim at Perps	ft	0.52F		3.83A
Static Heel Angle	deg	1.43S		0.00
Draft Aft	ft	20.65		24.25
Draft MS	ft	20.90		22.41
Draft Fwd	ft	21.15		20.50
Total Weight	LT	8,614	8,532	9,562
VCG	ft	22.80	22.93	22.06
LCG	Ft-FP	234.06A	232.98A	243.15A
TCG	Ft-BL	0.16S	0.25S	0.00P
Buoyancy	LT	8,614		9,562
KB	ft	12.21		13.41
LCB	Ft-FP	235.11A		243.22A
TCB	Ft-BL	0.01S		0.00S
TPin	LT/in	51.8		47.8
MTin	ft-LT/in	1,457		1,442
KMt	ft	29.10		28.49
GMt(solid)	ft	6.30		6.44
FS Adjustment	ft	0.11		0.87
GMt Upright	ft	6.19		5.56
GM @ Equil	ft			5.49

JSM Final
Trim and Stability Summary



Loading

Intact Displacement	8,279 LT	Specific Gravity	1.025
Flooding	71 LT		
Outflow	0 LT		
Total Displacement	8,351 LT		

Stability		**Trim**	
GMt Upright (Corrected)	5.70 ft	LCF Draft	20.65 ft
GMt @ Equil	5.69 ft	LCF	256.65A Ft-FP
		LCB	234.25A Ft-FP
		LCG	234.24A Ft-FP
		KB	12.19 Ft-BL
		TCB	0.04S Ft-CL
		TCG	0.01S Ft-CL
		TP1in	51.5 LT/in
		MT1in	1,428 ft-LT/in
		Trim at Perps	0.62A ft
		Heel Angle	0.14S deg

Drafts - Perps		**Drafts - Marks**	
AP	20.92 (20-11.1) ft	Aft	20.92 (20-11.0) ft
MS	20.61 (20-7.4) ft	MS	20.62 (20-7.4) ft
FP	20.30 (20-3.6) ft	Fwd	20.31 (20-3.7) ft

Strength –At Sea–

Shear (Min)	-264 LT	186.40A Ft-FP	— %
Shear (Max)	317 LT	372.80A Ft-FP	— %
Moment (Max Hog)	47,306H ft-LT	247.95A Ft-FP	— %
Moment (Max Sag)	— ft-LT	— Ft-FP	— %

Notes

Drafts from Keel

Hull from Offsets

GMt from GZ Curve Slope

Tanks from Tables

JSM Final

Righting Arm Summary

Angle deg	GZ ft	Draft AP ft	Draft FP ft	Trim deg	Flooded LT	CDisp LT	CTrim ft	Iter	#Calcs
0.00	-0.01	20.92	20.30	0.08A	71	0	0.00	4	4
0.14S	0.00	20.92	20.30	0.08A	71	0	0.00	1	1
1.00S	0.09	20.92	20.30	0.08A	71	0	0.00	2	2
5.00S	0.49	20.88	20.28	0.07A	71	0	0.00	2	2
10.00S	1.01	20.74	20.21	0.06A	71	0	0.00	3	3
20.00S	2.12	20.03	19.95	0.01A	71	0	0.00	3	3
30.00S	3.36	18.53	19.34	0.10F	71	0	0.00	3	3
45.00S	5.18	14.95	16.83	0.23F	71	0	0.00	4	4
60.00S	5.13	9.77	12.16	0.29F	71	0	0.00	4	4
75.00S	4.20	-4.15	1.45	0.69F	71	0	0.00	9	9
								35	35

Notes

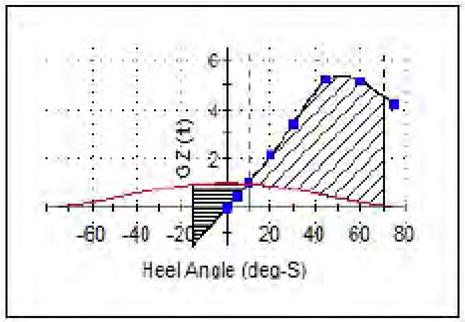
GZ Curve from Offsets

Tanks from Tables

Disp. of Remaining Intact Hull = 8,351

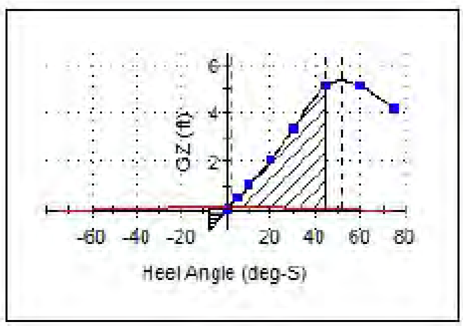
DDS079-1 2.2 USN Beam Winds Combined with Rolling

PASS	DDS079-1 2.2 USN Beam Winds Combined with		Value	Required
PASS	Maximum Righting Arm	ft	5.38	>=1.65
PASS	Reserve Area	ft-deg	201.19	>=45.35



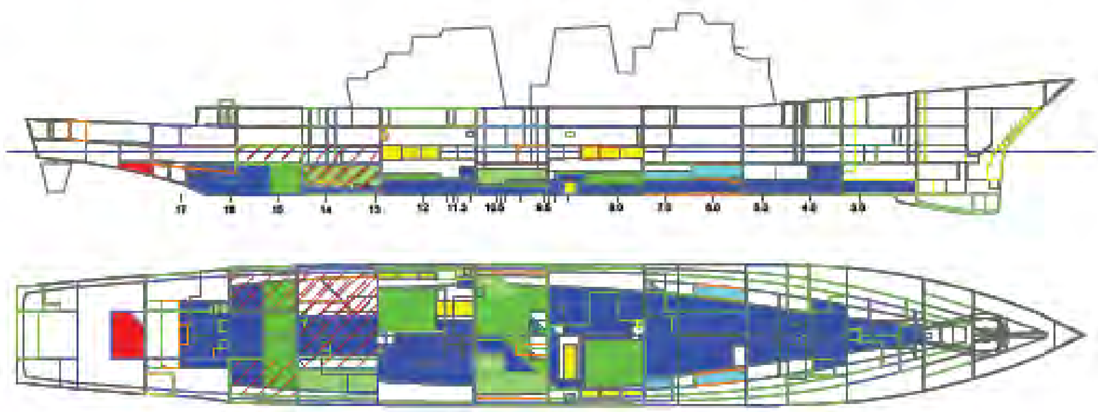
DDS079-1 3. USN Damage Stability Standards

PASS	DDS079-1 3. USN Damage Stability Standards		Value	Required
PASS	Static Angle of Heel (No Wind Moment)	deg	0.14	>=-15.00 and <=15.00
PASS	Angle to Margin Line (Static)	deg	N/A	>=0.14
PASS	Reserve Area	ft-deg	106.45	>=6.34
PASS	Maximum Righting Arm	ft	5.14	>=0.30



JSM Final

Damage Summary



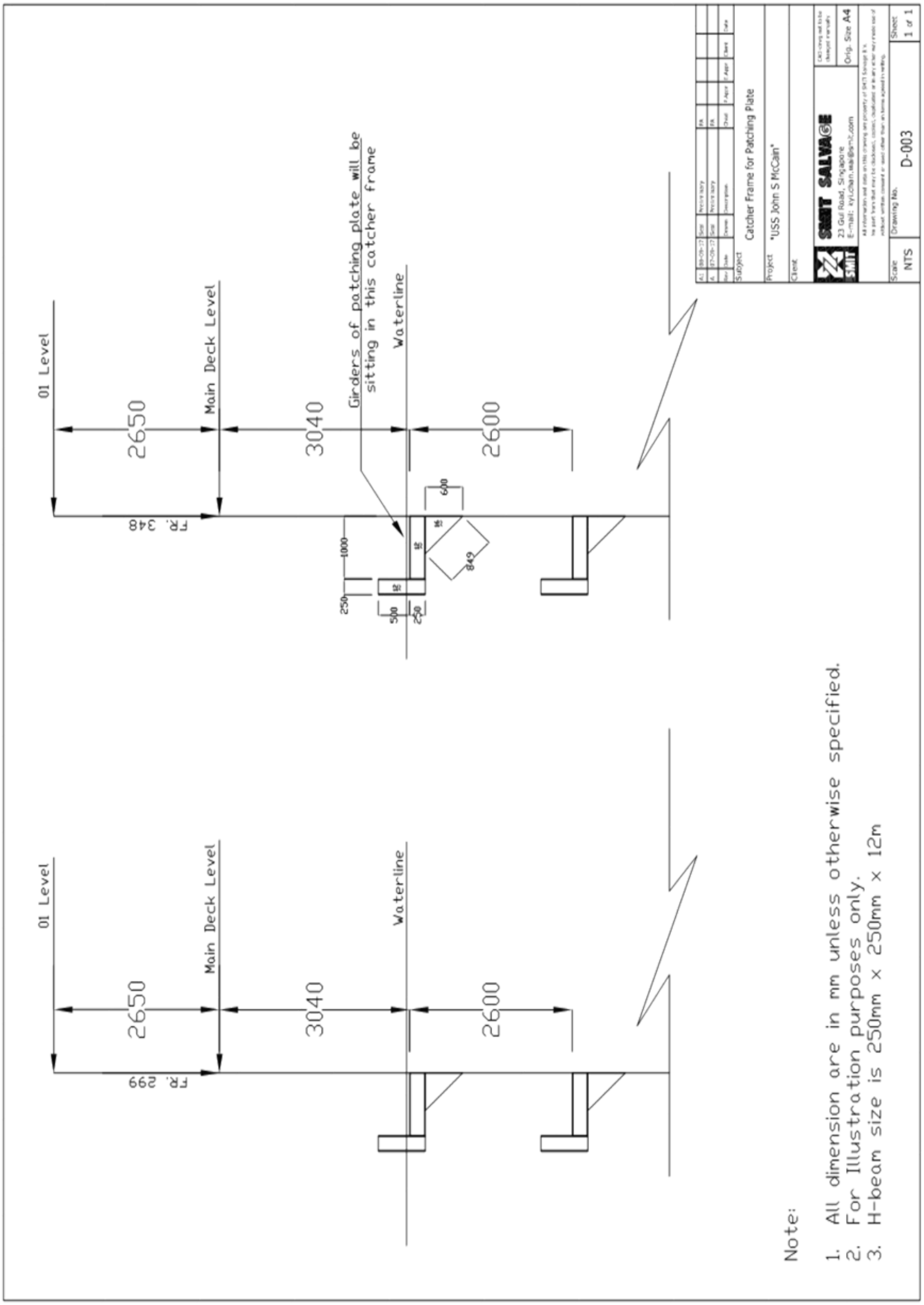
Damaged Spaces

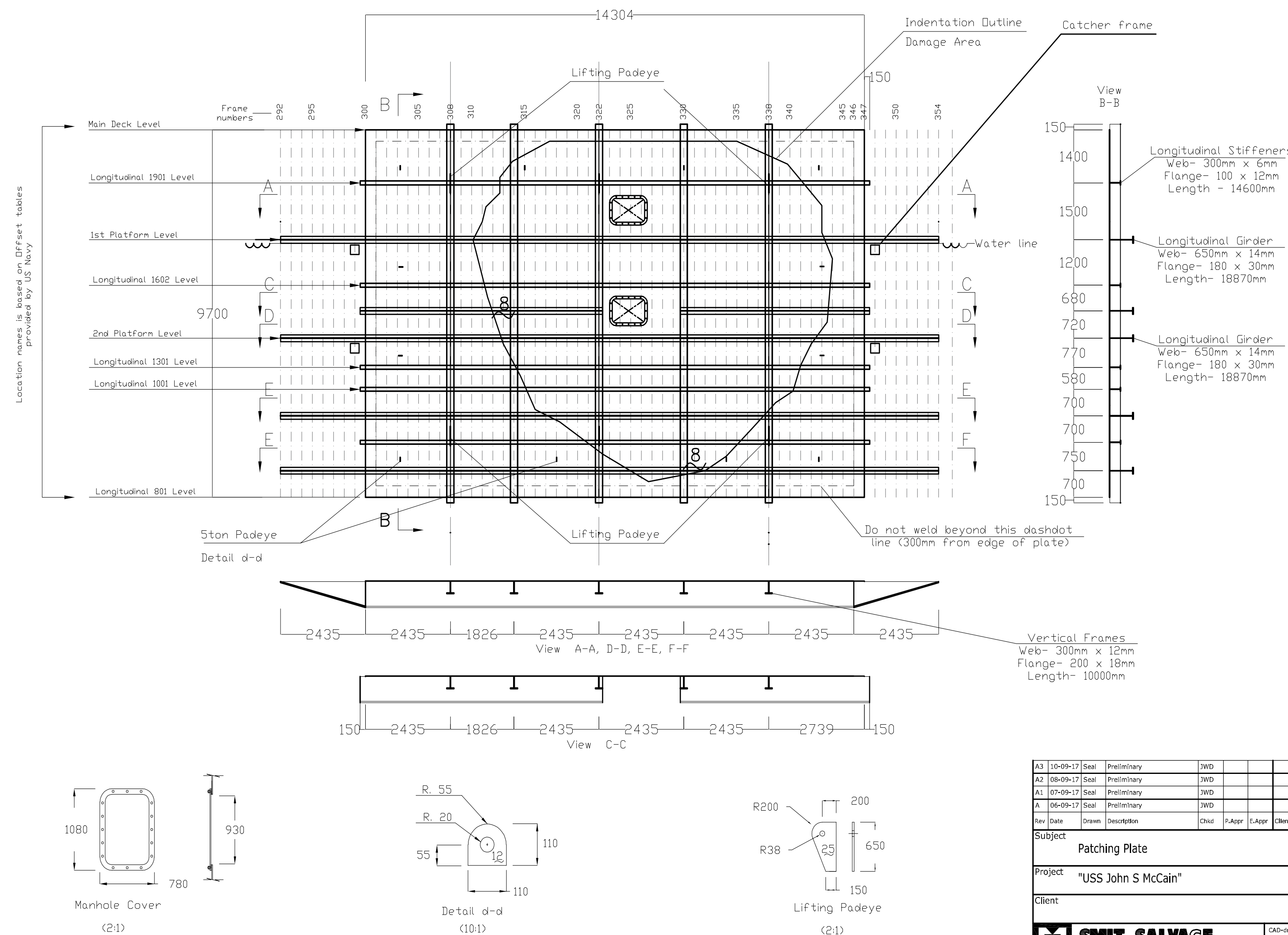
Name	Int Weight LT	Outflow LT	Flooding LT	Net Wt LT	LCG Ft-FP	VCG Ft-BL	TCG Ft-CL	Damage Opt
5-300-4-F	0	0	38	38	312.77A	7.48	16.38P	DAMAGED-%Flood
3-310-2-L	0	0	8	8	319.05A	14.98	17.85P	DAMAGED-%Flood
3-338-1-L	0	0	5	5	353.65A	15.00	18.09S	DAMAGED-%Flood
3-338-2-L	0	0	5	5	353.68A	15.00	17.93P	DAMAGED-%Flood
5-300-1-E	0	0	15	15	317.02A	4.14	3.68S	DAMAGED-%Flood
Damage Totals	0	0	71	71	320.33A	8.69	9.93P	

Abbreviations:

		Free-Floating Draft / Displacement Data		
		Intact	After Outflow	Damaged
Draft AP	ft	20.17		20.92
Draft FP	ft	20.53		20.30
Trim at Perps	ft	0.36F		0.62A
Static Heel Angle	deg	0.88S		0.14S
Draft Aft	ft	20.17		20.92
Draft MS	ft	20.35		20.62
Draft Fwd	ft	20.53		20.31
Total Weight	LT	8,279	8,351	8,351
VCG	ft	22.92	22.80	22.80
LCG	Ft-FP	233.50A	234.24A	234.24A
TCG	Ft-BL	0.10S	0.01S	0.01S
Buoyancy	LT	8,279		8,351
KB	ft	11.87		12.19
LCB	Ft-FP	234.25A		234.25A
TCB	Ft-BL	0.01S		0.04S
TPin	LT/in	51.4		51.5
MTin	ft-LT/in	1,434		1,428
KMt	ft	29.09		29.19
GMt(solid)	ft	6.17		6.39
FS Adjustment	ft	0.35		0.69
GMt Upright	ft	5.82		5.70
GM @ Equil	ft			5.69

Appendix I – JOHN S MCCAIN Patch Drawings





Note:
1. Curvature of the patch is not show in this drawing.
2. KEPPEL needs to refer to the provided offset tables for shaping patch according to the USS McCain hull form.
3. This drawing is interpreted based on the file received titled "JSM salvage patch for SS3 condition"
4. All dimension are in mm unless otherwise specified.
5. All structural members will be full weld

Rev	Date	Drawn	Description	Chkd	P.Appr	E.Appr	Client	Date
A3	10-09-17	Seal	Preliminary	JWD				
A2	08-09-17	Seal	Preliminary	JWD				
A1	07-09-17	Seal	Preliminary	JWD				
A	06-09-17	Seal	Preliminary	JWD				

Subject: Patching Plate

Project: "USS John S McCain"

Client:

SMIT SALVAGE
23 Gul Road, Singapore
E-mail: kyl.chan.wal@smit.com

CAD-drwg not to be changed manually

Orig. Size A4

Scale	Drawing No.	Sheet
NTS	D-001	1 of 1

Appendix J – JOHN S MCCAIN Stiffened Patch Calculations

From Salvage Engineer's Handbook p. 2-40, 41

Initial Patch Design with stiffeners spaced every 4.6 x 16 ft

$$r = 4.6 \text{ ft}$$
$$R = 16 \text{ ft}$$
$$\frac{R}{r} = 3.48$$
$$\text{Fixed: } \mathrm{k} = 0.5$$
$$\text{Simply Supported: } \mathrm{k} = 0.727$$
$$p = 10 \text{ x } 0.445 = 4.45\, psi$$
$$\sigma = k\frac{pr^2}{t^2}$$
$$\text{Fixed: } \sigma = 68{,}326\, psi$$
$$\text{Simply Supported: } \sigma = 99{,}346\, psi$$

Add another vertical stiffener

$$r = 4.6 \text{ ft}$$
$$R = 8 \text{ ft}$$
$$\frac{R}{r} = 1.74$$
$$\text{Fixed: } \mathrm{k} = 0.476$$
$$\text{Simply Supported: } \mathrm{k} = 0.549$$
$$\text{Fixed: } \sigma = 65{,}046\, psi$$
$$\text{Simply Supported: } \sigma = 75{,}022\, psi$$

Add another horizontal stiffener

$$r = 2.3 \text{ ft}$$
$$R = 8 \text{ ft}$$
$$\frac{R}{r} = 3.48$$
$$\text{Fixed: } \mathrm{k} = 0.5$$
$$\text{Simply Supported: } \mathrm{k} = 0.727$$
$$\text{Fixed: } \sigma = 17{,}082\, psi$$
$$\text{Simply Supported: } \sigma = 24{,}837\, psi$$

Appendix K.

JSM Desiccant Application Figures (2,000 lbs)

Bag Weight
1

Desiccant Onload: 29 September
Application: 30 September - 3 October

* X drums / Y bags of
*Coverage: 13.33 cu. ft. / 1.25 lbs
*2000 lbs. added to ships weight

Location	Space	Volume	A/C Required	Min. Desiccant (lbs)	# Bags
01-130-0-Q	CSMC FWD & AFT	4095.84	Y	42.0	42.0
01-274-1-C	Radar Room #3	3412.64	Y	35.0	35.0
01-300-1-Q	CIWS Workshop #2	2131.5	Y	21.0	21.0
02-112-0-Q	CIWS Workshop #1	1465.71	Y	17.5	17.5
02-299-0-C	CIWS Control Room #2	1743.47	Y	17.5	17.5
03-112-0-C	CIWS Control Room #1	1743.47	Y	17.5	17.5
03-128-0-C	Radar Room #1	3687.74	Y	38.5	38.5
03-128-2-Q	SPY Array Rm #2 (FWD/PORT)	2376.6	Y	24.5	24.5
03-142-0-C	Radar Room #2	6925.5	Y	70.0	70.0
03-142-1-Q	Electronic Workshop #1	1798.2	Y	17.5	17.5
03-142-2-Q	Electric Load Center #1	1464.08	Y	17.5	17.5
03-158-2-Q	SPY Array Rm #4 (AFT/PORT)	4285.65	Y	42.0	42.0
03-158-3-Q	SPY Array Rm #3 (AFT/STBD)	4285.65	Y	42.0	42.0
03-282-0-Q	Director Equip Room #3	1419.03	Y	14.0	14.0
04-130-0-C	Pilot House	6070	Y	59.5	59.5
04-150-0-C	Chart Room	932.8	Y	10.5	10.5
04-272-0-Q	Director Equip Room #2	1325.21	Y	14.0	14.0
05-131-0-Q	Director Equip Room #1	1434.69	Y	14.0	14.0
1-100-2-Q	VLS Security Station (Fwd)	432	Y	7.0	7.0
1-126-0-C	CIC	17424.43	Y	171.5	171.5
1-18-0-Q	Sonar Equip Room #1	5284	Y	52.5	52.5
1-158-0-C	TSCSI Room	1320	Y	14.0	14.0
1-268-0-C	CCS (VLS Alarms)	5170.16	Y	52.5	52.5
1-300-0-C	CSER #3	3435.39	Y	35.0	35.0
1-314-0-C	CSER #3 Annex (HER)	1713.04	Y	17.5	17.5
1-330-0-Q	VLS Service Interface Room (Aft)	933.53	Y	10.5	10.5
1-330-2-Q	VLS Security Station (Aft)	436.8	Y	7.0	7.0
1-97-2-Q	VLS Service Interface Room (Fwd)	628.26	Y	7.0	7.0
2-18-0-Q	Sonar Equipment Room #2	3780	Y	38.5	38.5
2-126-1-C	Communications Center	8482.5	Y	84.0	84.0
2-126-2-C	CSER #2	8290	Y	80.5	80.5
2-153-2-C	Tomahawk Equip Room	3027.51	Y	31.5	31.5
2-157-1-C	Radio Transmitter Room	3211.65	Y	31.5	31.5
2-220-1-Q	SNAP III Computer Room	754.88	Y	10.5	10.5
2-50-2-C	Sonar Control Room	4291.44	Y	42.0	42.0
2-53-1-C	CSER #1	4013.56	Y	42.0	42.0
3-126-2-Q	Power Supply/Conversion Room	4682.03	Y	45.5	45.5
3-18-0-Q	Sonar Equipment Room #3	2221	Y	24.5	24.5
3-300-0-C	IC & Gyro Room #2	3693.64	Y	38.5	38.5
3-319-0-Q	Power Conversion Room	2997.07	Y	31.5	31.5
3-338-0-M	VLS Magazine #2 (Aft, 61 cell)	20131.2	Y	196.0	196.0
3-78-0-M	VLS Magazine #1 (Fwd, 29 cell)	12870.88	Y	126.0	126.0
4-94-0	FWD IC GYRO Room #1	3200	y	31.5	31.5
			Totals	**1743.00**	**1743.00**

4-254-0-E	#2 SWBD			65.8	65.8
3-370-0-E	#3 SWBD			65.8	65.8
2-53-1-C	LC 11			26.6	26.6
03-142-2-Q	LC 21			26.6	26.6
1-254-2-Q	LC 31			26.6	26.6
			Totals	**211.4**	**211.4**

(45 lbs) Remaining to be distributed as needed

Appendix L: USS John S. McCain Transport Manual

Discussion

The transport manual required by contract to be created by Dockwise was delivered in several separate pieces. First, the Cargo Securing Manual (0032098-TRE-CSM-Rev 1, dated 28 Sep 2017, attached here in its entirety) includes the details of the loading, voyage, offload and pertinent calculations. Second, the drawings (DW-0032098, Rev 0 – 2 depending on the drawing number, dated Sep 2017, excerpts attached here) show the cribbage/block design, catcher design, guide post placement and line handling plan. Third, the Float-On Ballast Plan (0032098-TREAS-ER-03, Rev 0, dated 25 Sep 2017, excerpt attached here). Lastly, the engineering reports (0033098-TREAS-ER01 Rev 1, "Steel Support Structures…" and 0032098-TREAS-ER-02 Rev 1, "Seafastening" dated 28 Sep 2017, not attached here) are detailed engineering analysis reports.

Plan Development

The documentation presented here represents the final version before on-load in Singapore. The development of the transfer manual began with the HLPO and NAVSEA00C SME traveling to Dockwise headquarters in the Netherlands. During that September 2017 trip, the Transport Manual *was not completed* in its entirety according to the schedule. But, the decision to use the docking drawing block layout and the patch design was finalized. Also, it was decided to flip the cargo by 180 degrees to minimize the stress on the damaged area. The full Transport Manual was completed after the team left the Netherlands or around 28 September 2017.

During the planned voyage to Japan, cracking was found in the hull of the USS John S. McCain. The MV Treasure was diverted to Subic Bay to add additional blocks. The additional blocks are shown in the drawings below.

Cargo Securing Manual

Float-On Ballast Plan (lowest GM Steps)

Drawings

Additional Blocks added in Subic Bay

DOCKWISE SHIPPING B.V.

CARGO SECURING MANUAL

DOCKWISE

TRANSPORT OF THE USS JOHN S. MCCAIN
ONBOARD OF THE TREASURE
FROM SINGAPORE (SINGAPORE)
TO YOKOSUKA (JAPAN)

CONTRACT NR: 0032098

DOCKWISE DOC. NR: 0032098-TRE-CSM
CLIENT DOC. NR: -

REVISION: 1

CLIENT: SMIT SALVAGE

Rev.	Date	Originator		Disciplinary Check		Inter Disciplinary		Approval DW	
1	28/SEP/17	A. Santalla Diaz Transport Engineer	AS	N. Vernes Senior Transport Engineer	NV	S. de Jong Lead Superintendent	SdJ	R. Postma Lead Transport Engineer	RP
0	24/SEP/17	A. Santalla Diaz Transport Engineer		N. Vernes Senior Transport Engineer		S. de Jong Lead Superintendent		T. Hofslot Senior Transport Engineer	
A	11/SEP/17	A. Santalla Diaz Transport Engineer		A. Hellinga Transport Engineer		S. de Jong Lead Superintendent		T. Hofslot Senior Transport Engineer	

REVISION LOG

Revision	Date	Reason for new revision	Applicable section(s)
A	11/SEP/17	Internal Issue For Review and Comment (IFRC)	All
0	24/SEP/17	Issued for Approval	All
1	28/SEP/17	Approved as Final	Left Margin

DISTRIBUTION MATRIX

External distribution	Team	Volumes	Media E: Electronic H: Hardcopy
Project Manager	CLIENT	1	E
Internal distribution	**Team**	**Volumes**	**Media** **E: Electronic** **H: Hardcopy**
Project Manager	DW	1	E
Project Superintendent	DW	1	H
Dockwise HTV	DW	1	H
Transport Engineering	DW	1	E

CONTENTS

1. GENERAL

1.1 Project scope

The USS John S. McCain of USS Navy needs to be dry transported. Smit Salvage has contracted Dockwise to transport this vessel. The transport shall be done by the Treasure and starts around 1-OCT-2017. The USS John S. McCain will be loaded in Singapore (Singapore) using the float-on method. After the voyage, it will be discharged using the float-off method in Yokosuka (Japan). The USS John S. McCain shall be placed onboard diagonally with the bow facing fwd port side. See the stowage plan drawings DW-0032098-001 for the global position of the USS John S. McCain onboard the HTV.

1.2 Document scope

This document includes technical information for the transport of the USS John S. McCain from Singapore (Singapore) to Yokosuka (Japan) onboard of the Treasure. This document is used as a guideline for the voyage, loading- and discharge operation.
The calculations/drawings contained in this document are based on the currently available cargo properties. Neither Dockwise Shipping B.V. nor any of its corporate affiliates or employees of these corporate affiliates warrants the accuracy of these cargo properties.

Note - all measurements in this booklet are metric unless stated otherwise.

1.3 Abbreviations

CoG	Center of Gravity
CSM	Cargo Securing Manual
DW	Dockwise Shipping B.V.
GWS	Global Wave Statistics
HTV	Heavy Transport Vessel
hr	Hour
kn	Knot
LCG	Longitudinal Center of Gravity
m	Meter
MDR	Master Document Register
mm	Millimeter
MWS	Marine Warranty Surveyor
NPR	Noon Position Report
OEP	Operational Execution Plan
PS	Port Side
s	Second
SB	StarBoard side
SoW	Scope of Work
SPOS	Ship Performance Optimization System
TCG	Transverse Center of gravity
VCG	Vertical Center of Gravity

1.4 Reference Documents

[ref. 1]	Dockwise Engineering Guidelines and Criteria	--
[ref. 2]	Master Document Register[1]	0032098-MDR
[ref. 3]	Operational Execution Plan	0032098-TRE-OEP
[ref. 4]	Global Wave Statistics	--

[1] The MDR shows all the documents issued by the client and by Dockwise Shipping B.V. in preparation of this contract. The latest revision and issue date of each document is recorded in this register.

1.5 Calculation methods

All calculations for this transport are executed according to [ref. 1]. A copy of this document can be obtained by contacting the Dockwise head office in Papendrecht, The Netherlands.

1.6 Software description

The following software packages are used for the preparation of the transport of the USS John S. McCain.

- DOSUITE version 5.3.1.0: In-house developed software for the assessment of heavy transports.;
- GHS version 14.92: A general-purpose hydrostatics program to perform stability calculations, which includes free-surface effects within the HTV's tanks. Global HTV strength calculations are executed with the help of this program as well.
- ShipMo: Hydrodynamics program for the analysis of ship motions. It includes both radiation-diffraction calculations based on strip theory, and viscous roll damping.

2. PARTICULARS OF VESSEL AND CARGO

2.1 Particulars of the vessel

The following table shows the vessel particulars of the HTV Treasure.

PRINCIPAL CHARACTERISTICS:

Length o.a.	216.79	m
Length b.p.	207.93	m
Breadth over all	45.00	m
Beam moulded	44.50	m
Height	52.30	m
Depth	14.00	m
Draft submerged	23.00	m
Summer draft	10.43	m
GRT	42,609	-
NRT	12,783	-
Deadweight	53,868	t
Deck space	130 x 44.50	m
Deck load	20	t/m^2
Anchors forward	2 * 15.4	t
Chains forward	2 * 357.5 m * 97	mm

COMMUNICATION EQUIPMENT:

All communication aids available to standards as required for size, type and age of vessel

NAVIGATION EQUIPMENT:

All navigational aids available to standards as required for size, type and age of vessel
Bridges forward and aft

BALLASTING:

Four main ballast pumps (electric driven)
2,500m^3/hr at 30m head
One ballast pump (electric driven)
4,000m^3/hr at 30m head
One stripping pump 600m^3/hr at 150 m head
One stripping pump 350m^3/hr at 120 m head
One stripping ejector 300m^3/hr at 20 m head
One stripping ejector 400m^3/hr at 20 m head
Two drain tank pumps 600m^3/hr at 30 m head (par.)
One fire pump 110m^3/hr at 80 m head
One fire pump 180m^3/hr at 30 m head
One fire gen. service pump 110m^3/hr at 80 m head
One fire gen. service pump 180m^3/hr at 30 m head
One emergency fire pump 72m^3/hr at 80 m head

PROPULSION/MANOEUVRING:

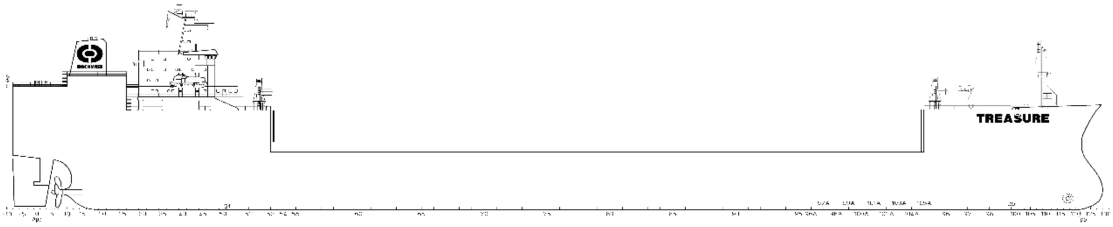
One SPLIT MAN B&W 6S 70MC, 13,365 kW driving one 4-bladed fixed propeller
One rudder
One bow thruster 1,500 kW

AUXILIARY ENGINES:

3 MAN B&W 6L28/32H diesel generators
1,200 kW each

CARGO HANDLING

Hydraulic winch	4 * 15 t
Store crane fwd	1 * 10 t
Store crane aft	2 * 10 t



2.2 Particulars of the cargo

The USS John S. McCain is operated / owned by USS Navy. The USS John S. McCain has the Dockwise cargo number 64356. The following are the main particulars of the cargo as per latest information supplied by the client.:

Weight		8500	[ton]
Longitudinal center of gravity	(measured from stern fr.0 – Fwd+)	-71.000	[m]
Transverse center of gravity	(measured from centerline – PS+)	-0.010	[m]
Vertical center of gravity	(measured from baseline – Up+)	7.200	[m]
Length overall		154.000	[m]
Length between perpendiculars		142.000	[m]
Width		20.300	[m]
Width overall		20.300	[m]
Depth	(measured from baseline	11.100	[m]
Total height	(measured from baseline)	52.000	[m]
Trim	(in loading condition)	0.02 Aft	[deg]
Heel	(in loading condition)	0.0	[deg]
Protrusion of sonar dome		3.029	[m]
<u>Patched (Loading Draft)</u>			
Loading draft Mid Ship	(including protrusions)	6.266	[m]
Loading draft Aft Ship	(including protrusions)	6.274	[m]

The Dockwise cargo drawings DW-0032098-009 have been used for the preparation of this manual and are based on the client drawings as listed in [ref. 2].

Figure 2.1: 3D representation of the USS John S. McCain

3. LOADING OPERATION

This chapter describes the preparation required prior to the loading operation and the execution of the loading operation.

3.1 Description of the proposed loading location

The USS John S. McCain will be loaded in Singapore (Singapore). Details of the proposed loading location are given in Attachment 1.

3.2 Preparation of the HTV

The HTV preparations include, but are not limited to;

- HTV's deck to be prepared in accordance with the cribbing plan drawing DW-0032098-002. The cribbing is a combination of: hard, soft and plywood with a total height of 575 [mm]. On grillage the combination will be: steel construction, wood and on top a steel plate with total height of 575 [mm];
- 2 guideposts to be installed in order to position the cargo correctly, in accordance with drawing DW-0032098-002 ;
- All equipment that is necessary for the loading operation to be checked by the vessel crew prior to the HTV's arrival in Singapore (Singapore). The resources required for the transport are summarized in Attachment 4;

3.3 Preparation of the cargo

The cargo must be prepared as described in the contract. The preparations include, but are not limited to:

- Catcher to be installed at the location as indicated in drawing DW-0032098-004, in order to position the USS John S. McCain correctly on the deck;
- The USS John S. McCain to be ballasted as per loading condition (as per paragraph 2.2)
- All cranes and lifting equipment, if present, to be secured and stowed in transit condition;
- All anchors, if present, need to be fastened or rigidly connected to the cargo;
- Sufficient connection points (pad eyes, bollards or similar) to be present at the cargo's bow and stern, in order to be able to connect tugger-wires to the USS John S. McCain;

Furthermore Smit Salvage must confirm that:

- Particulars of the cargo as stated in paragraph 2.2 are consistent with actual condition of the USS John S. McCain;
- Drawings of the cargo (in MDR) are, in all respects, consistent with the actual condition of the USS John S. McCain;
- Any protruding items, other than as listed in paragraph 2.2, are absent;
- Position of the guideposts will not result in any clash with cargo appendages.
- Removal of propeller blades which are protruding below the baseline.
- Repairing damaged area to have a watertight hull.

3.4 Weather conditions and limitations for loading operations

For the loading operation, favorable weather conditions are required. The operational limits are not strict limits and are subject to the interpretation of the Superintendent and the Master of the HTV. Also, the actual relative motion of the cargo with respect to the HTV is to be considered before the loading operation commences.

Guidelines for the limiting criteria are:

• Maximum wave height	0.5	[m]
• Maximum swell	0.3	[m]
• Maximum wave/swell period	5 – 7	[s]
• Maximum wind speed	15	[kn]
• Maximum current speed	0.5	[kn]

3.5 Loading procedure

Loading of the USS John S. McCain will be carried out by means of the float-on method.

3.5.1 Loading meeting

Prior to the loading operation, a meeting with all relevant parties, if available, to be held in which at least the following must be discussed:

- Loading schedule & sequence;
- Responsibilities;
- Communication lines;
- Loading specific issues;
- Safety issues.

3.5.2 Submerging of the HTV

It is the HTV's crew's responsibility to prepare a ballast plan for submerging, with the help of GHS software. After approval of the deck preparations by the attending Marine Warranty Surveyor, the HTV will ballast down to a draft of approximately 21.97 [m], achieving 6.77 [m] water above the cribbing. A water depth of 22.97 [m] will be required, see table below:

Required Water Depth	Aft	
Cargo draft (including protrusions)	6.27	[m]
Clearance	0.50	[m]
Cribbing side block at Cargo Fr. 286	1.20	[m]
Vessel depth	14.00	[m]
Vessel loading draft	21.97	[m]
Under keel clearance	1.00	[m]
Required water depth	22.97	[m]

Table 3-1: Required water depth

3.5.3 Go / No Go moment

Final assessment of the environmental condition is to be performed by the Superintendent, the Master of the HTV and US Navy representative, after which is decided whether or not the cargo will be loaded.

3.5.4 Loading of the cargo

The following describes the loading steps as shown in drawing DW-0032098-005:

1. USS John S. McCain to be brought close to the bow of the HTV with assistance of tugs.
2. First tugger-wire to be connected to USS John S. McCain. Tugger-lines/wires will be brought to the cargo by dedicated line handlers. Smit Salvage needs to arrange line handlers in order to connect these tugger-lines/wires.
3. Once all tugger-lines/wires are connected to the cargo, positioning of USS John S. McCain to the correct position above the HTV's deck can commence.
4. Once USS John S. McCain is in position, the de-ballast operation can start. Stability of the HTV during submerging/emerging to be positive at all times.
5. Once the cargo is on the cribbing, the tugs to be disconnected (at Superintendent's and/or Master's discretion). Disconnection of tugs, use of extra tugs, or the use of tugs on standby will be at the discretion of the Superintendent and the Master of the HTV, depending on local circumstances.
6. Sea fastening can be brought into position as soon as the deck is dry, but welding cannot start until the sailing draft has been reached.

4. VOYAGE

Attachment 2 lists all the results of the voyage calculations performed for the transit from Singapore (Singapore) to Yokosuka (Japan).

4.1 Route

The route as shown in Attachment 2 is used as base for the voyage calculations. The Master is to avoid adverse conditions and take all required precautions for sheltering or deviation from the intended track, when weather conditions are endangering the HTV's safe maneuverability and/or when environmental conditions are expected to reach the maximum allowable conditions as listed in paragraph 4.2.

4.2 Environmental conditions

The following environmental design conditions, based on a departure date of 1-October-2017, have been assessed using Dockwise's in-house wind and wave database.

- Significant wave height: 6.63 [m]
- Zero Upcrossing wave period: 6.5 to 9.50 [s]
- 1-hour wind speed: 60.00 [kn] (client requirement)

The HTV is equipped with SPOS[2], which offers onboard weather routing. The HTV will receive weather and routing information on a regular basis. In the areas 29, 40 and 41 (according to world area definitions as used in [ref. 4]) the weather routing is taken into account for the design wave height calculation, according to [ref. 1].

4.3 HTV ballast condition

The HTV ballast condition is designed, taking the following into account:

- HTV stability must be such that stability requirements are passed;
- The draft does not exceed the HTV summer load line draft;
- Global bending moment and shear force of the HTV are within allowable limits;
- The ballast condition is optimized in order to minimize the HTV's accelerations.

4.4 HTV stability

The HTV stability calculation is provided in Attachment 2. The results of the calculation show that the stability requirements are passed.

4.5 HTV strength

The global HTV longitudinal strength calculations are provided in Attachment 2. The shear force and global bending moment are written as a percentage of the maximum allowed value in sailing condition. The results show that the shear force and global bending moment are within the allowable values in sailing condition.

[2] The SPOS software offers the staff on board a simple but powerful tool in taking the decisions with regard to voyage planning in relation to weather conditions and display the weather forecast. Detailed charts with wind, sea and swell forecasts together with hurricane/typhoon forecasts and actual ice information are presented in SPOS.
In addition Routeguard is used. Meteoconsult as a meteorological office prepares a set of weather information for standards ocean regions. This information includes wind and wave forecasts but also tropical storm and ice information. Via e-mail, the weather information is sent to the vessel twice a day.

4.6 Motion response

The natural roll period of the total system is 9.06 [s].

The following maximum design accelerations in the center of gravity of the cargo have been computed using the environmental conditions mentioned in paragraph 4.2:

	Maximum Acceleration		
	Longitudinal [g]	Transverse [g]	Vertical [g]
USS John S. McCain CoG	0.067	0.509	0.201

Table 4-1: Maximum accelerations

Maximum roll angle 19.7 deg — Maximum roll acceleration 0.1324 rad / s²
Maximum pitch angle 4.2 deg — Maximum pitch acceleration 0.0283 rad / s²

- The accelerations above are derived from four sea-states. These are maximum values and thus do not necessarily occur at the same time.
- It is the responsibility of the client/cargo owner to ensure that the cargo is capable of withstanding these accelerations and that those items within or connected to the cargo are properly secured.

4.7 Support pressure

Dockwise accepts a maximum support pressure for soft wood of 20 [kg/cm²], as described in [ref. 1]. The results of the support pressure calculations are given in Attachment 2. The maximum support pressure during the transport is shown below:

	Maximum Support Pressure [kg/cm²]
Static	9.33
Static + Dynamic	17.69

Table 4-2: Support pressures

4.8 Seafastening

Seafastening will be installed as per DW-0032098-003. The results of the seafastening calculations are given in Attachment 2. The design load for each type of seafastening is:

- Bracing capacity = 200 [ton]
- Strongbox capacity = 200 [ton]

The extreme design forces and total capacity available are summarized below:

	PS [ton]	SB [ton]	Aft [ton]	Forward [ton]
Total capacity available	4332	4332	2400	2400
Extreme design force	3583	3583	2400	2400

Table 4-3: Extreme design force and seafastening capacity

4.9 Overturning moment calculation

The overturning moment of the cargo as a result of inertia- and wind loads acting on the cargo is calculated. The results of this calculation is given in Attachment 2 and shows that uplift will not occur.

5. DISCHARGE OPERATION

This chapter describes the preparation required before the discharge operation commences and how the discharge operation will be carried out.

5.1 Description of the proposed discharge location

The USS John S. McCain to be discharged in Yokosuka (Japan). Details of the discharge location are given in Attachment 3.

5.2 Preparation of the HTV

The HTV preparations include, but are not limited to;

- All equipment that is necessary for the discharge operation to be prepared and checked before the HTV's arrival in Yokosuka (Japan).
- All seafastenings to be cut loose from the HTV's deck and moved sufficient distance away from the USS John S. McCain.

5.3 Weather conditions and limitations for discharge operation

For the discharge operation, favorable weather conditions are required. The operational limits are not strict limits and are subject to the interpretation of the Superintendent and the Master of the HTV. Also, the actual relative motion of the cargo with respect to the HTV has to be considered before the actual discharge commences.

Guidelines for the limiting criteria are:

• Maximum wave height	0.5	[m]
• Maximum swell	0.3	[m]
• Maximum wave/swell period	5 – 7	[s]
• Maximum wind speed	15	[kn]

5.4 Discharge procedure

Discharging of the USS John S. McCain will be carried out by means of the float-off method.

5.4.1 Discharge meeting

Prior to the discharge operation, a meeting with all relevant parties, if available, to be held in which at least the following must be discussed:

- Discharging schedule & sequence;
- Responsibilities;
- Communication lines;
- Discharging specific issues;
- Safety issues.

5.4.2 Submerging of the HTV

The HTV will ballast down until discharge draft, which is the same as the loading draft, as defined in paragraph 3.5.2.

5.4.3 Go / No Go moment

Final assessment of the environmental condition is to be performed by the Superintendent, the Master of the HTV and US Navy representative, after which is decided whether or not the cargo will be discharged.

5.4.4 Discharge of the cargo

The following describes the discharging steps, as shown in drawing DW-0032098-006:

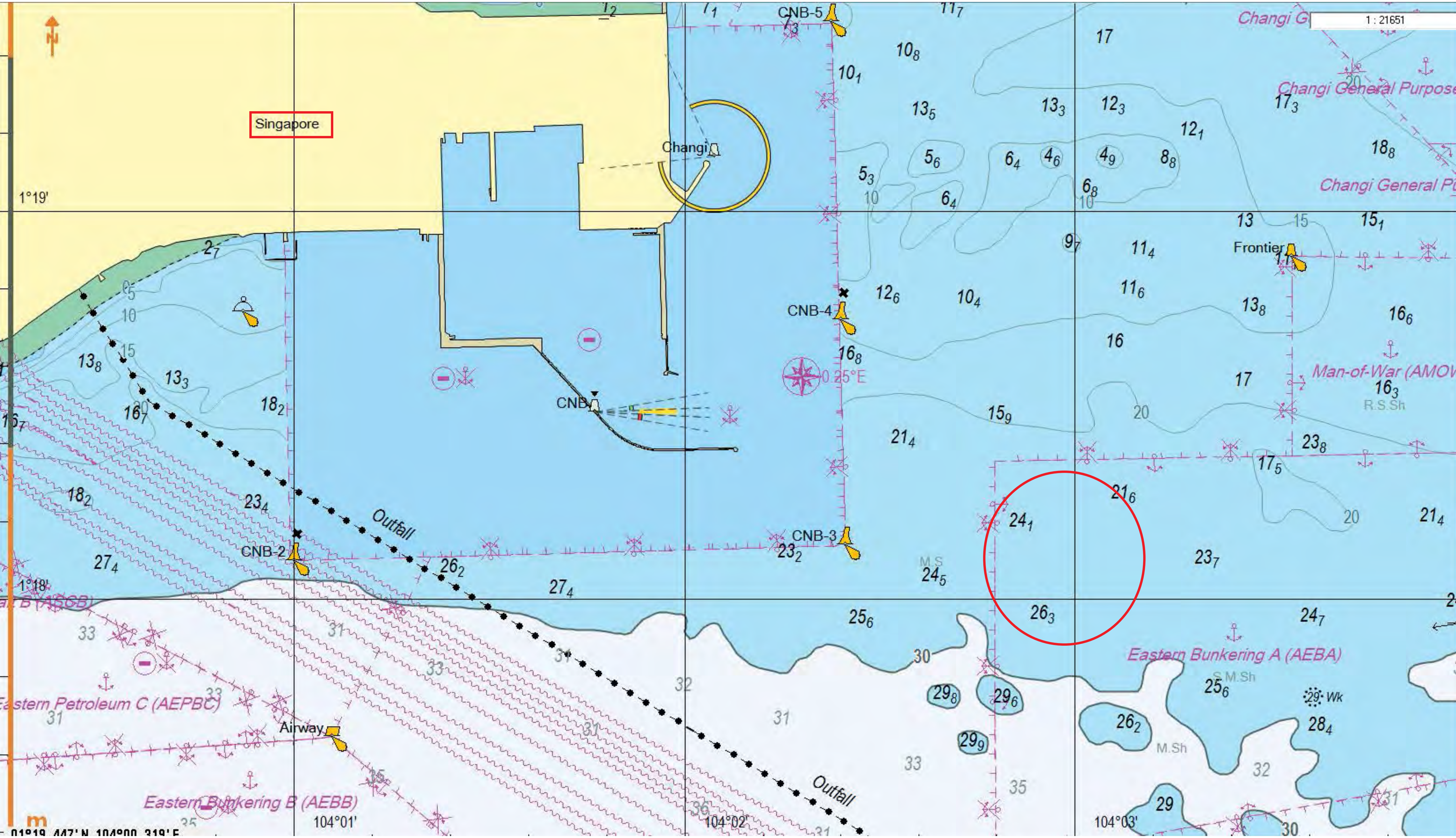
1. Tugger-lines/wires to be connected by the crew members before arrival. HTV ballasted to float-off draft. The stability of the HTV during submerging/emerging to be positive at all times.
2. Tugs connected to the cargo, just prior to the floating draft has been reached.
3. USS John S. McCain shifted towards aft of HTV by HTV's tugger-lines/wires and with assistance of tugs.
4. All HTV's tugger-lines/wires disconnected from the cargo by USS Navy's crew at the command of the Master of the HTV and/or attending Superintendent, cargo clear off HTV. The connection of tugs, use of extra tugs or the use of tugs on standby to be at the discretion of the master of the HTV and/or Superintendent, depending on local circumstances.

6. ATTACHMENTS

ATTACHMENT 1.	PROPOSED LOADING LOCATION	REV 0
ATTACHMENT 2.	VOYAGE CALCULATIONS	REV 0
ATTACHMENT 3.	PROPOSED DISCHARGE LOCATION	REV 0
ATTACHMENT 4.	OVERVIEW OF RESOURCES (HOLD)	REV 0
ATTACHMENT 5.	ACCERELATIONS RESULTS IN CARGO AXIS	REV 0

ATTACHMENT 1. PROPOSED LOADING LOCATION REV 0

The attached page shows information for a proposed loading location near Singapore (Singapore).



Singapore
Changi
1 : 21651
Changi General Purpose
Changi General P
Man-of-War (AMOW
Frontier
CNB-5
CNB-4
CNB-3
CNB-2
CNB
0.25°E
Outfall
Outfall
Airway
Eastern Bunkering A (AEBA)
Eastern Bunkering B (AEBB)
Eastern Petroleum C (AEPBC)
1°19'
1°18'
104°01'
104°02'
104°03'
Wk
M.Sh
S.M.Sh
R.S.Sh
M.S

ATTACHMENT 2. VOYAGE CALCULATIONS REV 0

The attached pages show the voyage calculations, which contain the following:

- Loading condition
- Ballast tanks
- Stability curve
- Stability rules assessment
- Longitudinal strength
- Cargo information
- Vessel route
- Environmental conditions
- Wind loads and moments
- Radii of gyration
- Motion response calculation
- Support pressure calculation
- Extreme design forces
- Seafastening calculation

- Strongbox design calculation
- Overturning moment calculation

Voyage Calculation

Loading Condition

Vessel	Treasure
Description	USS John McCain
Condition	Sailing
Hydrostatic model	Voyage3 [Enquiry Model]

Condition summary

Draught APP	10.84 m	KMt	22.01 m	Sea Water	1.025 t/m3
Draught MID	9.16 m	KG	10.25 m	Weight/cm	79.98 t/cm
Draught FPP	7.48 m	F.S. Corr	0.72 m	MCT	1043.21 t.m/cm
Trim	Aft 3.37/207.86 m	KG-Fluid	10.96 m		
Heel Angle	No Heel	GM-Fluid	11.05 m		

Condition details

Item	Weight (t)	LCG (m)	TCG (m)	VCG (m)	FSM (t.m)
Light Ship+	22137.83	93.153	-0.033	11.780	
Crew/Effects/Spares	50.00	25.000	0.000	26.000	
Cargo					
USS John S. McCain	8500.00	110.275	-1.276	21.775	
Tank Summary					
Sea Water	30815.80	126.248	0.385	5.449	44701
Fresh Water	466.34	11.138	-0.004	20.366	315
Fuel Oil	3115.61	28.892	0.786	13.182	1656
Diesel Oil	256.27	18.167	-10.561	17.588	126
Lube Oil	71.82	23.619	0.000	1.333	26
Sludge	3.25	23.791	3.121	0.497	2
Dirty/Bilge	7.36	27.275	-3.297	0.410	7
Totals	65424.27	106.888	0.000	10.245	46833

Ballast Tanks

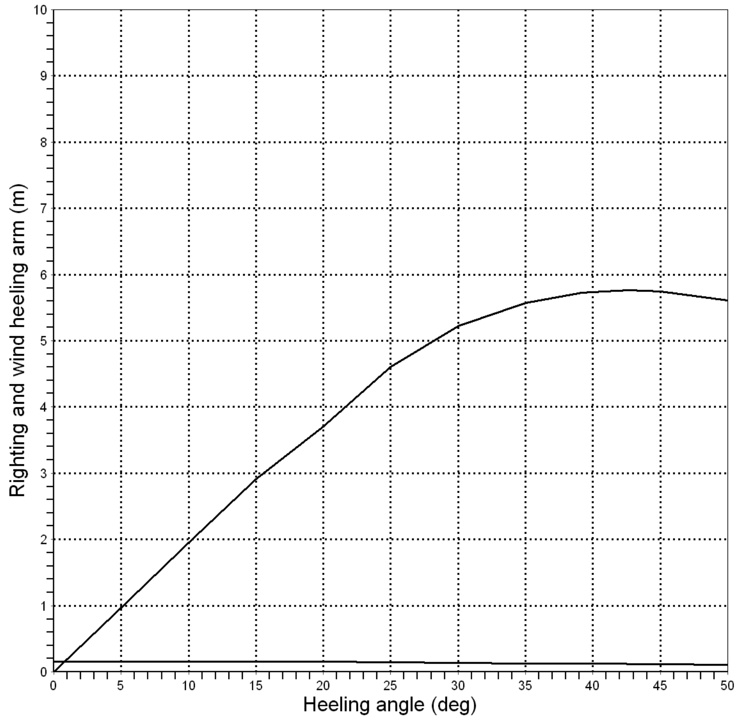
Vessel	Treasure
Description	USS John McCain
Condition	Sailing
Hydrostatic model	Voyage3 [Enquiry Model]

Item Treasure	Sound (m)	Fill %	Density (t/m)	Weight (t)	LCG (m)	TCG (m)	VCG (m)	FSM (t.m)
2 P	10.800	100.0	1.025	2780.8	161.043	17.020	8.657	0
2 S	10.800	100.0	1.025	2780.8	161.043	-17.020	8.657	0
2 C DB	3.200	100.0	1.025	2478.3	161.161	0.000	1.600	0
2 P DB	3.200	100.0	1.025	635.3	160.063	16.290	1.784	0
2 S DB	3.200	100.0	1.025	635.3	160.063	-16.290	1.784	0
3 C	10.800	100.0	1.025	8242.2	131.470	0.016	8.700	0
3 C DB	3.200	100.0	1.025	2540.7	131.470	0.000	1.600	0
3 P DB	3.200	100.0	1.025	832.6	131.397	17.343	1.670	0
3 S DB	3.200	100.0	1.025	832.6	131.397	-17.343	1.670	0
4 C DB	3.200	100.0	1.025	2540.7	101.470	0.000	1.600	0
4 P DB	3.200	100.0	1.025	836.9	101.482	17.362	1.667	0
4 S DB	3.200	100.0	1.025	836.9	101.482	-17.362	1.667	0
5 C	5.514	50.0	1.025	4090.3	71.335	0.032	6.024	43620
6 P	6.403	39.9	1.025	752.5	48.000	15.424	4.638	1080
Totals				30815.8	126.248	0.385	5.449	44700

Stability Curve

Vessel	Treasure
Description	USS John McCain
Condition	Sailing
Hydrostatic model	Voyage3 [Enquiry Model]

Stability curve (heel to starboard)



Angle of heel (deg)	Wind arm (m)	GZ (m)
0.0	0.159	0.000
5.0	0.159	0.967
10.0	0.157	1.956
15.0	0.154	2.908
20.0	0.150	3.708
25.0	0.144	4.601
30.0	0.138	5.226
35.0	0.130	5.566
40.0	0.122	5.739
45.0	0.113	5.745
50.0	0.102	5.608

Note: The Center of Gravity shown above is for the Fixed Weight of 30687.83 MT. As the tank load centers shift with heel and trim, the total Center of Gravity varies. The righting arms shown above include the effect of the C.G. variation.

The calculation uses a standard vessel model and cargo bouyancy.

DOCKWISE STABILITY (INTACT)

Description		Min/Max		Attained	
GM Upright	>	1.000	m.	11.048	P
Angle from abs 0 deg to RAzero	>	35.00	deg	100.39	P

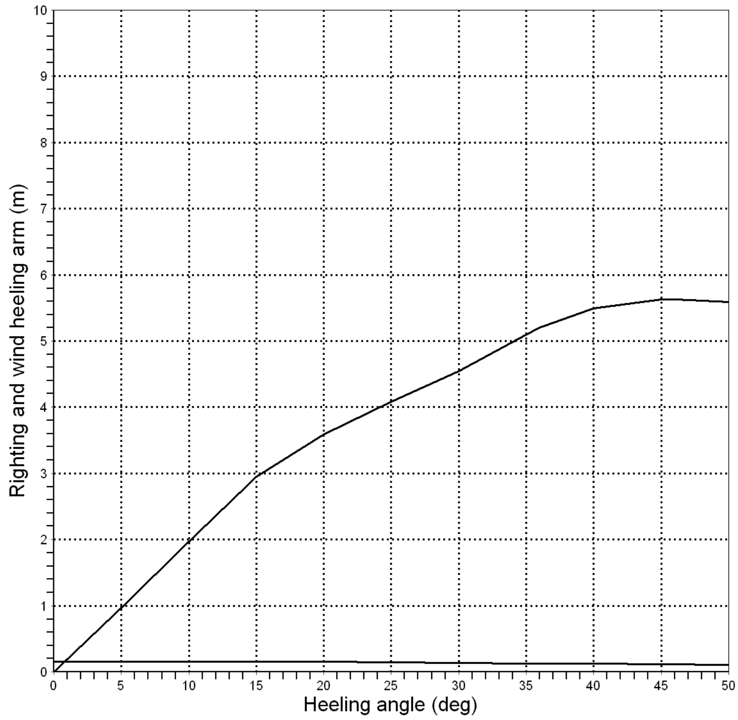
WINDARM CURVE TYPE: STANDARD
HEEL TO STARBOARD, EXTREME WIND SPEED 72.6KT, HEELING ARM@0 DEG 0.16M
DOCKWISE STABILITY (DYNAMIC)

Description		Min/Max		Attained	
GM Upright	>	1.000	m.	11.048	P
Absolute Angle at Equilibrium	<	10.00	deg	0.82	P
Angle from abs 0 deg to RAzero	>	10.00	deg	100.39	P
Absolute Area Ratio from abs 0 deg to RAzero	>	1.400		39.640	P

Stability Curve

Vessel	Treasure
Description	USS John McCain
Condition	Sailing
Hydrostatic model	Voyage3 [Enquiry Model]

Stability curve (heel to portside)



Angle of heel (deg)	Wind arm (m)	GZ (m)
0.0	0.159	0.000
5.0	0.159	0.967
10.0	0.157	1.970
15.0	0.154	2.949
20.0	0.150	3.591
25.0	0.144	4.078
30.0	0.138	4.543
35.0	0.130	5.101
40.0	0.122	5.492
45.0	0.113	5.628
50.0	0.102	5.586

Note: The Center of Gravity shown above is for the Fixed Weight of 30687.83 MT. As the tank load centers shift with heel and trim, the total Center of Gravity varies. The righting arms shown above include the effect of the C.G. variation.

The calculation uses a standard vessel model and cargo bouyancy.

DOCKWISE STABILITY (INTACT)

Description		Min/Max		Attained	
GM Upright	>	1.000	m.	11.048	P
Angle from abs 0 deg to RAzero	>	35.00	deg	101.84	P

WINDARM CURVE TYPE: STANDARD
HEEL TO PORTSIDE, EXTREME WIND SPEED 72.6KT, HEELING ARM@0 DEG 0.16M
DOCKWISE STABILITY (DYNAMIC)

Description		Min/Max		Attained	
GM Upright	>	1.000	m.	11.048	P
Absolute Angle at Equilibrium	<	10.00	deg	0.83	P
Angle from abs 0 deg to RAzero	>	10.00	deg	101.84	P
Absolute Area Ratio from abs 0 deg to RAzero	>	1.400		39.360	P

Stability Rules Assessment

Vessel	Treasure
Description	USS John McCain
Condition	Sailing
Hydrostatic model	Voyage3 [Enquiry Model]

The calculation uses a standard vessel model and cargo bouyancy.

RULE EVALUATION - HEEL TO STARBOARD SIDE

IMO A.749 CH 4.5.6 INTACT STABILITY

Description		Min/Max		Attained	
Area from abs 0 deg to MaxRA (42.7)	>	0.0550	m.-Rad	2.6996	P
Area from abs 0 deg to abs 30 or RAzero	>	0.0550	m.-Rad	1.4653	P
Area from abs 30 deg to abs 40 or RAzero	>	0.0300	m.-Rad	0.9667	P
Area from abs 30 deg to Flood or RAzero	>	0.0300	m.-Rad	3.8277	P
Righting Arm at abs 30 deg or MaxRA	>	0.200	m.	5.762	P
Absolute Angle at MaxRA	>	15.00	deg	42.66	P
GM Upright	>	0.150	m.	11.048	P

IMO A749 CH.3.2 (WIND-STATIC)

Description		Min/Max		Attained	
Absolute Angle at Equilibrium	<	16.00	deg	0.33	P

IMO A749 CH.3.2 (WIND-GUST)

Description		Min/Max		Attained	
Res. Area Ratio from Roll to Flood or RAzero	>	1.000		6.594	P
Res. Ratio from Roll to abs 50 deg or RAzero	>	1.000		4.265	P

Stability Rules Assessment

Vessel Treasure
Description USS John McCain
Condition Sailing
Hydrostatic model Voyage3 [Enquiry Model]

The calculation uses a standard vessel model and cargo bouyancy.

RULE EVALUATION - HEEL TO PORTSIDE

IMO A.749 CH 4.5.6 INTACT STABILITY

Description		Min/Max		Attained	
Area from abs 0 deg to MaxRA (-46.3)	>	0.0550	m.-Rad	2.8802	P
Area from abs 0 deg to abs 30 or RAzero	>	0.0550	m.-Rad	1.3846	P
Area from abs 30 deg to abs 40 or RAzero	>	0.0300	m.-Rad	0.8842	P
Area from abs 30 deg to Flood or RAzero	>	0.0300	m.-Rad	3.2093	P
Righting Arm at abs 30 deg or MaxRA	>	0.200	m.	5.632	P
Absolute Angle at MaxRA	>	15.00	deg	46.27	P
GM Upright	>	0.150	m.	11.048	P

IMO A749 CH.3.2 (WIND-STATIC)

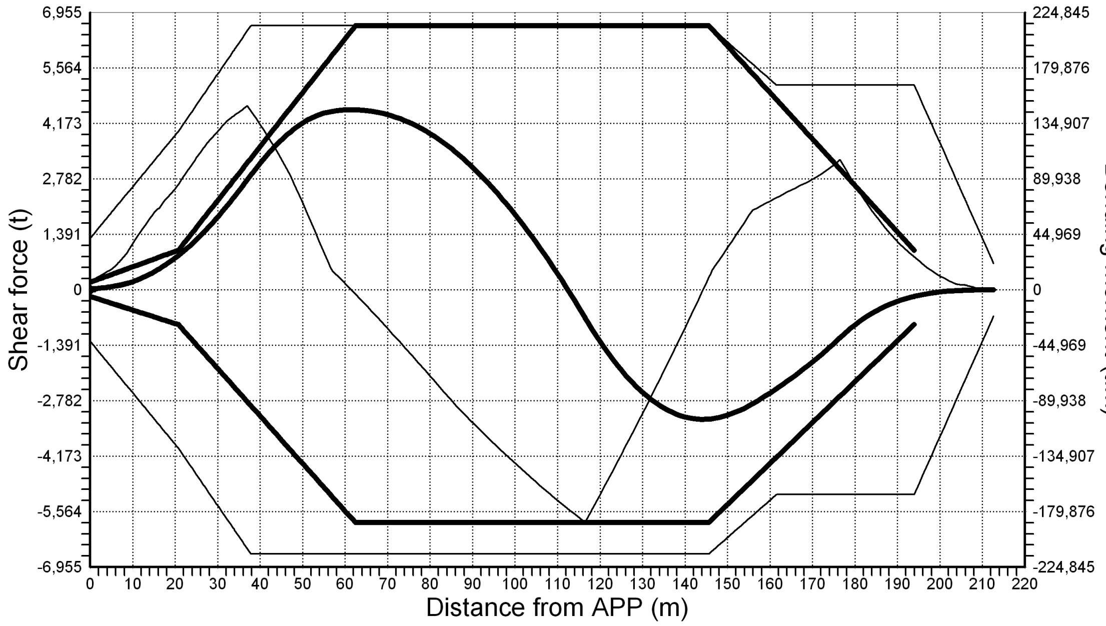
Description		Min/Max		Attained	
Absolute Angle at Equilibrium	<	16.00	deg	0.34	P

IMO A749 CH.3.2 (WIND-GUST)

Description		Min/Max		Attained	
Res. Area Ratio from Roll to Flood or RAzero	>	1.000		5.714	P
Res. Ratio from Roll to abs 50 deg or RAzero	>	1.000		4.028	P

Longitudinal Strength

Vessel	Treasure
Description	USS John McCain
Condition	Sailing



Frame	Location	Shear force			Bending moment		
	(m)	Actual (t)	Per %	Limit (t)	Actual (t.m)	Per %	Limit (t.m)
FR.51	37.80	4488	68	6628	93069	87	106560
FR.53	47.68	2728	41	6628	129531	86	149767
FR.57	56.47	574	9	6628	144425	77	188207
FR.69	86.47	-2948	44	-6628	110269	51	214140
FR.81	116.47	-5832	88	-6628	-22774	12	-188648
FR.93	146.47	507	8	6547	-104442	56	-185759
FR.99A	161.50	2309	45	5140	-80231	59	-135868
FR.105A	176.47	3262	63	5139	-38808	45	-86163
FR.99	193.81	842	16	5139	-5436	19	-28596

Longitudinal strength summary

Limits applied SAILING CONDITION

Largest shear 88.0 % at 116.470
Largest bending moment 88.6 % at 42.000

Cargo Information

Cargo Number	64356
Revision	1
Name	USS John S. McCain
Description	
Design	AEGIS DDG-67
Yard	Ingalls shipbuilding

Cargo description

Length	142.00 m	Hull No.		
Width	20.30 m	Built		
Height	11.10 m	Draught	6.27 m	
Total height	52.00 m	Protrusion	-3.029 m	

Weight 8500.0 t

LCG	-71.000 m	Longitudinal axis	From Fr. 0	K_{xx}	7.20 m
TCG	-0.010 m	Transverse axis	CL	K_{yy}	41.30 m
VCG	7.200 m	Vertical axis	BL	K_{zz}	41.30 m

All values refer to the local axis of the cargo

Support definition

Description	Type	Weight (t)	LCG (m)	Begin (m)	End (m)
support	Line	8500.00	-63.810	-117.00	-18.30

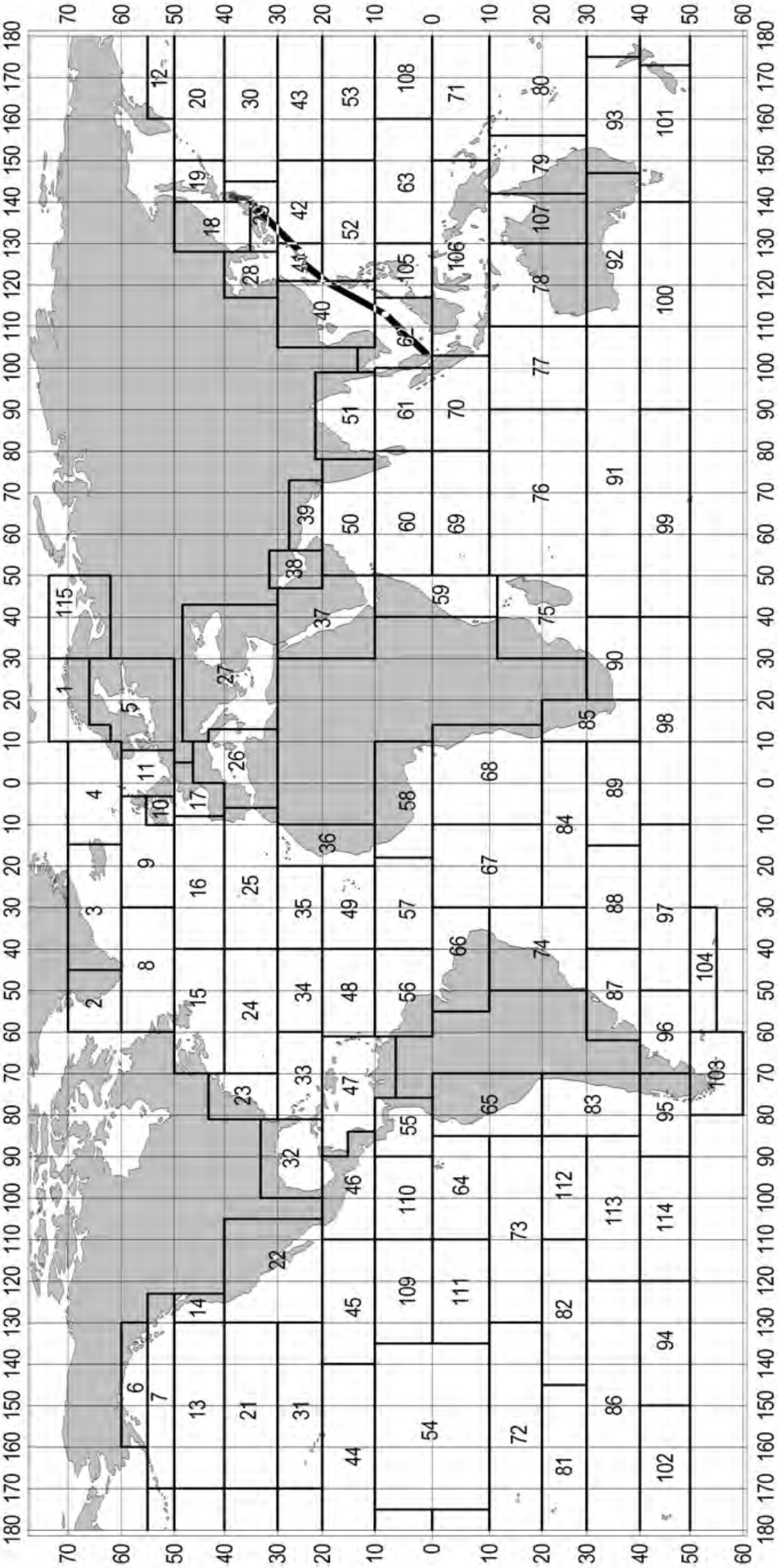
The cargo supports are given with respect to the cargo origin in the vessel coordinate system assuming a cargo rotation of 26.00 degrees.

Wind area definition

Description	Length (m)	Width (m)	Height (m)	Start at (m)	C_s
hull	153.77	20.27	16.71	0.00	1.00
accommodation-1	63.40	20.27	7.42	16.71	1.00
accommodation-2	46.50	11.00	2.20	24.13	1.00
mast	7.95	5.00	23.20	26.33	1.00

Total wind area: LxHxCs 3326.7 m^2, WxHxCs 629.3 m^2

Vessel Route



Vessel	Treasure
Description	USS John McCain
Condition	Sailing
Data source	GWS Enhanced 2.0
Port of departure	Singapore
Via	
Port of destination	Japan

Environmental Conditions

Vessel	Treasure
Description	USS John McCain
Condition	Sailing

Route description

Departure from	Singapore	Departure date	01 Oct 2017
Via		Transit speed	12.0 kn
Arrival at	Japan	Route No	4039
Data source	GWS Enhanced 2.0		

Environmental data

Area	Season	Transit time (hours)	Hsig (m)	Wind speed (kn)	Weather routing	Remarks
62	September-November	66.7	4.15	17.9		
40	September-November	63.3	6.63	28.7	Yes	Typhoon season
41	September-November	54.1	6.41	31.8	Yes	Typhoon season
42	October-December	22.6	5.67	26.2		Typhoon season
29	September-October	54.1	5.67	27.0	Yes	Typhoon season
Summary		260.8	6.63	31.8		

1-hour mean wind speed	16.4 m/s (31.8 kn)
1-minute sustained wind speed	19.8 m/s (38.5 kn)

Environmental Conditions

Wave scatter diagram

The following scatter diagram presents the number of observed wave period combinations for the most severe area of the route.

Area	40	Wave direction	NE (Predominant)
Season	September-November	Wave note	Typhoon season

Hsig	Observations (All directions)											Total	P(Hsig)
(m)	3	46	184	304	259	137	52	15	4	0	0	1004	
15	0	0	0	0	0	0	0	0	0	0	0	0	0.9995
14	0	0	0	0	0	0	0	0	0	0	0	0	0.9995
13	0	0	0	0	0	0	0	0	0	0	0	0	0.9995
12	0	0	0	0	0	0	0	0	0	0	0	0	0.9995
11	0	0	0	0	0	0	1	0	0	0	0	1	0.9990
10	0	0	0	0	0	1	1	0	0	0	0	2	0.9975
9	0	0	0	0	1	1	1	0	0	0	0	3	0.9950
8	0	0	0	1	2	2	1	1	0	0	0	7	0.9900
7	0	0	1	3	5	5	3	1	0	0	0	18	0.9776
6	0	0	1	7	12	10	5	2	1	0	0	38	0.9496
5	0	0	5	18	26	19	9	3	1	0	0	81	0.8897
4	0	1	14	42	51	32	13	4	1	0	0	158	0.7677
3	0	4	35	83	78	39	12	3	1	0	0	255	0.5519
2	0	13	72	110	70	25	6	1	0	0	0	297	0.2516
1	3	28	56	40	14	3	0	0	0	0	0	144	0.0119
	<4	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	>13		

Zero crossing periods (s)

Design sea states

P(Hsig) = $\sqrt[n]{(1 - Pdesign)}$

Where

n	= is the number of 3 hour periods, corrected for calm periods
Pdesign	= 0.10
Design wave height	= 6.63 m
P(Hsig)	= 0.9671

Sea state	$H_{Extreme}$ (m)	H_{Sig} (m)	T_z (sec)	T_m (sec)	Wave Slope
1	12.8	6.63	6.5	7.1	1/12
2	12.6	6.63	7.5	8.2	1/16
3	12.5	6.63	8.5	9.3	1/20
4	12.4	6.63	9.5	10.4	1/25

Wind Loads and Moments

Vessel Treasure
Description USS John McCain
Condition Sailing

Vessel wind area definition

Item	Length (m)	Breadth (m)	Height (m)	Start at (m)	Cs
Hull	207.00	44.50	14.00	0.00	1.00
Bow	44.00	44.50	10.00	14.00	1.00
Stern	51.40	44.50	10.00	14.00	1.00
Accom 1	28.00	44.50	16.00	24.00	1.00
Accom 2	23.00	44.50	8.00	24.00	1.00

Total wind loads (Longitudinal)

Item	Force	Vessel overturning moment		Cargo support moment		
	(t)	Vertical center of pressure (m)	Overturning moment (t.m)	Support height (m)	Vertical center of pressure (m)	Overturning moment (t.m)
Treasure	135.2	24.32	3288	0.00	0.00	0
USS John S. McCain	128.9	28.90	3724	-0.58	14.90	1920
Totals	264.1	26.55	7012			

Total wind loads (Transverse)

Item	Force	Vessel overturning moment		Cargo support moment		
	(t)	Vertical center of pressure (m)	Overturning moment (t.m)	Support height (m)	Vertical center of pressure (m)	Overturning moment (t.m)
Treasure	157.3	19.30	3036	0.00	0.00	0
USS John S. McCain	206.7	27.81	5748	-0.58	13.81	2854
Totals	364.0	24.13	8784			

Wind loads summary

Results using mean wind speed 60.0 kn

Total wind overturning moment mean	7117 t.m	Total wind lever mean	0.11 m
Total wind overturning moment extreme	10420 t.m	Total wind lever extreme	0.16 m

Radii of Gyration

Vessel Treasure
Description USS John McCain
Condition Sailing

Roll

Item	Weight (t)	Steiner term (m)	Radius of gyration (m)	Moment of inertia (t.m²)
USS John S. McCain	8500	11.60	13.75	2751585
Treasure	56924	1.73	12.80	9495974
Total	65424		13.68	12245484

Pitch

Item	Weight (t)	Steiner term (m)	Radius of gyration (m)	Moment of inertia (t.m²)
USS John S. McCain	8500	12.02	34.75	11490064
Treasure	56924	1.79	52.28	155787155
Total	65424		50.56	167277219

Yaw

Item	Weight (t)	Steiner term (m)	Radius of gyration (m)	Moment of inertia (t.m²)
USS John S. McCain	8500	3.62	41.30	14609731
Treasure	56924	0.54	53.02	160062977
Total	65424		51.67	174672708

Motion Response Calculation

Vessel	Treasure
Description	USS John McCain
Condition	Sailing

Condition Data

Draught FPP	7.48 m	System LCG	106.888 m	System Kxx	13.68 m
Draught APP	10.84 m	System VCG	10.245 m	System Kyy	50.56 m
GM Fluid	11.05 m	Displacement	65424 t	System Kzz	51.67 m

Nat. roll period 9.06 s

Defined sea-states

Heading (deg)	HSig (m)	Tz1 (sec)	Tz2 (sec)	Tz3 (sec)	Tz4 (sec)	Calculation Type
0	6.63	6.54	7.54	8.54	9.54	DOSUITE
15	6.63	6.54	7.54	8.54	9.54	DOSUITE
30	6.63	6.54	7.54	8.54	9.54	DOSUITE
45	6.63	6.54	7.54	8.54	9.54	DOSUITE
60	6.63	6.54	7.54	8.54	9.54	DOSUITE
75	6.63	6.54	7.54	8.54	9.54	DOSUITE
90	6.63	6.54	7.54	8.54	9.54	DOSUITE
105	6.63	6.54	7.54	8.54	9.54	DOSUITE
120	6.63	6.54	7.54	8.54	9.54	DOSUITE
135	6.63	6.54	7.54	8.54	9.54	DOSUITE
150	6.63	6.54	7.54	8.54	9.54	DOSUITE
165	6.63	6.54	7.54	8.54	9.54	DOSUITE
180	6.63	6.54	7.54	8.54	9.54	DOSUITE
195	6.63	6.54	7.54	8.54	9.54	DOSUITE
210	6.63	6.54	7.54	8.54	9.54	DOSUITE
225	6.63	6.54	7.54	8.54	9.54	DOSUITE
240	6.63	6.54	7.54	8.54	9.54	DOSUITE
255	6.63	6.54	7.54	8.54	9.54	DOSUITE
270	6.63	6.54	7.54	8.54	9.54	DOSUITE
285	6.63	6.54	7.54	8.54	9.54	DOSUITE
300	6.63	6.54	7.54	8.54	9.54	DOSUITE
315	6.63	6.54	7.54	8.54	9.54	DOSUITE
330	6.63	6.54	7.54	8.54	9.54	DOSUITE
345	6.63	6.54	7.54	8.54	9.54	DOSUITE

Response summary

No	Location	Position			Acceleration		
		Long (m)	Trans (m)	Vert (m)	Long (g)	Trans (g)	Vert (g)
1	USS John S. McCain	110.28	-1.28	21.78	0.067	0.509	0.201

All values refer to the global axis of the vessel

Maximum roll angle	19.7 deg	Maximum roll acceleration	0.1324 rad / s²
Maximum pitch angle	4.2 deg	Maximum pitch acceleration	0.0283 rad / s²

- The presented angles and accelerations are single extreme values. For each point these are maximum values for all the calculated wave headings and speeds. These maximums do not necessarily occur simultaneously.
- All values refer to the global axis of the vessel.

Motion Response Calculation

Point 1 : USS John S. McCain

Sea State		Roll		Pitch		Longitudinal	Transverse	Vertical
HSig	Tz (1-4)	Angle (deg)	Accel. (rad/s2)	Angle (deg)	Accel. (rad/s2)	(g)	(g)	(g)
Heading 0 deg, speed 0 knots								
6.63	6.54	0.0	0.0000	1.9	0.0135	0.043	0.000	0.042
6.63	7.54	0.0	0.0000	2.7	0.0156	0.047	0.000	0.046
6.63	8.54	0.0	0.0000	3.4	0.0168	0.050	0.000	0.049
6.63	9.54	0.0	0.0000	3.9	0.0171	0.050	0.000	0.054
Heading 15 deg, speed 0 knots								
6.63	6.54	2.1	0.0166	1.9	0.0140	0.037	0.055	0.041
6.63	7.54	2.3	0.0171	2.8	0.0161	0.045	0.057	0.046
6.63	8.54	2.4	0.0161	3.5	0.0173	0.049	0.055	0.050
6.63	9.54	2.3	0.0146	3.9	0.0175	0.049	0.050	0.055
Heading 30 deg, speed 0 knots								
6.63	6.54	3.8	0.0286	2.2	0.0154	0.041	0.094	0.043
6.63	7.54	4.5	0.0301	3.1	0.0178	0.048	0.103	0.049
6.63	8.54	4.8	0.0293	3.7	0.0188	0.050	0.102	0.056
6.63	9.54	4.7	0.0271	4.0	0.0187	0.050	0.095	0.062
Heading 45 deg, speed 0 knots								
6.63	6.54	7.4	0.0498	2.6	0.0185	0.047	0.174	0.048
6.63	7.54	8.8	0.0550	3.4	0.0211	0.053	0.196	0.060
6.63	8.54	9.2	0.0544	3.9	0.0216	0.053	0.195	0.070
6.63	9.54	9.0	0.0510	4.1	0.0207	0.051	0.183	0.077
Heading 60 deg, speed 3 knots								
6.63	6.54	12.2	0.0841	3.2	0.0264	0.061	0.304	0.070
6.63	7.54	14.7	0.0952	3.8	0.0283	0.065	0.344	0.093
6.63	8.54	15.3	0.0954	4.0	0.0274	0.062	0.343	0.106
6.63	9.54	15.0	0.0906	4.0	0.0252	0.057	0.325	0.112
Heading 75 deg, speed 3 knots								
6.63	6.54	17.1	0.1233	2.9	0.0260	0.060	0.458	0.121
6.63	7.54	19.3	0.1312	3.0	0.0253	0.058	0.482	0.143
6.63	8.54	19.7	0.1276	3.0	0.0231	0.053	0.464	0.151
6.63	9.54	19.0	0.1192	2.8	0.0205	0.046	0.431	0.149
Heading 90 deg, speed 6 knots								
6.63	6.54	16.8	0.1312	0.6	0.0060	0.018	0.509	0.159
6.63	7.54	18.6	0.1324	0.7	0.0057	0.018	0.504	0.175
6.63	8.54	18.7	0.1250	0.6	0.0050	0.016	0.469	0.176
6.63	9.54	18.0	0.1144	0.6	0.0043	0.015	0.425	0.168
Heading 105 deg, speed 3 knots								
6.63	6.54	18.1	0.1265	2.6	0.0224	0.055	0.473	0.118
6.63	7.54	19.7	0.1298	2.7	0.0212	0.052	0.481	0.136
6.63	8.54	19.6	0.1238	2.6	0.0190	0.046	0.455	0.141
6.63	9.54	18.7	0.1142	2.5	0.0168	0.041	0.417	0.138
Heading 120 deg, speed 3 knots								
6.63	6.54	13.3	0.0861	3.2	0.0233	0.063	0.312	0.064
6.63	7.54	14.6	0.0901	3.7	0.0240	0.063	0.326	0.081
6.63	8.54	14.6	0.0865	3.8	0.0226	0.059	0.312	0.092
6.63	9.54	13.9	0.0798	3.7	0.0205	0.053	0.288	0.096
Heading 135 deg, speed 0 knots								
6.63	6.54	8.1	0.0538	2.8	0.0199	0.062	0.190	0.051
6.63	7.54	9.6	0.0596	3.6	0.0223	0.067	0.213	0.063
6.63	8.54	10.0	0.0591	4.0	0.0226	0.066	0.211	0.073
6.63	9.54	9.7	0.0553	4.2	0.0216	0.062	0.199	0.079

Motion Response Calculation

Point 1 : USS John S. McCain

Sea State		Roll		Pitch		Longitudinal	Transverse	Vertical
HSig	Tz (1-4)	Angle (deg)	Accel. (rad/s2)	Angle (deg)	Accel. (rad/s2)	(g)	(g)	(g)
Heading 150 deg, speed 0 knots								
6.63	6.54	3.9	0.0284	2.3	0.0158	0.056	0.095	0.047
6.63	7.54	4.8	0.0308	3.2	0.0185	0.062	0.107	0.053
6.63	8.54	5.1	0.0305	3.8	0.0197	0.063	0.107	0.059
6.63	9.54	5.1	0.0284	4.1	0.0193	0.061	0.101	0.064
Heading 165 deg, speed 0 knots								
6.63	6.54	1.8	0.0144	2.0	0.0139	0.053	0.047	0.044
6.63	7.54	2.1	0.0147	2.9	0.0164	0.059	0.050	0.049
6.63	8.54	2.2	0.0140	3.6	0.0178	0.061	0.049	0.053
6.63	9.54	2.2	0.0128	4.0	0.0180	0.059	0.045	0.058
Heading 180 deg, speed 0 knots								
6.63	6.54	0.0	0.0000	1.9	0.0134	0.057	0.000	0.045
6.63	7.54	0.0	0.0000	2.8	0.0159	0.060	0.000	0.048
6.63	8.54	0.0	0.0000	3.5	0.0173	0.061	0.000	0.052
6.63	9.54	0.0	0.0000	4.0	0.0175	0.060	0.000	0.056
Heading 195 deg, speed 0 knots								
6.63	6.54	1.8	0.0144	2.0	0.0139	0.053	0.047	0.047
6.63	7.54	2.1	0.0147	2.9	0.0164	0.059	0.050	0.051
6.63	8.54	2.2	0.0140	3.6	0.0178	0.060	0.049	0.055
6.63	9.54	2.2	0.0128	4.0	0.0180	0.059	0.045	0.059
Heading 210 deg, speed 0 knots								
6.63	6.54	3.9	0.0284	2.3	0.0158	0.056	0.095	0.050
6.63	7.54	4.8	0.0308	3.2	0.0185	0.061	0.107	0.056
6.63	8.54	5.1	0.0305	3.8	0.0197	0.062	0.107	0.062
6.63	9.54	5.1	0.0284	4.1	0.0193	0.060	0.101	0.067
Heading 225 deg, speed 0 knots								
6.63	6.54	8.1	0.0538	2.8	0.0199	0.061	0.190	0.057
6.63	7.54	9.6	0.0596	3.6	0.0223	0.065	0.213	0.069
6.63	8.54	10.0	0.0591	4.0	0.0226	0.064	0.211	0.078
6.63	9.54	9.7	0.0553	4.2	0.0216	0.060	0.199	0.083
Heading 240 deg, speed 3 knots								
6.63	6.54	13.3	0.0861	3.2	0.0233	0.060	0.312	0.076
6.63	7.54	14.6	0.0901	3.7	0.0240	0.060	0.326	0.092
6.63	8.54	14.6	0.0865	3.8	0.0226	0.056	0.312	0.101
6.63	9.54	13.9	0.0798	3.7	0.0205	0.051	0.288	0.103
Heading 255 deg, speed 3 knots								
6.63	6.54	18.1	0.1265	2.6	0.0224	0.051	0.473	0.143
6.63	7.54	19.7	0.1298	2.7	0.0212	0.048	0.481	0.159
6.63	8.54	19.6	0.1238	2.6	0.0190	0.043	0.455	0.161
6.63	9.54	18.7	0.1142	2.5	0.0168	0.037	0.417	0.155
Heading 270 deg, speed 6 knots								
6.63	6.54	16.8	0.1312	0.6	0.0060	0.018	0.509	0.187
6.63	7.54	18.6	0.1324	0.7	0.0057	0.018	0.504	0.201
6.63	8.54	18.7	0.1250	0.6	0.0050	0.016	0.469	0.198
6.63	9.54	18.0	0.1144	0.6	0.0043	0.015	0.425	0.187
Heading 285 deg, speed 3 knots								
6.63	6.54	17.1	0.1233	2.9	0.0260	0.056	0.458	0.146
6.63	7.54	19.3	0.1312	3.0	0.0253	0.054	0.482	0.167
6.63	8.54	19.7	0.1276	3.0	0.0231	0.050	0.464	0.171
6.63	9.54	19.0	0.1192	2.8	0.0205	0.044	0.431	0.166

Motion Response Calculation

Point 1 : USS John S. McCain

Sea State		Roll		Pitch		Longitudinal	Transverse	Vertical
HSig	Tz (1-4)	Angle (deg)	Accel. (rad/s2)	Angle (deg)	Accel. (rad/s2)	(g)	(g)	(g)
Heading 300 deg, speed 3 knots								
6.63	6.54	12.2	0.0841	3.2	0.0264	0.059	0.304	0.084
6.63	7.54	14.7	0.0952	3.8	0.0283	0.062	0.344	0.106
6.63	8.54	15.3	0.0954	4.0	0.0274	0.060	0.343	0.118
6.63	9.54	15.0	0.0906	4.0	0.0252	0.055	0.325	0.121
Heading 315 deg, speed 0 knots								
6.63	6.54	7.4	0.0498	2.6	0.0185	0.047	0.174	0.053
6.63	7.54	8.8	0.0550	3.4	0.0211	0.052	0.196	0.063
6.63	8.54	9.2	0.0544	3.9	0.0216	0.053	0.195	0.073
6.63	9.54	9.0	0.0510	4.1	0.0207	0.051	0.183	0.078
Heading 330 deg, speed 0 knots								
6.63	6.54	3.8	0.0286	2.2	0.0154	0.040	0.094	0.048
6.63	7.54	4.5	0.0301	3.1	0.0178	0.048	0.103	0.053
6.63	8.54	4.8	0.0293	3.7	0.0188	0.050	0.102	0.059
6.63	9.54	4.7	0.0271	4.0	0.0187	0.050	0.095	0.064
Heading 345 deg, speed 0 knots								
6.63	6.54	2.1	0.0166	1.9	0.0140	0.037	0.055	0.045
6.63	7.54	2.3	0.0171	2.8	0.0161	0.045	0.057	0.048
6.63	8.54	2.4	0.0161	3.5	0.0173	0.049	0.055	0.052
6.63	9.54	2.3	0.0146	3.9	0.0175	0.049	0.050	0.056

Support Pressure Calculation

Vessel	Treasure
Description	USS John McCain
Condition	Sailing

Cargo USS John S. McCain

Support properties

Area	99.90	m²
COG.Long	0.66	m
COG.Trans	0.33	m
Ixx	14083	m^4
Extreme to Port	22.62	m
Extreme to Sb	-20.89	m
Wx-port	623	m^3
Wx-sb	-674	m^3
Iyy	58737	m^4
Extreme to Forward	45.96	m
Extreme to Aft	-42.41	m
Wy-forward	1278	m^3
Wy-aft	-1385	m^3

Cargo properties

Weight	8500	t
LCG	-63.810	m
TCG	-31.133	m
VCG	7.200	m
Support	-0.58	m
Support.Lever	7.78	m
Kxx	13.75	m
Kyy	34.75	m

Wind heel and moments

Long.wind	1920	t.m
Trans.wind	2854	t.m
Mean loll	0.57	deg
Extreme loll	0.83	deg

Design accelerations

Longitudinal	0.067	g
Transverse	0.509	g
Vertical	0.201	g
Roll	0.1324	rad/s²
Pitch	0.0283	rad/s²

Loads or moments due to

Long.eccentric moment	-5616	t.m
Trans.eccentric moment	-2831	t.m
Static weight	8500	t

Moment about

Longitudinal axis	33982	t.m
Transverse axis	55329	t.m
Vertical axis	1709	t

Wind loads and moments

Wind heel moment.mean	652	t.m
Long.windforce.mean	1920	t.m
Trans.windforce.mean	2854	t.m
Wind heel moment.extreme	956	t.m
Long.windforce.extreme	2811	t.m
Trans.windforce.extreme	4179	t.m

Support Pressure Calculation

Vessel Treasure
Description USS John McCain
Condition Sailing

	Max. static pressure (kg/cm2)	Longitudinal coordinate (m)	Transverse coordinate (m)
	9.33	-103.81	-50.97
Heading (deg)	Max. static + dynamic pressure (kg/cm2)	Longitudinal coordinate (m)	Transverse coordinate (m)
0	11.31	-103.81	-50.97
15	11.58	-103.81	-50.97
30	12.16	-103.81	-50.97
45	13.42	-103.81	-50.97
60	15.67	-103.81	-50.97
75	17.58	-103.81	-50.97
90	17.60	-103.81	-50.97
105	17.43	-103.81	-50.97
120	15.27	-103.81	-50.97
135	13.70	-103.81	-50.97
150	12.29	-103.81	-50.97
165	11.61	-103.81	-50.97
180	11.38	-103.81	-50.97
195	11.61	-103.81	-50.97
210	12.30	-103.81	-50.97
225	13.71	-103.81	-50.97
240	15.29	-103.81	-50.97
255	17.50	-103.81	-50.97
270	17.69	-103.81	-50.97
285	17.64	-103.81	-50.97
300	15.70	-103.81	-50.97
315	13.43	-103.81	-50.97
330	12.17	-103.81	-50.97
345	11.59	-103.81	-50.97

Extreme Design Forces

Vessel Treasure
Description USS John McCain
Condition Sailing

Longitudinal Forces

Item	Inertia	Wind			Friction		Total	Req. Flong
		Mean	extreme					
	[t]	[t]	[t]		Coef.	[t]	[t]	[t]
Uss John S. Mc.Cain	2027.5	129	189		0.12	814.34	1213.19	1213.19

*Values for calculations on Attachment 5

Transverse Forces

Item	Inertia	Wind		Loll		Friction FFriction		Total FTotal	Req' FTrans
		Mean	Extreme	Mean	Extreme				
	(t)	(t)	(t)	(t)	(t)	Coef	(t)	(t)	(t)
USS John S. McCain	4327	207	303	84	123	0.12	1037	3583	3583

*) The calculated value has been replaced by the minimum required force

Item	Weight	Minimum force as % of cargo weight	
		long	trans
	(t)	%	%
USS John S. McCain	8500	2.5	10.0

Seafastening Calculation

Vessel Treasure
Description USS John McCain
Condition Sailing
Cargo **USS John S. McCain**

Seafastening description

No	Type	Capacity (t)	Force applied	Weld Length (mm)	Weld Type
1	Bracing	200	Push	1000	Double Fillet
2	Stronbox	200	Shear	2000	Full.Pen

Seafastening arrangement

No	Type	Capacity (t)	Angle (deg)	Seafastening acting to PS (t)	SB (t)	Aft (t)	Fwd (t)	Lever (mm)	Weld Length (mm)	Weld Leg (mm)
1	Bracing	200	116	0	173	0	0	0	1000	11.0
2	Bracing	200	116	0	173	0	0	0	1000	11.0
3	Bracing	200	116	0	173	0	0	0	1000	11.0
4	Bracing	200	116	0	173	0	0	0	1000	11.0
5	Bracing	200	116	0	173	0	0	0	1000	11.0
6	Bracing	200	116	0	173	0	0	0	1000	11.0
7	Bracing	200	116	0	173	0	0	0	1000	11.0
8	Bracing	200	116	0	173	0	0	0	1000	11.0
9	Bracing	200	116	0	173	0	0	0	1000	11.0
10	Bracing	200	116	0	173	0	0	0	1000	11.0
11	Bracing	200	115	0	173	0	0	0	1000	11.0
12	Bracing	200	116	0	173	0	0	0	1000	11.0
13	Bracing	200	116	0	173	0	0	0	1000	11.0
14	Bracing	200	116	0	173	0	0	0	1000	11.0
15	Bracing	200	116	0	173	0	0	0	1000	11.0
16	Bracing	200	116	0	173	0	0	0	1000	11.0
17	Bracing	200	116	0	173	0	0	0	1000	11.0
18	Bracing	200	116	0	173	0	0	0	1000	11.0
19	Bracing	200	116	0	173	0	0	0	1000	11.0
20	Bracing	200	116	0	173	0	0	0	1000	11.0
21	Bracing	200	116	0	173	0	0	0	1000	11.0
22	Bracing	200	116	0	173	0	0	0	1000	11.0
23	Bracing	200	116	0	173	0	0	0	1000	11.0
24	Bracing	200	116	0	173	0	0	0	1000	11.0
25	Bracing	200	296	173	0	0	0	0	1000	11.0
26	Bracing	200	296	173	0	0	0	0	1000	11.0
27	Bracing	200	296	173	0	0	0	0	1000	11.0
28	Bracing	200	296	173	0	0	0	0	1000	11.0
29	Bracing	200	296	173	0	0	0	0	1000	11.0
30	Bracing	200	296	173	0	0	0	0	1000	11.0
31	Bracing	200	296	173	0	0	0	0	1000	11.0
32	Bracing	200	296	173	0	0	0	0	1000	11.0
33	Bracing	200	296	173	0	0	0	0	1000	11.0
34	Bracing	200	296	173	0	0	0	0	1000	11.0
35	Bracing	200	296	173	0	0	0	0	1000	11.0
36	Bracing	200	296	173	0	0	0	0	1000	11.0
37	Bracing	200	296	173	0	0	0	0	1000	11.0
38	Bracing	200	296	173	0	0	0	0	1000	11.0
39	Bracing	200	296	173	0	0	0	0	1000	11.0
40	Bracing	200	296	173	0	0	0	0	1000	11.0
41	Bracing	200	296	173	0	0	0	0	1000	11.0
42	Bracing	200	296	173	0	0	0	0	1000	11.0
43	Bracing	200	296	173	0	0	0	0	1000	11.0
44	Bracing	200	296	173	0	0	0	0	1000	11.0

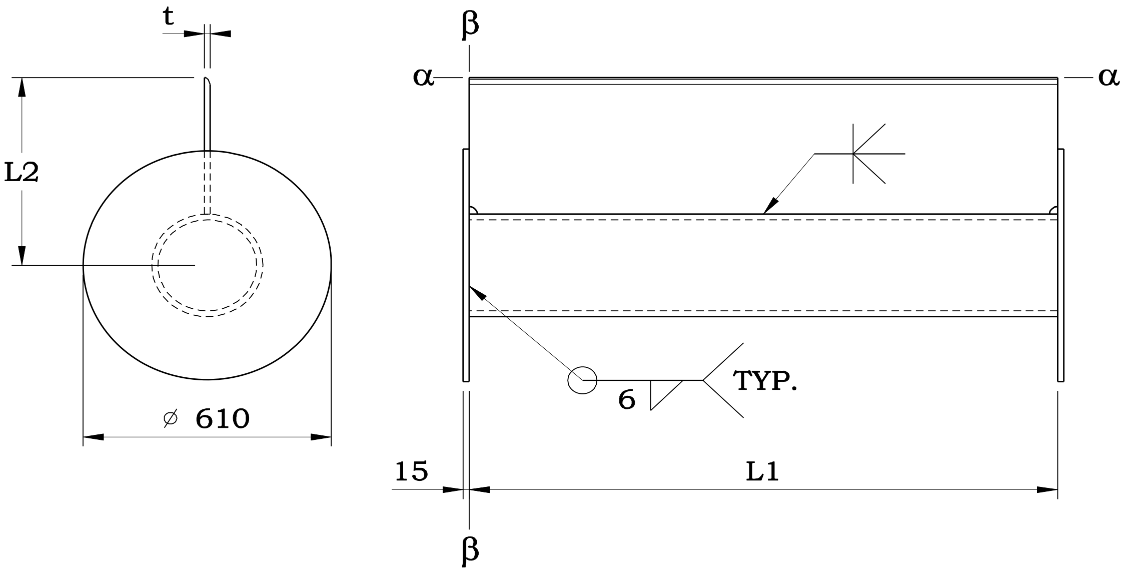
DOCKWISE

Voyage Calculation

No	Type	Capacity (t)	Angle (deg)	Seafastening acting to PS (t)	SB (t)	Aft (t)	Fwd (t)	Lever (mm)	Weld Length (mm)	Leg (mm)
45	Bracing	200	296	173	0	0	0	0	1000	11.0
46	Bracing	200	296	173	0	0	0	0	1000	11.0
47	Bracing	200	296	173	0	0	0	0	1000	11.0
48	Bracing	200	296	173	0	0	0	0	1000	11.0
49	Stronbox	200	204	0	0	200	200	422	2000	-
50	Stronbox	200	26	0	0	200	200	422	2000	-
51	Stronbox	200	204	0	0	200	200	422	2000	-
52	Stronbox	200	26	0	0	200	200	422	2000	-
53	Stronbox	200	204	0	0	200	200	422	2000	-
54	Stronbox	200	26	0	0	200	200	422	2000	-
55	Stronbox	200	26	0	0	200	200	422	2000	-
56	Stronbox	200	207	0	0	200	200	422	2000	-
57	Stronbox	200	26	0	0	200	200	422	2000	-
58	Stronbox	200	207	0	0	200	200	422	2000	-
59	Stronbox	200	26	0	0	200	200	422	2000	-
60	Stronbox	200	207	0	0	200	200	422	2000	-
			Total capacity available	4152	4152	2400	2400	(t)		
			Extreme design forces	3583	3583	2400	2400	(t)		
			Excess	569	569	0	0	(t)		

- The calculated weld leg only applies to a continuous weld over the weld length. In other cases the weld length will be calculated manually.
- Welds calculated to be smaller than 6mm will be welded on site at 6mm.

Strongbox Calculation



Design Properties		
Member i.d.	1	
Force	200	Ton
Plate length, L1	2000	mm
Plate plate thickness, t	15	mm
Lever, L2	620	mm
Pipe section	273x15.1	
Pipe section area	12234	mm^2
Pipe section outside diameter	273	mm
Poisson's ratio	0.3	
Yield stress	235	N/mm^2
Youngs modulus	210000	N/mm^2

Calculation & Results			
Force applied	1962000	N	
Plane alpha-alpha			
Section modulus plate	1.000E+07	mm^3	
Plate area	30000	mm^2	
Moment	1.216E+09	Nmm	
Shear (max = 0.53 Sigma y)	65.40	N/mm^2	UC= 0.53
Tension (max = 0.8 Sigma y)	121.64	N/mm^2	UC= 0.65
Combined stress (max = 0.88 Sigma y)	166.22	N/mm^2	UC= 0.80
Plate buckling (DNV Class. Notes-No.30.1 chapter 3.3)			
Buckling coeff. c. (table 3.2)	9.47858		
sigma E (Euler stress)	1053.03	N/mm^2	
Plane bèta-bèta, area required for pipe			
Max allowable stress (0.8 Sigma y)	188.00	N/mm^2	
Minimum required cross section area	10436	mm^2	
Actual pipe section area	12234	mm^2	UC= 0.85
Total weight of strongbox	374.76	kg	

Standard Calculation
Cargo overturning moment

DOCKWISE

Introduction

This calculation provides a indication of the tendency of the cargo to overturn (tip) and is subjected to uplift based on comparison of the sum of the external moments acting on the cargo and the moment generated by cargo weight around a pre-defined tipping point. Cargo will have the tendency to tip if the resulting moment is positive.

Cargo particulars

Cargo weight	W	8500	[t]	
Vertical center of gravity wrt. top of support	VCG	7.20	[m]	
Distance COG to tipping point	L1	8.80	[m]	*SB*
Inertia**	k_{xx}	7.20	[m]	

External Components

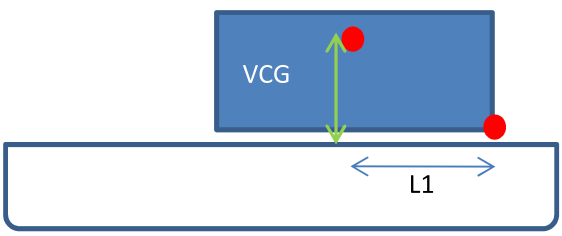
Wind (mean)*	$M_{wind,mean}$	7114.00	[ton.m]
Wind (extreme)*	$M_{wind,extr.}$	10415.61	[ton.m]
Mean loll	$Loll_{mean}$	0.57	[deg]
Extreme loll	$Loll_{extr}$	0.83	[deg]
Sway**	a_{yy}	0.461	[g]
Heave	a_{zz}	0.201	[g]
Roll**	φ	0.1196	[rad/s^2]
Gravity constant	g	9.81	[m/s^2]

Summary of moments

Weight	F_{weight}	6792	[ton]
Sway	M_{sway}	28198	[ton.m]
Rotation	$M_{rotation}$	5370	[ton.m]
Mean loll	$M_{mean\ loll}$	609	[ton.m]
Extreme loll	$M_{extr.\ loll}$	887	[ton.m]
Total	M_{total}	41481	[ton.m]
Moment arm	$L2=M_{total} / F_{weight}$	6.11	[m]
	L2/L1 ✓	69%	

Result

Cargo does not have tendency to tip / is not subject to uplift



*Client requirement: 60 kn
**Calculations are based on longitudinal axis of cargo and not reference system of HTV

ATTACHMENT 3. PROPOSED DISCHARGE LOCATION REV 0

The attached page shows information for a proposed discharge location near Yokosuka (Japan).


by Yokosuka Ko Oki-no-Ne Lt Buoy
Mo(D).R.8s
Oki-no-Ne
Tenjin Dashi
Yokosuka Ko East Bkw North
Fl(2).G.8s 10 m 4 M
N Bkw
E Bkw
NE Bkw
Yokosuka Ko North East Bkw East
Fl.R.3s 20 m 7 M
Public Quay
Nr 6
Nr 5
Nr UW
Azuma Shima
Ota Ne
Fl.G.3s 4 M
by Uraga Suido Traffic Route No 7 Lt Buoy
by Uraga Suido Traffic Route Center No.6 Lt Buoy
Fl(2).G.6s
Iso.W.4s

ATTACHMENT 4. OVERVIEW OF RESOURCES (HOLD) REV 0

The attached page summarizes the required resources mentioned elsewhere in this manual for the transport of the USS John S. McCain. Smit Salvage is responsible for the installation/delivering of the items in the client's column.

Item		DWG No.	Required No.	Responsibility	
				DW	Client
Cribbing wood 300x300	L= 6000 [mm]	-		X	
Cribbing wood 300x300	L= 5000 [mm]	-		X	
Cribbing wood 300x300	L= 4000 [mm]	-		X	
Cribbing wood 300x300	L= 3000 [mm]	-		X	
Cribbing wood 300x300	L= 2000 [mm]	-		X	
Cribbing wood 300x300	L= 1000 [mm]	-		X	
Angle Bar 100x100x10	L= 6000 [mm]	-		X	
Lag bolt 10x100 DIN 571		-		X	
Nail chip		EQUIP02-030-02		X	
Seafastening SF-1250		EQUIP03-001-04		X	
Seafastening SF-1250 plus rubber pad		EQUIP03-001-04		X	
Paint mark on hull		EQUIP04-031-01			X
Guidepost (with bumper)	H=8000 [mm]	EQUIP04-028-01	2	X	

ATTACHMENT 5. ACCERELATIONS RESULTS IN CARGO AXIS REV 0

Max Response Table Export

RAO ID :Local Axis Response for Acc. RAO for [3.385,-1.276,11.535] wrt. COG
RAO data source :Acc. spectrum from SM000001.OT2

Summary 1: Significant Double Amplitude over all the following spectra: HsTp Wave Spectra

Hs [m]	Tp [s]	gamma [-]	Vs [kn]
6.63	9.21	1.00	0.00
6.63	10.62	1.00	0.00
6.63	12.02	1.00	0.00
6.63	13.43	1.00	0.00

variable / dir [deg]	x acc. [m/s^2]	y acc. [m/s^2]	z acc. [m/s^2]	roll acc. [deg/s^2]	pitch acc. [deg/s^2]	yaw acc. [deg/s^2]
0.00	0.54	0.26	0.55	0.44	0.90	0.00
15.00	0.42	0.64	0.58	1.02	0.80	0.19
30.00	0.44	1.15	0.65	1.90	0.90	0.40
45.00	0.80	2.03	0.81	3.34	1.49	0.66
60.00	1.43	3.20	1.14	5.14	2.55	0.98
75.00	1.98	4.40	1.65	7.17	3.48	1.33
90.00	2.12	4.52	1.97	6.85	3.26	0.21
105.00	2.20	4.12	1.60	6.33	3.57	1.15
120.00	1.66	2.89	1.07	4.64	3.02	0.88
135.00	1.15	1.64	0.77	2.63	2.17	0.60
150.00	0.78	0.83	0.62	1.43	1.48	0.38
165.00	0.56	0.49	0.55	0.90	1.09	0.18
180.00	0.44	0.21	0.53	0.43	0.88	0.00
195.00	0.40	0.59	0.54	1.04	0.86	0.18
210.00	0.43	1.04	0.61	1.79	0.92	0.38
225.00	0.75	1.85	0.75	3.12	1.31	0.60
240.00	1.35	3.04	1.01	5.02	2.31	0.89
255.00	1.96	4.24	1.41	6.55	3.15	1.15
270.00	2.27	4.45	1.72	6.77	3.41	0.21
285.00	2.34	4.23	1.45	6.95	3.83	1.33
300.00	1.82	3.00	1.04	4.89	3.01	0.98
315.00	1.33	1.75	0.77	2.90	2.27	0.66
330.00	0.95	0.79	0.63	1.42	1.59	0.40
345.00	0.70	0.37	0.56	0.78	1.15	0.19
360.00	0.54	0.26	0.55	0.44	0.90	0.00

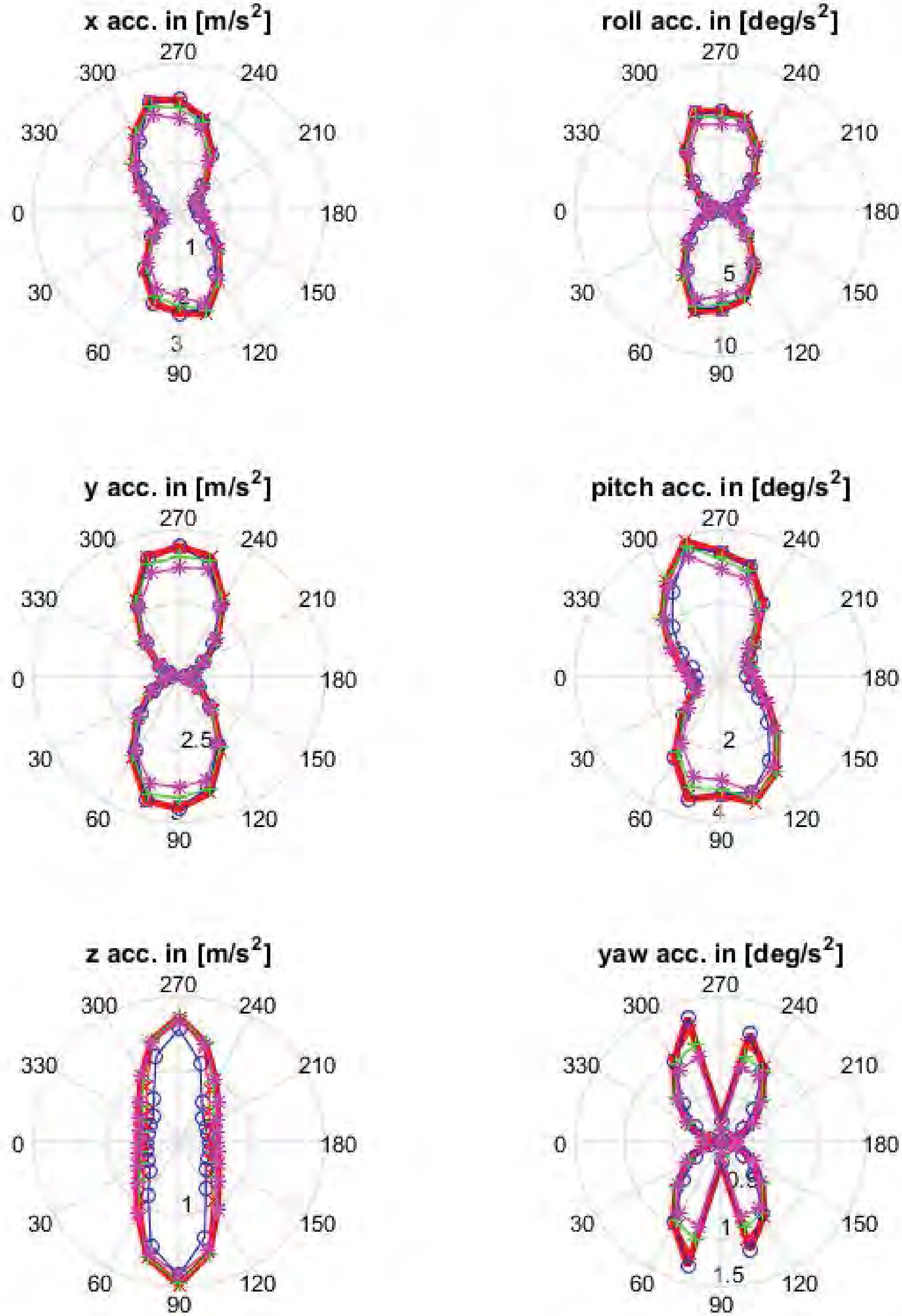
OVERALL MAXIMUM RESPONSE

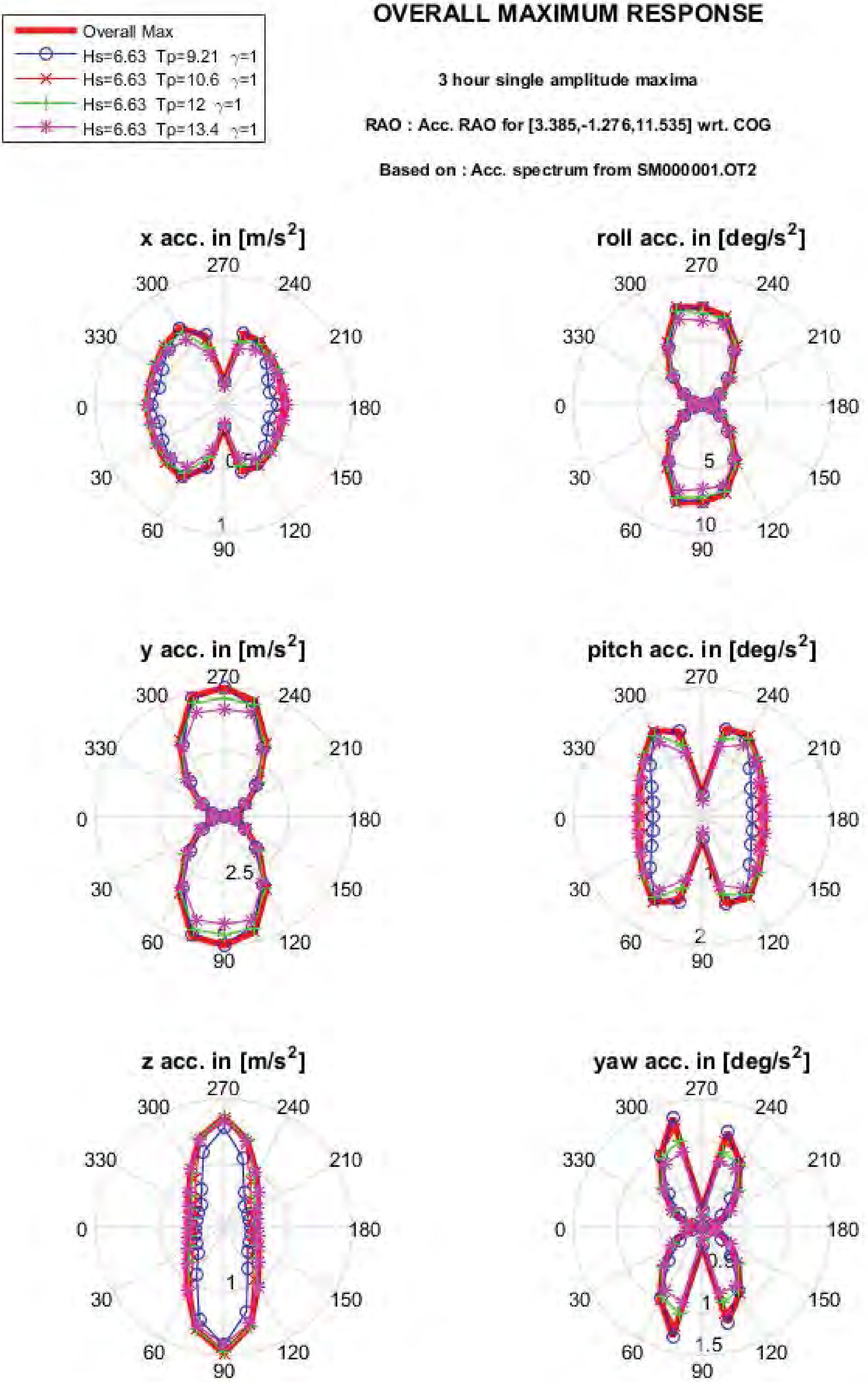
Overall Max
Hs=6.63 Tp=9.21 γ=1
Hs=6.63 Tp=10.6 γ=1
Hs=6.63 Tp=12 γ=1
Hs=6.63 Tp=13.4 γ=1

3 hour single amplitude maxima

RAO : Local Axis Response for Acc. RAO for [3.385,-1.276,11.535] wrt. COG

Based on : Acc. spectrum from SM000001.OT2

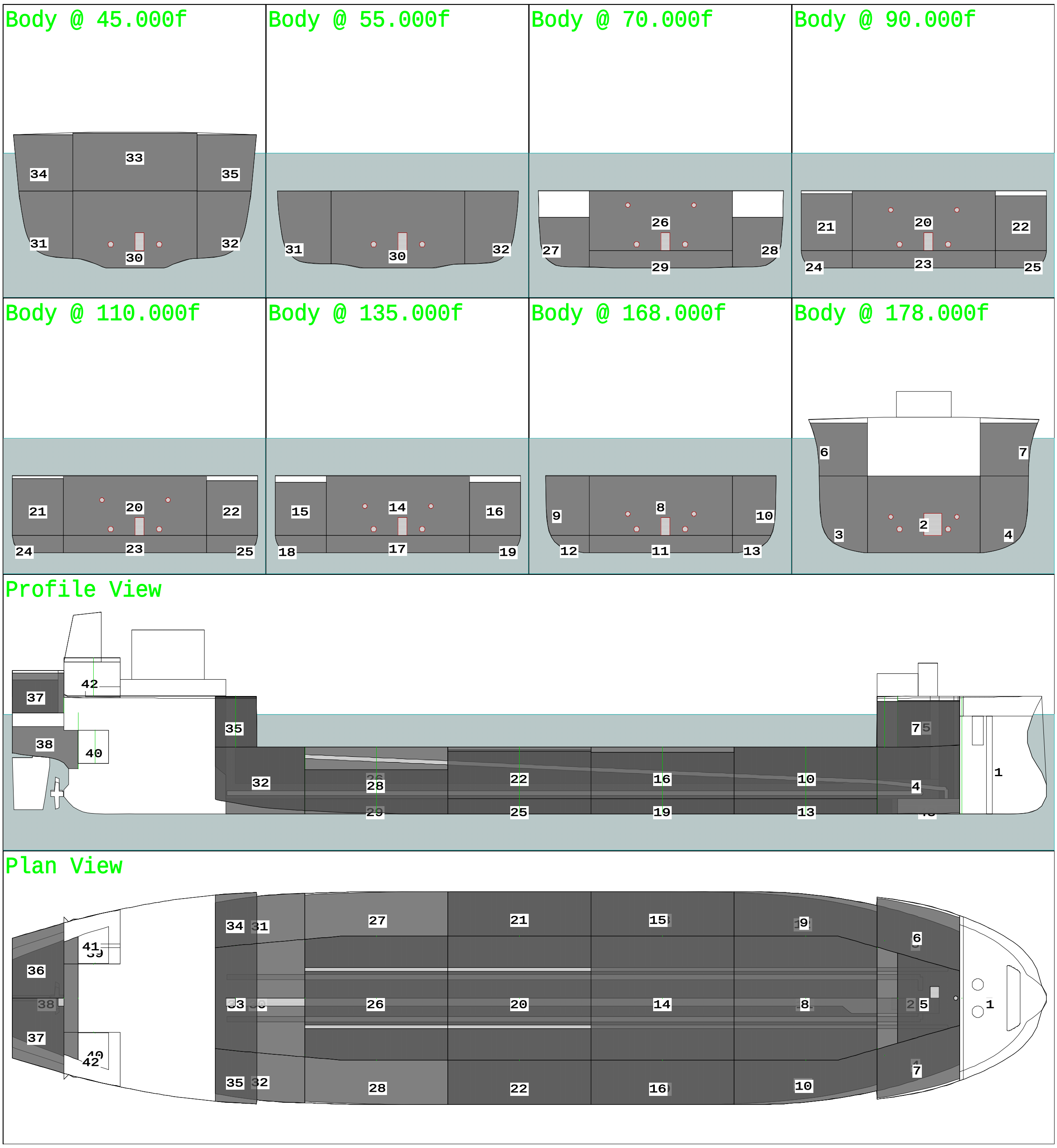



OVERALL MAXIMUM RESPONSE
3 hour single amplitude maxima
RAO : Acc. RAO for [3.385,-1.276,11.535] wrt. COG
Based on : Acc. spectrum from SM000001.OT2
Overall Max
Hs=6.63 Tp=9.21 γ=1
Hs=6.63 Tp=10.6 γ=1
Hs=6.63 Tp=12 γ=1
Hs=6.63 Tp=13.4 γ=1
x acc. in [m/s2]
roll acc. in [deg/s2]
y acc. in [m/s2]
pitch acc. in [deg/s2]
z acc. in [m/s2]
yaw acc. in [deg/s2]

```
                    REFERENCE NUMBER : 0032098

                          DRAFTS SUMMARY
 DRAFT  @ PERPENDICULARS-----------DRAFT  @ MARKS-----------------------------
20.84M @ FPP    207.86f FROM APP  20.84M @ BOW               206.60f FROM APP
20.85M @ MID    103.97f FROM APP  20.85M @ MIDSHIPS          103.47f FROM APP
20.85M @ APP      0.00a FROM APP  20.85M @ AFT/RUDDER         13.09f FROM APP
                                  20.84M @ BOW.BULKHEAD      175.84f FROM APP
                                  20.85M @ ACCOM.BULKHEAD     46.97f FROM APP
------------------------------------------------------------------------------


                 CLASS AND FLAG STATE REQUIREMENTS
- RULE/REQUIREMENT --------------------------------- REQUIRED - OBTAINED - P/F
DRAFT AT LOADLINE (B)                                <= 10.44M :  20.85M   WARN
DRAFT SUBMERGED AT FPP                               <= 23.00M :  20.84M   PASS
DRAFT SUBMERGED AT APP                               <= 23.00M :  20.85M   PASS
-----------------------------------------------------------------------------


                      HYDROSTATIC PROPERTIES
              Trim: 0.00/207.86, No Heel, VCG = 9.401

    LCF   Displacement   Buoyancy-Ctr.  Weight/         Moment/
   Draft----Weight(MT)----LCB-----VCB-------cm-----LCF---cm trim----GML-----GMT
  20.846   122,964.20 105.879f  8.809    28.09  82.700f  866.17  146.42   1.392
  Distances in METERS.-----Specific Gravity = 1.025.-----------Moment in m.-MT.
                           Trim is per 207.86m.
  Draft is from Baseline.       Free Surface included.  GMT is from RA curve.
                                              Caution: Standard GMT is   1.390

                            WEIGHT STATUS
                      Trim: 0.00/207.86,  Heel: zero
 Part-----------------------------Weight(MT)----LCG-----TCG-----VCG-------FSM
   Total Fixed--------->           22,187.83  92.999f  0.033s 11.812
   Total Tanks--------->          100,776.42 108.715f  0.007p  8.870   48522.7
   Total Weight-------->          122,964.25 105.879f  0.000   9.401
     Free Surface Adjustment---------->                        0.395
     Adjusted CG--------------------->      105.879f  0.000   9.795
 Distances in METERS.-----------------------------------------Moments in m.-MT.

                          DISPLACEMENT STATUS
       Baseline draft: 20.844 @ 207.86f, 20.846 @ 103.97f, 20.847 @ 0.00
                      Trim: 0.00/207.86,  Heel: zero
      Part---------------------SpGr------Displ(MT)----LCB-----TCB-----VCB
      HULL                     1.025    122,964.20 105.879f  0.000   8.809
      Distances in METERS.-----------------------------------------------
```

BOSKALIS
M.V. TREASURE - IMO 8617940
REFERENCE 0032098, STEP 11
FLOAT-ON - USS JOHN S. McCAIN

Condition Graphic - Draft: 20.844 @ 207.860f, 20.847 @ 0.000 Heel: zero



Tanks

1 WBTFOREPEAK.C
2 WBT1.C
3 WBT1.P
4 WBT1.S
5 WBT1-UPPER.C
6 WBT1-UPPER.P
7 WBT1-UPPER.S
8 WBT2.C
9 WBT2.P
10 WBT2.S
11 WBT2-DB.C
12 WBT2-DB.P
13 WBT2-DB.S
14 WBT3.C
15 WBT3.P
16 WBT3.S
17 WBT3-DB.C
18 WBT3-DB.P
19 WBT3-DB.S
20 WBT4.C
21 WBT4.P
22 WBT4.S
23 WBT4-DB.C
24 WBT4-DB.P
25 WBT4-DB.S
26 WBT5.C
27 WBT5.P
28 WBT5.S
29 WBT5-DB.C
30 WBT6.C
31 WBT6.P
32 WBT6.S
33 WBT6-UPPER.C
34 WBT6-UPPER.P
35 WBT6-UPPER.S
36 WBT7.P
37 WBT7.S
38 WBTAFTPEAK.C
39 WBT-BW-ENG.P
40 WBT-BW-ENG.S
41 WBTDECKTANK.P
42 WBTDECKTANK.S
43 WBTOVERFLOW.C

M.V. TREASURE - IMO 8617940

REFERENCE 0032098, STEP 14

FLOAT-ON - USS JOHN S. McCAIN

REFERENCE NUMBER : 0032098

DRAFTS SUMMARY

DRAFT @ PERPENDICULARS		DRAFT @ MARKS	
16.50M @ FPP	207.86f FROM APP	16.50M @ BOW	206.60f FROM APP
17.08M @ MID	103.97f FROM APP	17.08M @ MIDSHIPS	103.47f FROM APP
17.66M @ APP	0.00a FROM APP	17.59M @ AFT/RUDDER	13.09f FROM APP
		16.68M @ BOW.BULKHEAD	175.84f FROM APP
		17.40M @ ACCOM.BULKHEAD	46.97f FROM APP

CLASS AND FLAG STATE REQUIREMENTS

RULE/REQUIREMENT	REQUIRED	OBTAINED	P/F
DRAFT AT LOADLINE (B)	<= 10.44M	17.08M	WARN
DRAFT SUBMERGED AT FPP	<= 23.00M	16.50M	PASS
DRAFT SUBMERGED AT APP	<= 23.00M	17.66M	PASS

HYDROSTATIC PROPERTIES

Trim: Aft 1.17/207.86, Heel: Stbd 0.29 deg., VCG = 9.205

Draft	Displacement Weight(MT)	Buoyancy-Ctr. LCB	VCB	Weight/ cm	LCF	Moment/ cm trim	GML	GMT
17.153	115,346.68	107.207f	8.075	38.21	91.165f	844.02	152.10	2.407

Distances in METERS.-----Specific Gravity = 1.025.-----------Moment in m.-MT.
Trim is per 207.86m.
Draft is from Baseline. Free Surface included. GMT is from RA curve.

WEIGHT STATUS

Trim: Aft 1.17/207.86, Heel: Stbd 0.29 deg.

Part	Weight(MT)	LCG	TCG	VCG	FSM
Total Fixed--------->	30,687.83	97.784f	0.377s	14.572	
Total Tanks--------->	84,654.05	110.633f	0.138p	7.259	25628.7
Total Weight-------->	115,341.88	107.214f	0.001	9.205	
Free Surface Adjustment---------->				0.222	
Adjusted CG---------------------->		107.216f	0.002p	9.427	

Distances in METERS.--Moments in m.-MT.

DISPLACEMENT STATUS

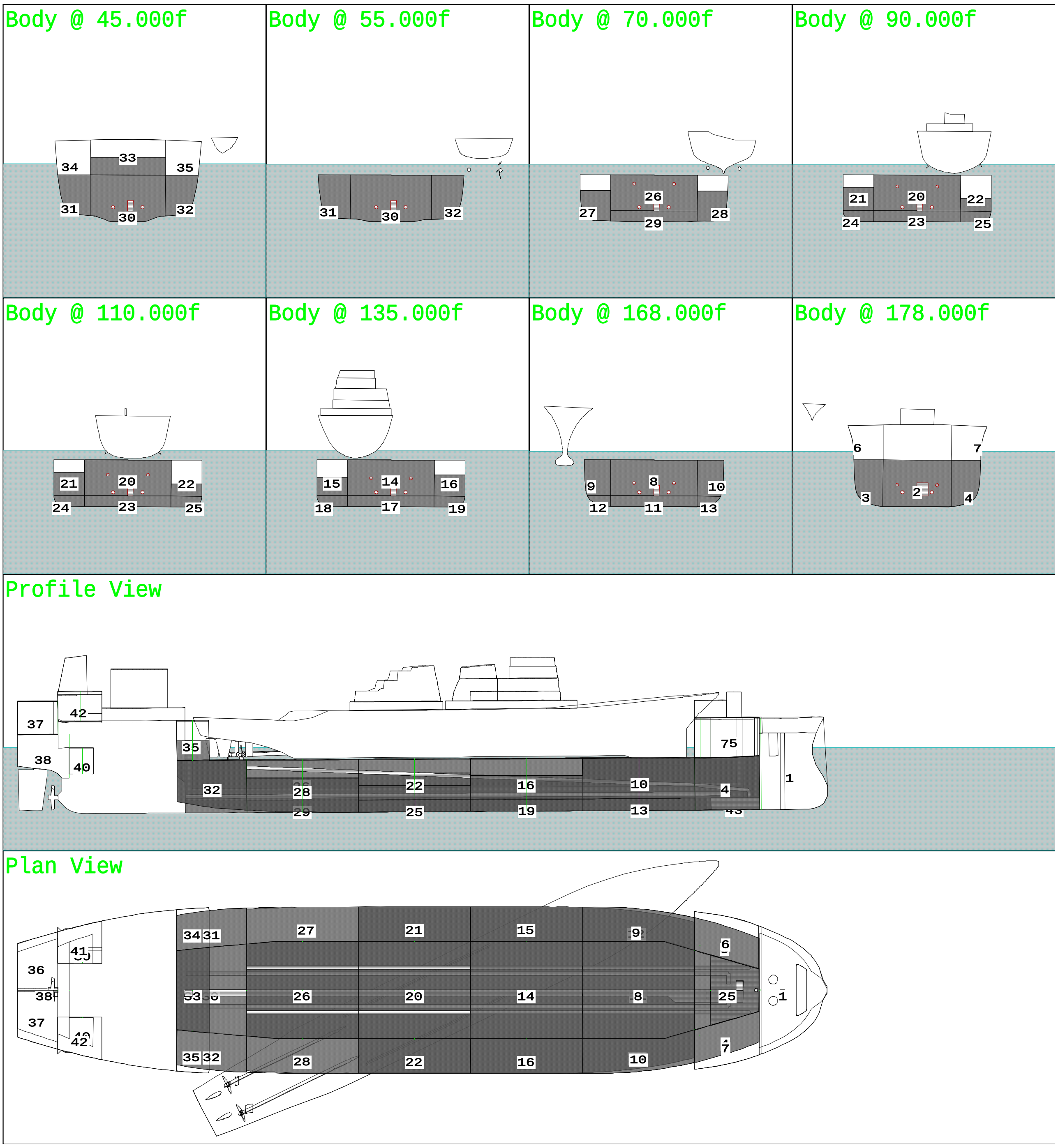
Baseline draft: 16.498 @ 207.86f, 17.081 @ 103.97f, 17.665 @ 0.00
Trim: Aft 1.17/207.86, Heel: Stbd 0.29 deg.

Part	SpGr	Displ(MT)	LCB	TCB	VCB
64356	1.025	2,195.92	113.584f	0.315p	15.907
HULL	1.025	113,150.77	107.084f	0.011s	7.923
Total Displacement-->	1.025	115,346.68	107.207f	0.005s	8.075

Distances in METERS.---

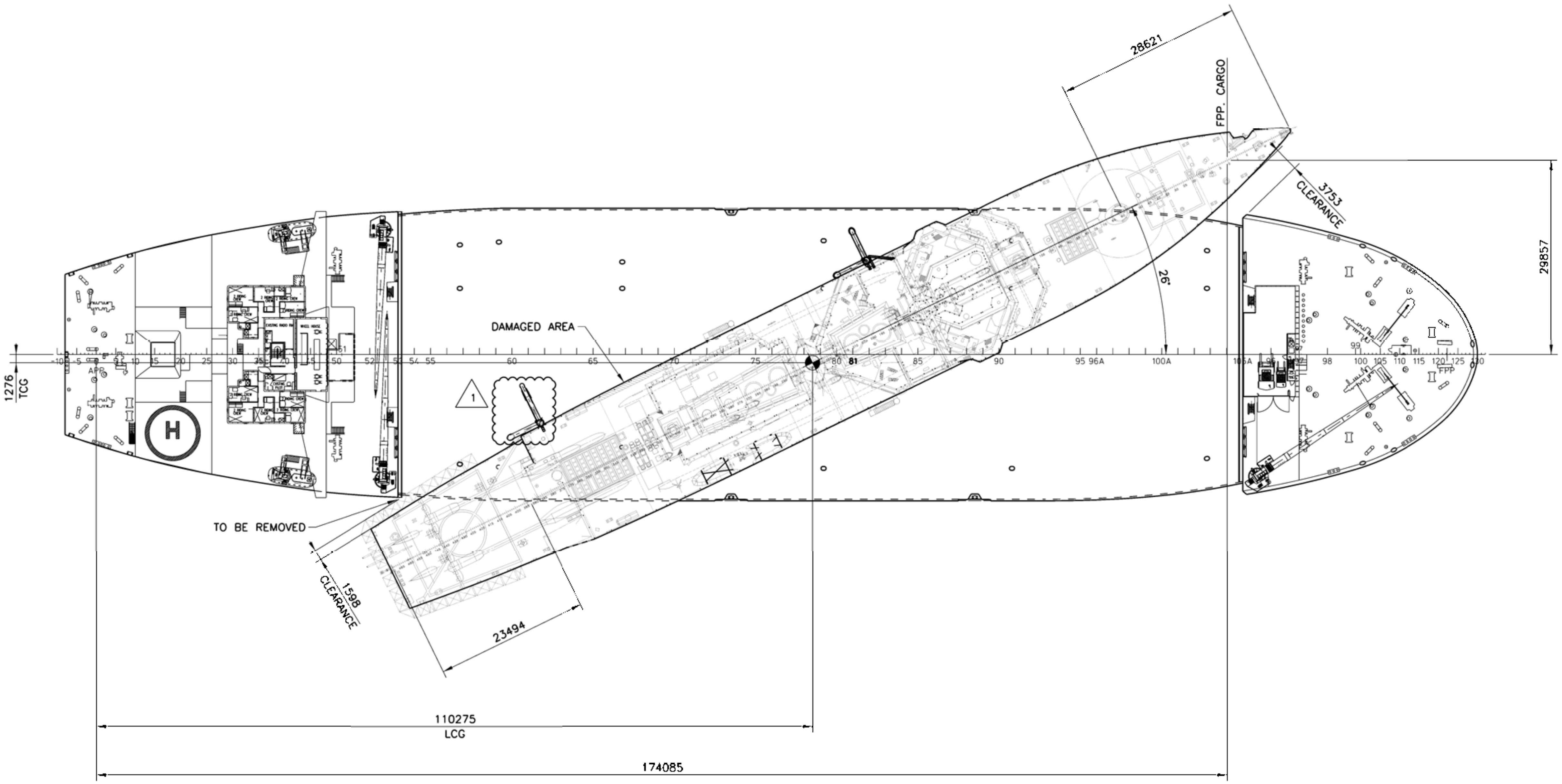
BOSKALIS
M.V. TREASURE - IMO 8617940
REFERENCE 0032098, STEP 14
FLOAT-ON - USS JOHN S. McCAIN

CG - Draft: 16.498 @ 207.860f, 17.665 @ 0.000   Heel: stbd 0.29 deg.



Tanks

1 WBTFOREPEAK.C
2 WBT1.C
3 WBT1.P
4 WBT1.S
5 WBT1-UPPER.C
6 WBT1-UPPER.P
7 WBT1-UPPER.S
8 WBT2.C
9 WBT2.P
10 WBT2.S
11 WBT2-DB.C
12 WBT2-DB.P
13 WBT2-DB.S
14 WBT3.C
15 WBT3.P
16 WBT3.S
17 WBT3-DB.C
18 WBT3-DB.P
19 WBT3-DB.S
20 WBT4.C
21 WBT4.P
22 WBT4.S
23 WBT4-DB.C
24 WBT4-DB.P
25 WBT4-DB.S
26 WBT5.C
27 WBT5.P
28 WBT5.S
29 WBT5-DB.C
30 WBT6.C
31 WBT6.P
32 WBT6.S
33 WBT6-UPPER.C
34 WBT6-UPPER.P
35 WBT6-UPPER.S
36 WBT7.P
37 WBT7.S
38 WBTAFTPEAK.C
39 WBT-BW-ENG.P
40 WBT-BW-ENG.S
41 WBTDECKTANK.P
42 WBTDECKTANK.S
43 WBTOVERFLOW.C



NOTES	REFERENCE LIST		REV	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
			1	09/28/2017	ISSUED FOR TRANSPORT MANUAL APPROVED AS FINAL
			0	09/24/2017	ISSUED FOR TRANSPORT MANUAL

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED – TRANSPORT ENGINEERING	YRPO
CHECKED – TRANSPORT ENGINEERING	YASO
CHECKED – DISCIPLINE	YJPA
CHECKED – ORIGINATOR	YHHO

CLIENT
SMIT SALVAGE

CLIENT 2 REF — REV.
CLIENT 1 REF — REV.

DEVELOPMENT

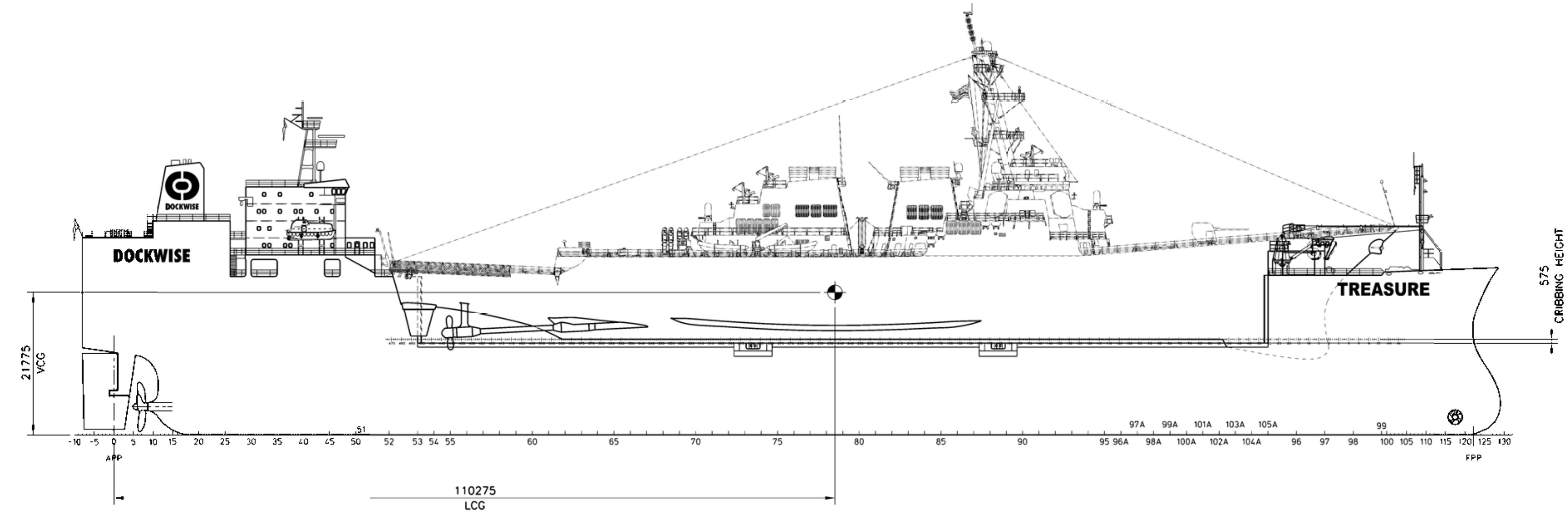
PROJECT
USS JOHN S MCCAIN

SUBJECT
STOWAGE PLAN
TOP VIEW

Dockwise Shipping B.V.
DOCKWISE

SCALE	DOCKWISE DRAWING NO. SHT.	REV.
1:750	DW–0032098–001–01	1

PREPARED USING DOCKWISE MICROSTATION CAD SYSTEM FORMATS



NOTES	REFERENCE LIST	REV	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
VESSEL LENGTH NOT CORRECT, VESSEL ROTATED 26 DEGREES		1	09/28/2017	ISSUED FOR TRANSPORT MANUAL APPROVED AS FINAL
		0	09/24/2017	ISSUED FOR TRANSPORT MANUAL

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED – TRANSPORT ENGINEERING	YRPO
CHECKED – TRANSPORT ENGINEERING	YASO
CHECKED – DISCIPLINE	YLPA
CHECKED – ORIGINATOR	YHHO

CLIENT: SMIT SALVAGE

CLIENT 2 REF — REV.

CLIENT 1 REF — REV.

DEVELOPMENT

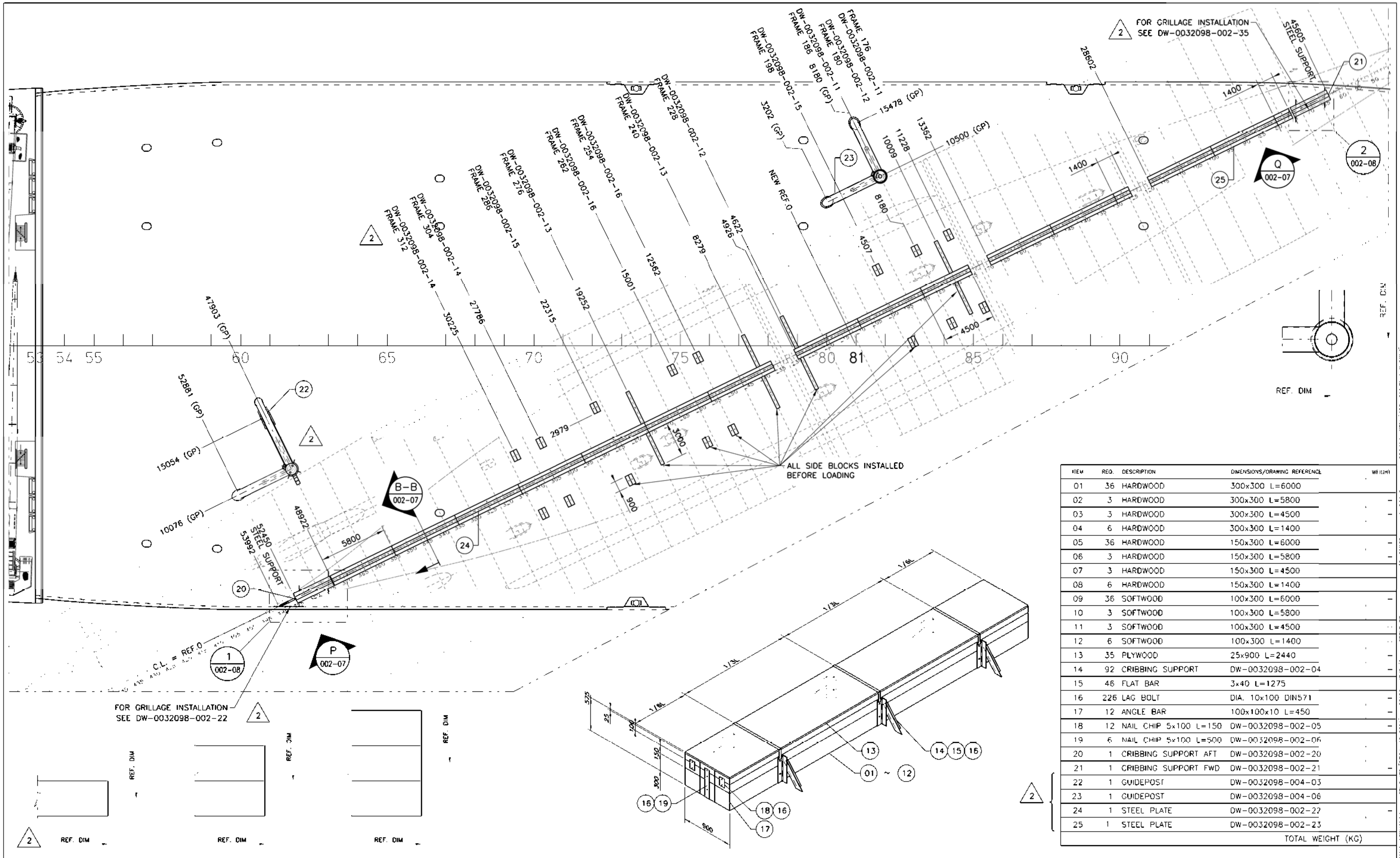
PROJECT: USS JOHN S MCCAIN

SUBJECT: STOWAGE PLAN SIDE VIEW

Dockwise Shipping B.V.

DOCKWISE

SCALE	DOCKWISE DRAWING NO.	SHT.	REV.
1:750	DW-0032098-001-02		1



ITEM	REQ.	DESCRIPTION	DIMENSIONS/DRAWING REFERENCE	WEIGHT
01	36	HARDWOOD	300x300 L=6000	
02	3	HARDWOOD	300x300 L=5800	-
03	3	HARDWOOD	300x300 L=4500	-
04	6	HARDWOOD	300x300 L=1400	
05	36	HARDWOOD	150x300 L=6000	-
06	3	HARDWOOD	150x300 L=5800	-
07	3	HARDWOOD	150x300 L=4500	
08	6	HARDWOOD	150x300 L=1400	
09	36	SOFTWOOD	100x300 L=6000	-
10	3	SOFTWOOD	100x300 L=5800	
11	3	SOFTWOOD	100x300 L=4500	
12	6	SOFTWOOD	100x300 L=1400	
13	35	PLYWOOD	25x900 L=2440	-
14	92	CRIBBING SUPPORT	DW-0032098-002-04	-
15	46	FLAT BAR	3x40 L=1275	
16	226	LAG BOLT	DIA. 10x100 DIN571	-
17	12	ANGLE BAR	100x100x10 L=450	-
18	12	NAIL CHIP 5x100 L=150	DW-0032098-002-05	-
19	6	NAIL CHIP 5x100 L=500	DW-0032098-002-06	
20	1	CRIBBING SUPPORT AFT	DW-0032098-002-20	
21	1	CRIBBING SUPPORT FWD	DW-0032098-002-21	-
22	1	GUIDEPOST	DW-0032098-004-03	
23	1	GUIDEPOST	DW-0032098-004-06	
24	1	STEEL PLATE	DW-0032098-002-22	-
25	1	STEEL PLATE	DW-0032098-002-23	
			TOTAL WEIGHT (KG)	

NOTES

MATERIALS [UNLESS NOTED OTHERWISE]
ALL STEEL YIELD STRESS 235 N/MM2 OR EQUIVALENT

WELDING [UNLESS NOTED OTHERWISE]
TO BE IN ACCORDANCE AMERICAN WELDING SOCIETY CODES
ALL WELDING PREPARATIONS TO BE MADE BY FABRICATOR
TO BE FULLY PENETRATED UNLESS NOTED OTHERWISE

PLYWOOD TO BE SECURED WITH NAILS

FOR TRANSVERSE CRIBBING SEE DRAWINGS:
DW-0032098-002-11 ~ DW-0032098-002-16

REFERENCE LIST	
DW-0032098-002-02	CRIBBING PLAN MARKING LINES
DW-0032098-002-07	CRIBBING PLAN DETAILS

REV	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
2	09/28/2017	ISSUED FOR TRANSPORT MANUAL APPROVED AS FINAL
1	09/24/2017	ISSUED FOR TRANSPORT MANUAL REVISED AS INDICATED
0	09/22/2017	ISSUED FOR TRANSPORT MANUAL

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED - TRANSPORT ENGINEERING	YRPO
CHECKED - TRANSPORT ENGINEERING	YASO
CHECKED - DISCIPLINE	YJPA
CHECKED - ORIGINATOR	YHHO

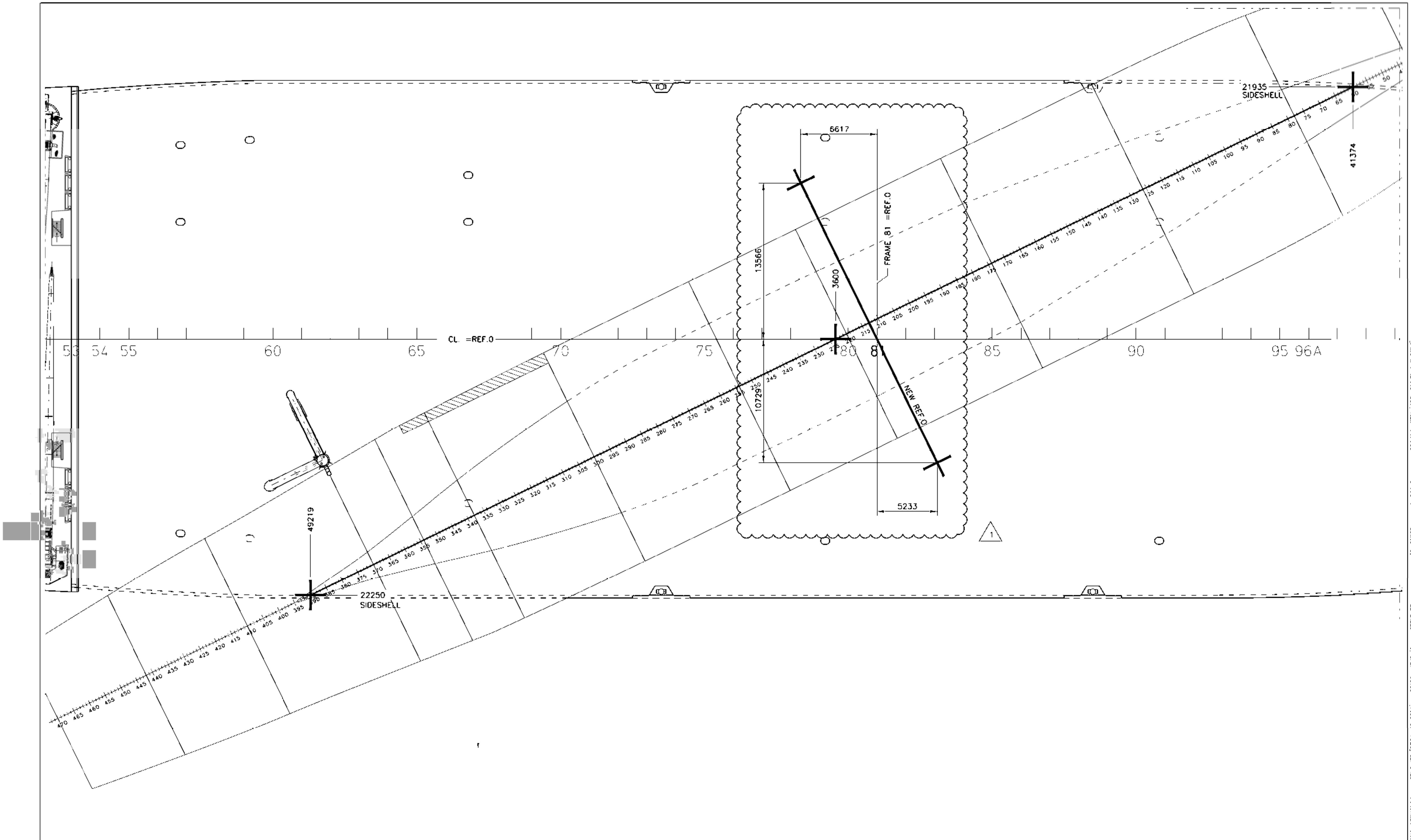
CLIENT: SMIT SALVAGE

CLIENT 2 REF — REV.
CLIENT 1 REF — REV.

DEVELOPMENT
PROJECT: USS JOHN S MCCAIN
SUBJECT: CRIBBING PLAN
TOP VIEW

Dockwise Shipping B.V.

SCALE	DOCKWISE DRAWING NO.	SHT.	REV.
1:300	DW-0032098-002-01		2



NOTES	REFERENCE LIST		REV	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
	DW-0032098-002-01	CRIBBING PLAN TOP VIEW	1	09/28/2017	ISSUED FOR TRANSPORT MANUAL APPROVED AS FINAL
	DW-0032098-002-07	CRIBBING PLAN DETAILS	0	09/22/2017	ISSUED FOR TRANSPORT MANUAL

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED – TRANSPORT ENGINEERING	YRPO
CHECKED – TRANSPORT ENGINEERING	YASO
CHECKED – DISCIPLINE	YJPA
CHECKED – ORIGINATOR	YHHO

CLIENT: SMIT SALVAGE

CLIENT 2 REF — REV.

CLIENT 1 REF — REV.

DEVELOPMENT

PROJECT: USS JOHN S MCCAIN

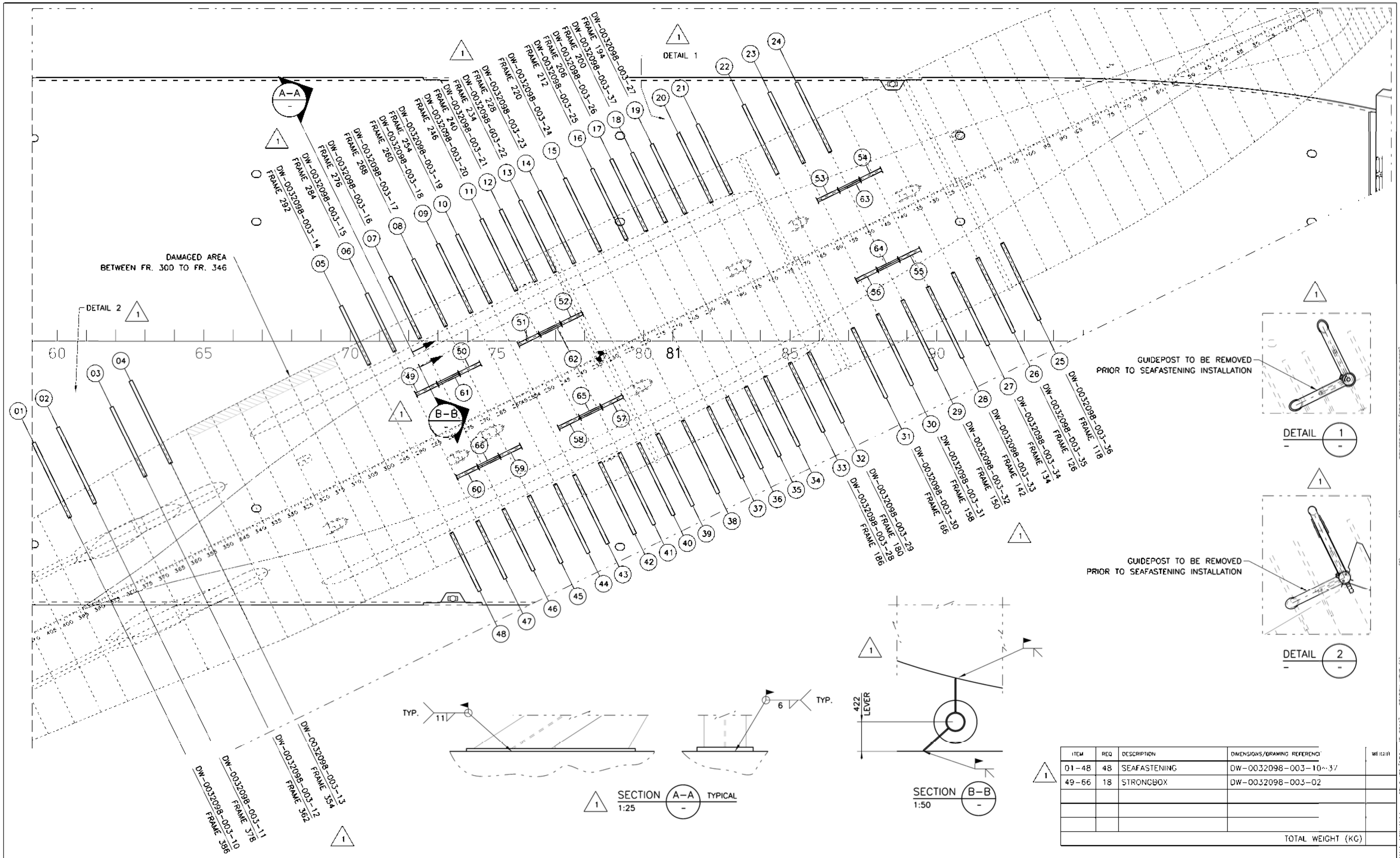
SUBJECT: CRIBBING PLAN MARKING LINES

Dockwise Shipping B.V.

DOCKWISE

SCALE	DOCKWISE DRAWING NO.	SHT.	REV.
1:300	DW-0032098-002-02		1

PREPARED USING DOCKWISE MICROSTATION CAD SYSTEM FORMATS



ITEM	REQ	DESCRIPTION	DIMENSIONS/DRAWING REFERENCE	WEIGHT
01–48	48	SEAFASTENING	DW–0032098–003–10~37	
49–66	18	STRONGBOX	DW–0032098–003–02	
			TOTAL WEIGHT (KG)	

NOTES

MATERIALS [UNLESS NOTED OTHERWISE]
ALL STEEL YIELD STRESS 235 N/MM2 OR EQUIVALENT

WELDING [UNLESS NOTED OTHERWISE]
TO BE IN ACCORDANCE AMERICAN WELDING SOCIETY CODES
ALL WELDING PREPARATIONS TO BE MADE BY FABRICATOR
TO BE FULLY PENETRATED UNLESS NOTED OTHERWISE

REFERENCE LIST

REV.	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
1	09/28/2017	ISSUED FOR TRANSPORT MANUAL APPROVED AS FINAL
0	09/24/2017	ISSUED FOR TRANSPORT MANUAL

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED – TRANSPORT ENGINEERING	YRPO
CHECKED – TRANSPORT ENGINEERING	YASO
CHECKED – DISCIPLINE	YJPA
CHECKED – ORIGINATOR	YHHO

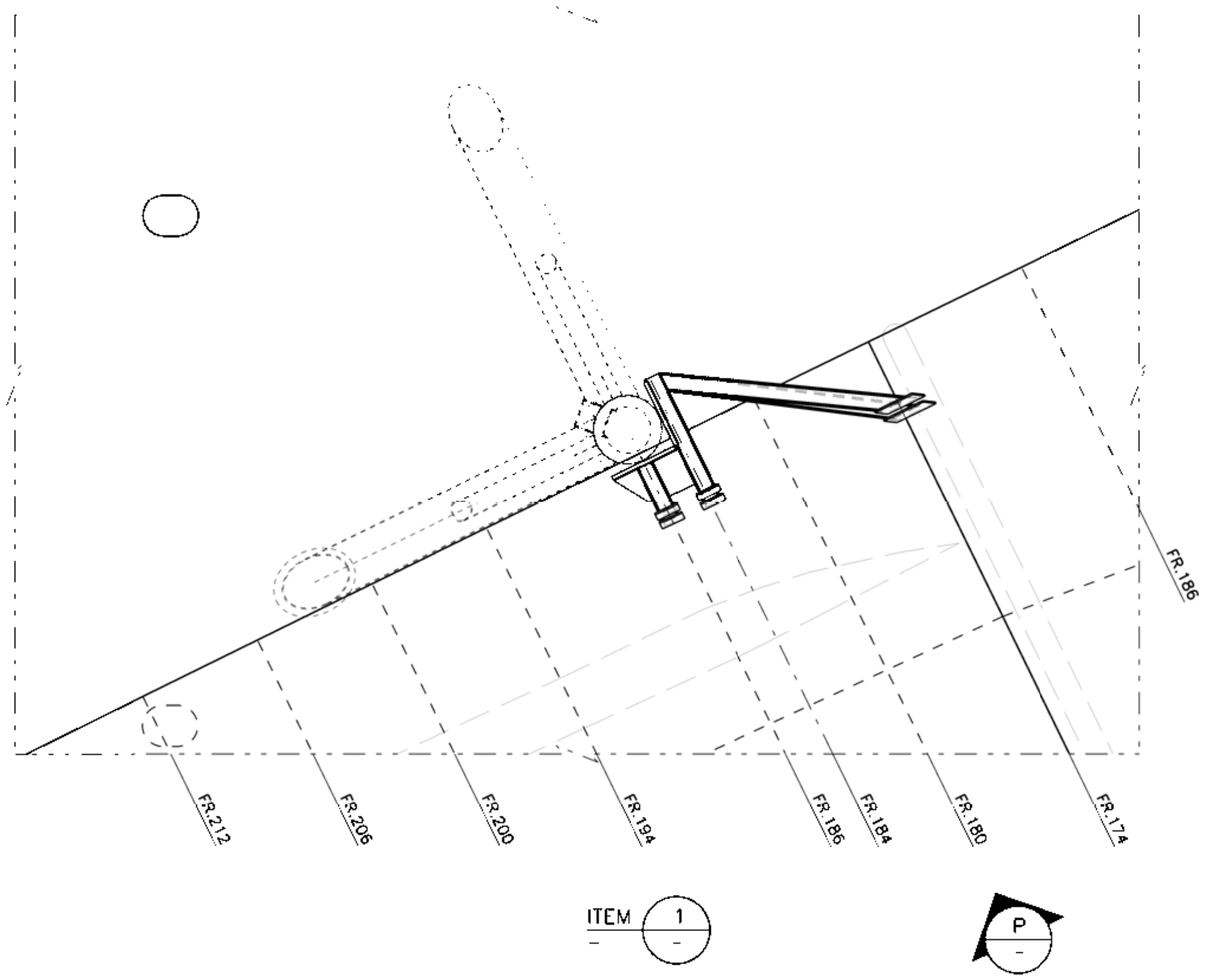
CLIENT: SMIT SALVAGE

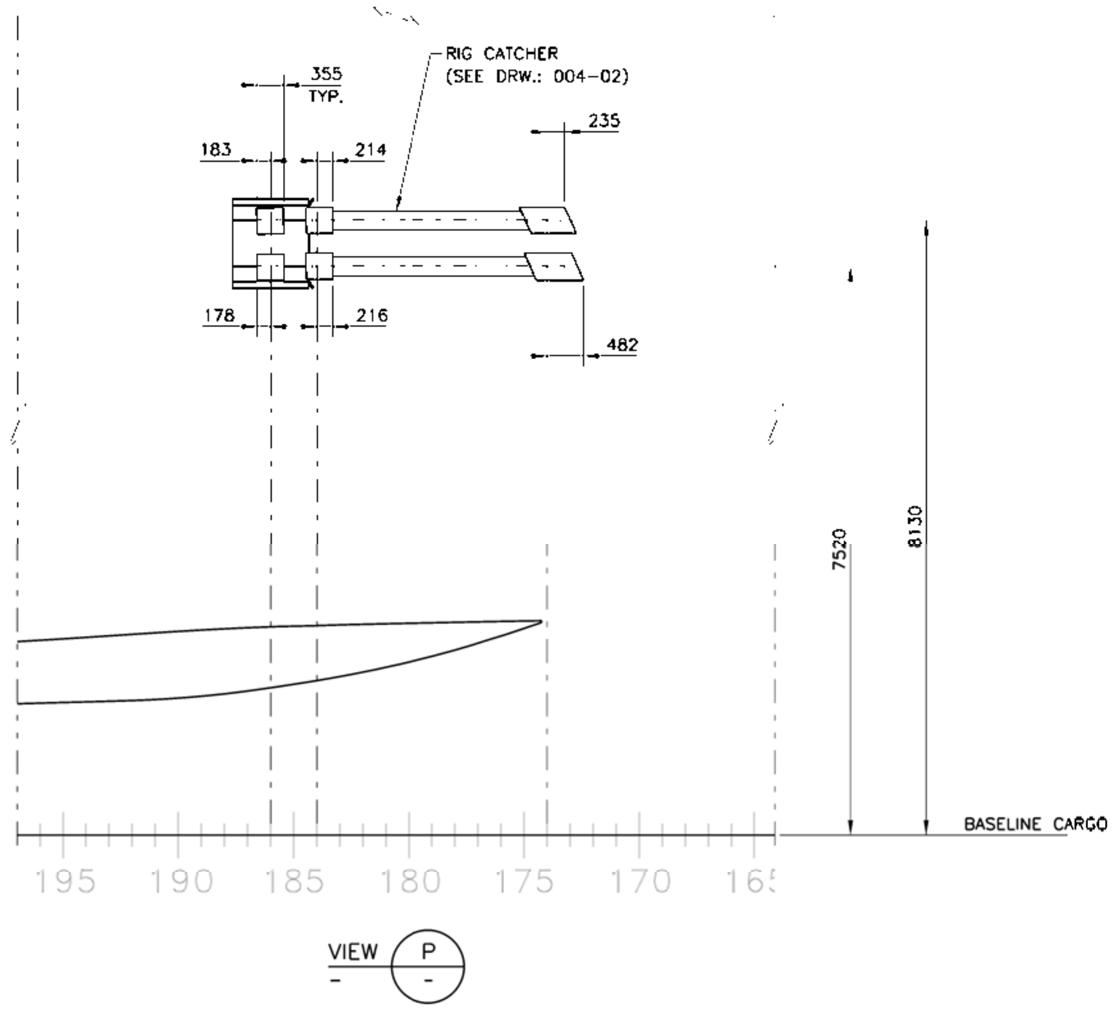
PROJECT: USS JOHN S MCCAIN

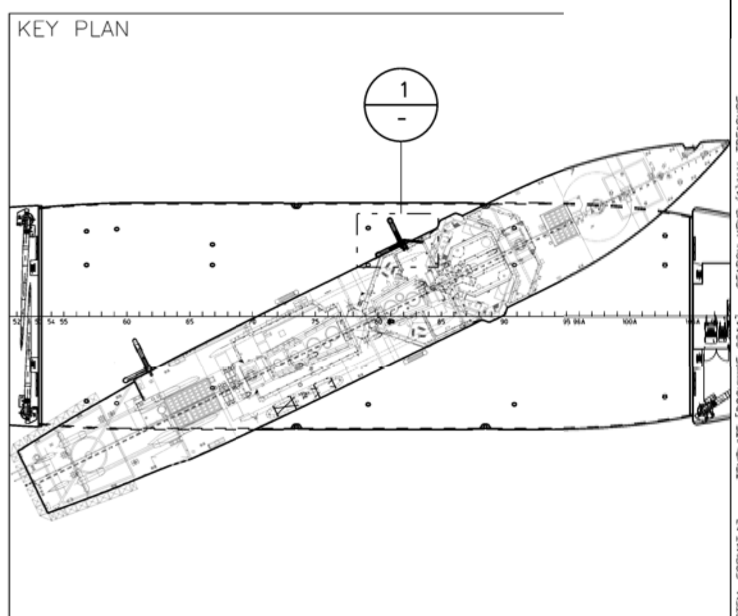
SUBJECT: SEAFASTENING PLAN
TOP VIEW

Dockwise Shipping B.V.

SCALE	DOCKWISE DRAWING NO.	SHT.	REV.
1:300	DW–0032098–003–01		1







NOTES	REFERENCE LIST		REV	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
MATERIALS [UNLESS NOTED OTHERWISE] ALL STEEL YIELD STRESS 235 N/MM2 OR EQUIVALENT WELDING [UNLESS NOTED OTHERWISE] TO BE IN ACCORDANCE AMERICAN WELDING SOCIETY CODES ALL WELDING PREPARATIONS TO BE MADE BY FABRICATOR TO BE FULLY PENETRATED UNLESS NOTED OTHERWISE			1	09/28/2017	ISSUED FOR TRANSPORT MANUAL APPROVED AS FINAL
			0	09/24/2017	ISSUED FOR TRANSPORT MANUAL

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED – TRANSPORT ENGINEERING	YRPO
CHECKED – TRANSPORT ENGINEERING	YASO
CHECKED – DISCIPLINE	YLPA
CHECKED – ORIGINATOR	YHHO

CLIENT: SMIT SALVAGE

CLIENT 2 REF — REV.
CLIENT 1 REF — REV.

DEVELOPMENT

PROJECT: USS JOHN S MCCAIN

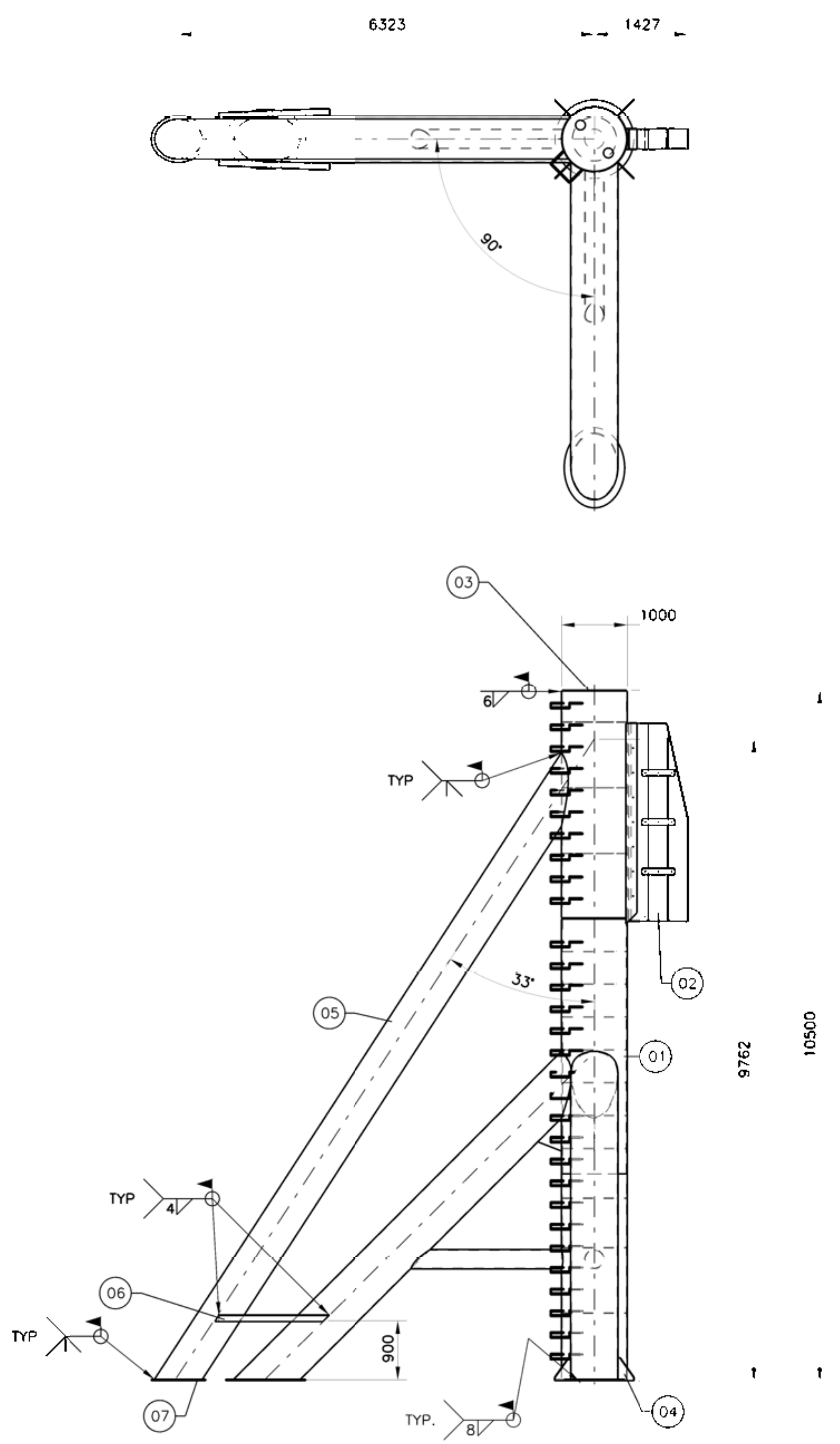
SUBJECT: RIG CATCHER INSTALLATION PLAN

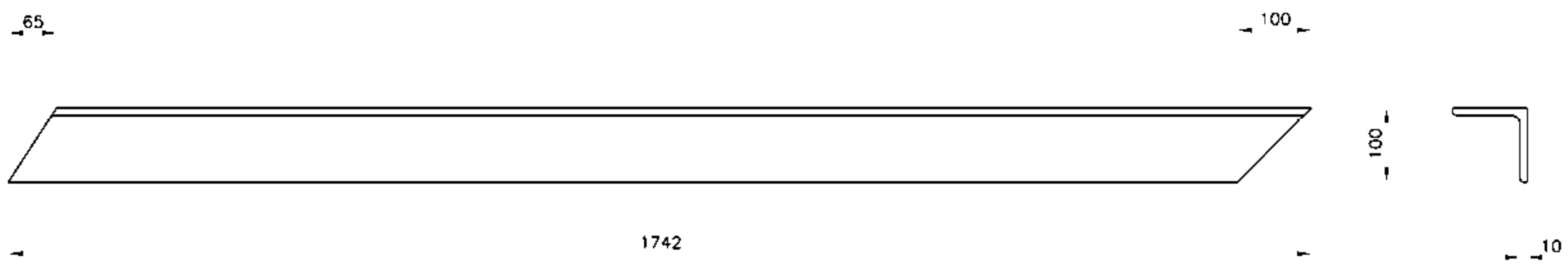
Dockwise Shipping B.V.

DOCKWISE

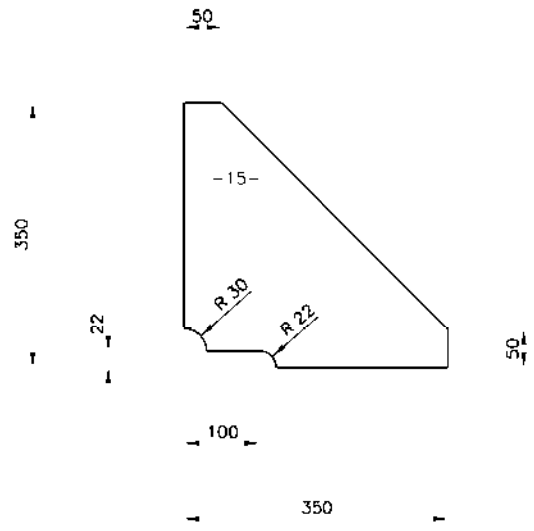
SCALE	DOCKWISE DRAWING NO.	SHT.	REV.
1:100	DW-0032098-004-01	1	

PREPARED USING DOCKWISE MICROSTATION CAD SYSTEM FORMAT:A3 TEMPLATE [DOCKWISE_2011] SEARCH KEYS (1) M.V. TREASURE

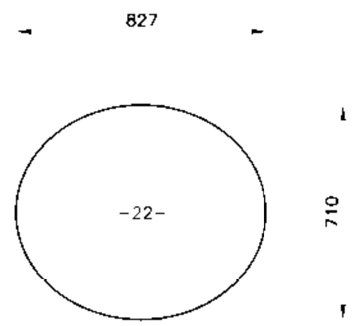




ITEM 06
1:10 -



ITEM 04
1:10 -



ITEM 07
1:25 -

ITEM	REQ.	DESCRIPTION	DIMENSIONS/DRAWING REFERENCE	WEIGHT
01	1	GUIDEPOST EXTRA LARGE	EQUIP04-010-01	
02	1	FENDER	DW-0032098-004-04	
03	1	PLATE	ø980x15	80
04	4	BRACKET	350x350x15	35
05	1	PIPE	O.D. 609.6x W.T. 9.52 L=11388	3078
06	2	ANGLE BAR	100x100x10 L= 1742	100
07	1	PLATE	710x22 L= 827	160
			TOTAL WEIGHT (KG)	12889

NOTES

MATERIALS [UNLESS NOTED OTHERWISE]
ALL STEEL YIELD STRESS 235 N/MM2 OR EQUIVALENT

WELDING [UNLESS NOTED OTHERWISE]
TO BE IN ACCORDANCE AMERICAN WELDING SOCIETY CODES
ALL WELDING PREPARATIONS TO BE MADE BY FABRICATOR
TO BE FULLY PENETRATED UNLESS NOTED OTHERWISE

REFERENCE LIST

REV	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
0	09/28/2017	ISSUED FOR TRANSPORT MANUAL APPROVED AS FINAL

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED - TRANSPORT ENGINEERING	YRPO
CHECKED - TRANSPORT ENGINEERING	YASO
CHECKED - DISCIPLINE	YLPA
CHECKED - ORIGINATOR	VKST

CLIENT
SMIT SALVAGE

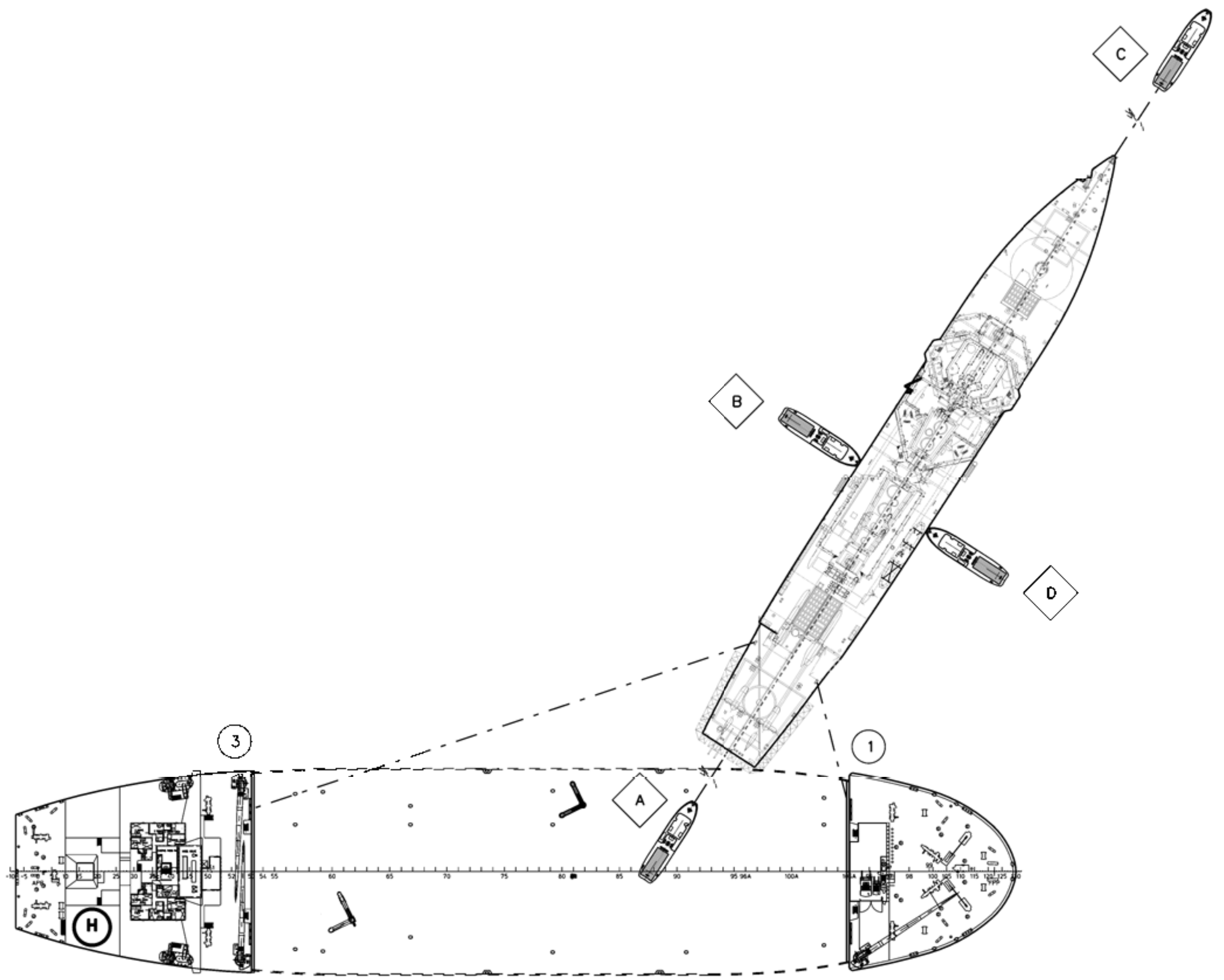
CLIENT 2 REF REV.
CLIENT 1 REF REV.

DEVELOPMENT
PROJECT
USS JOHN S MCCAIN
SUBJECT
GUIDEPOST 10.5 MTR
CONSTRUCTION
MARLIN CLASS

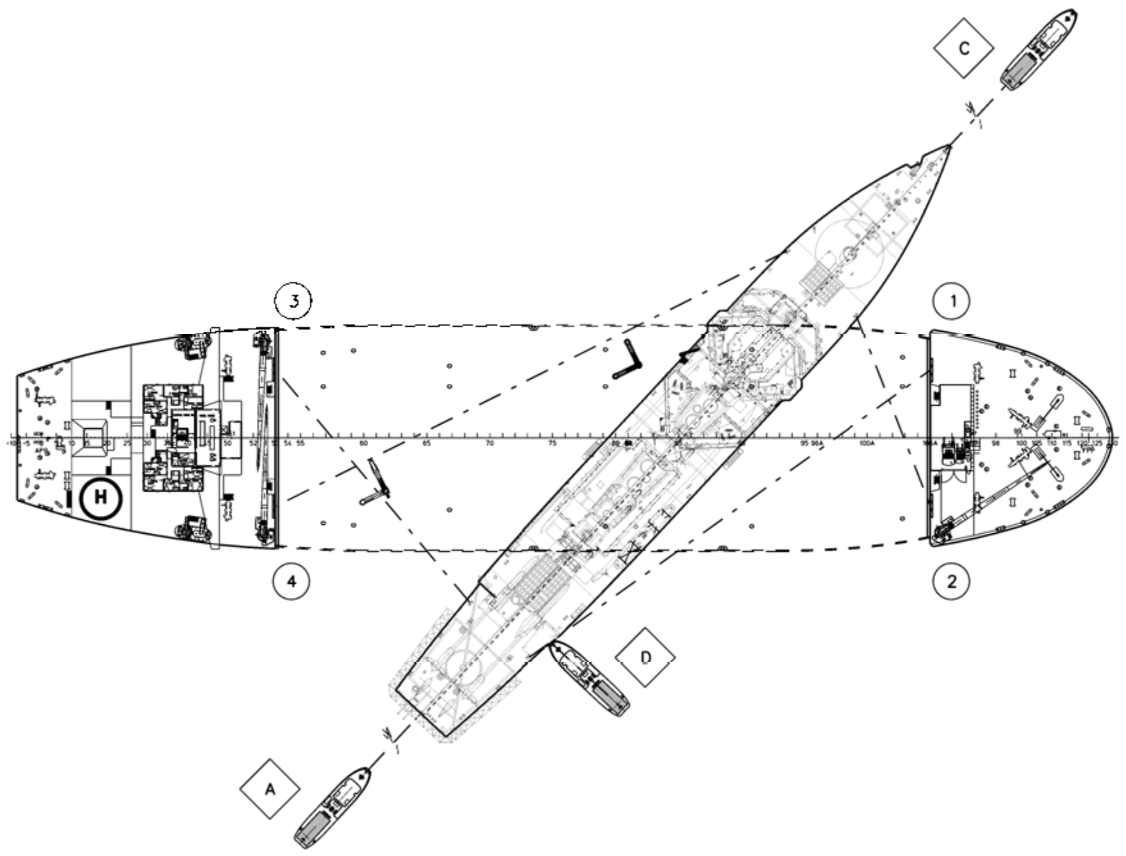
Dockwise Shipping B.V.
DOCKWISE

SCALE	DOCKWISE DRAWING NO. SHT.	REV.
1:100	DW-0032098-004-03	0

PREPARED USING DOCKWISE MICROSTATION CAD SYSTEM



STEP 1



STEP 2

NOTES	REFERENCE LIST		REV	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
THE STEPS IN THIS DRAWING ARE FOR GUIDANCE ONLY			1	09/28/2017	ISSUED FOR TRANSPORT MANUAL APPROVED AS FINAL
			0	09/24/2017	ISSUED FOR TRANSPORT MANUAL

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED – TRANSPORT ENGINEERING	YRPO
CHECKED – TRANSPORT ENGINEERING	YASO
CHECKED – DISCIPLINE	YJPA
CHECKED – ORIGINATOR	YHHO

CLIENT: SMIT SALVAGE

CLIENT 2 REF — REV.

CLIENT 1 REF — REV.

DEVELOPMENT

PROJECT: USS JOHN S MCCAIN

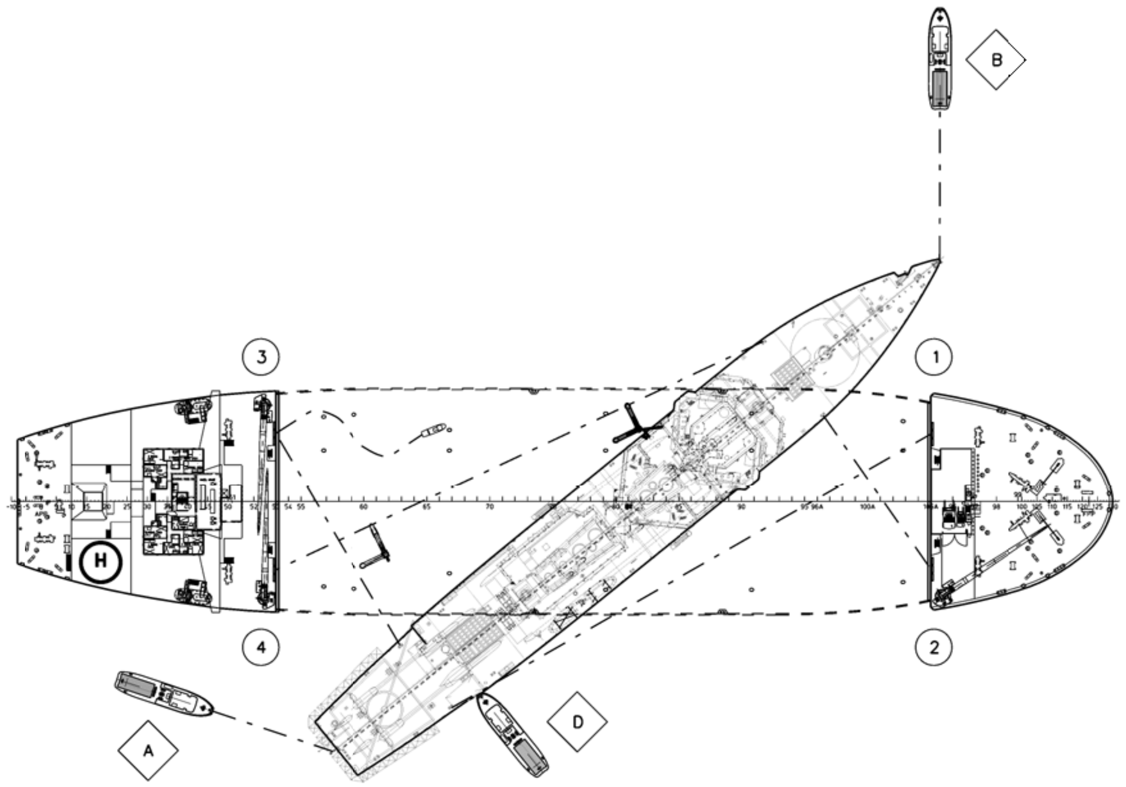
SUBJECT: LOADING SEQUENCE
TOP VIEW
STEP 1 – 2

Dockwise Shipping B.V.

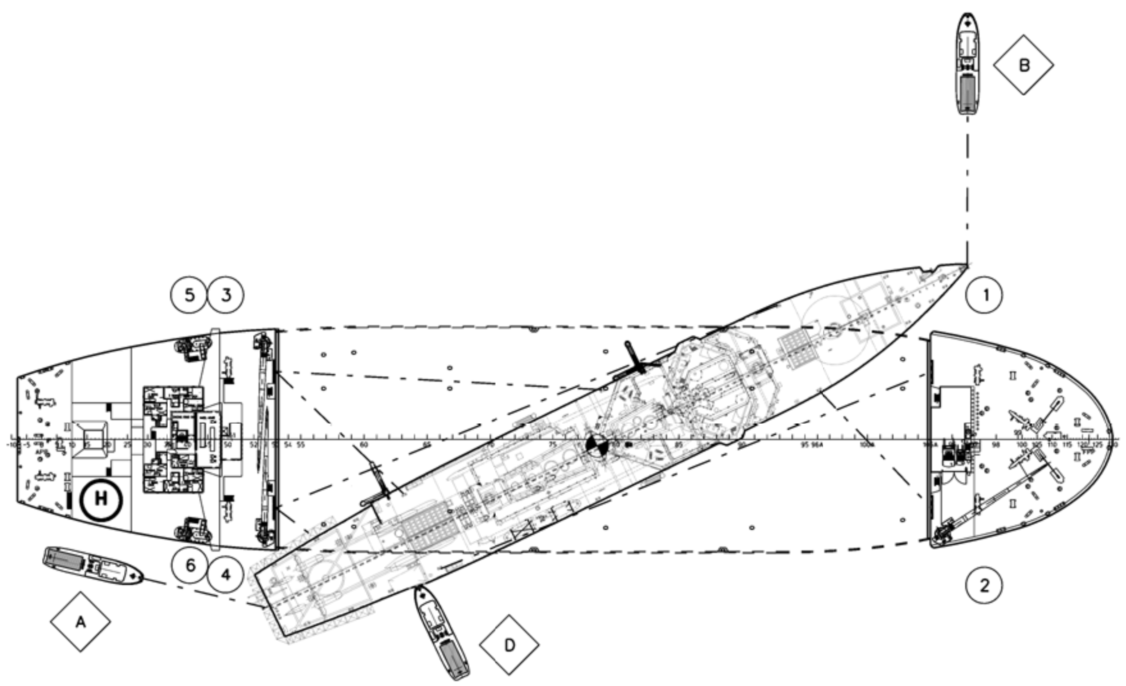
DOCKWISE

SCALE	DOCKWISE DRAWING NO.	SHT.	REV.
1:1,500	DW–0032098–005–01	1	

PREPARED USING DOCKWISE MICROSTATION



STEP 3



STEP 4

NOTES	REFERENCE LIST	REV	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
THE STEPS IN THIS DRAWING ARE FOR GUIDANCE ONLY		1	09/28/2017	ISSUED FOR TRANSPORT MANUAL APPROVED AS FINAL
		0	09/24/2017	ISSUED FOR TRANSPORT MANUAL

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED – TRANSPORT ENGINEERING	YRPO
CHECKED – TRANSPORT ENGINEERING	YASO
CHECKED – DISCIPLINE	YLPA
CHECKED – ORIGINATOR	YHHO

CLIENT: SMIT SALVAGE

CLIENT 2 REF — REV.

CLIENT 1 REF — REV.

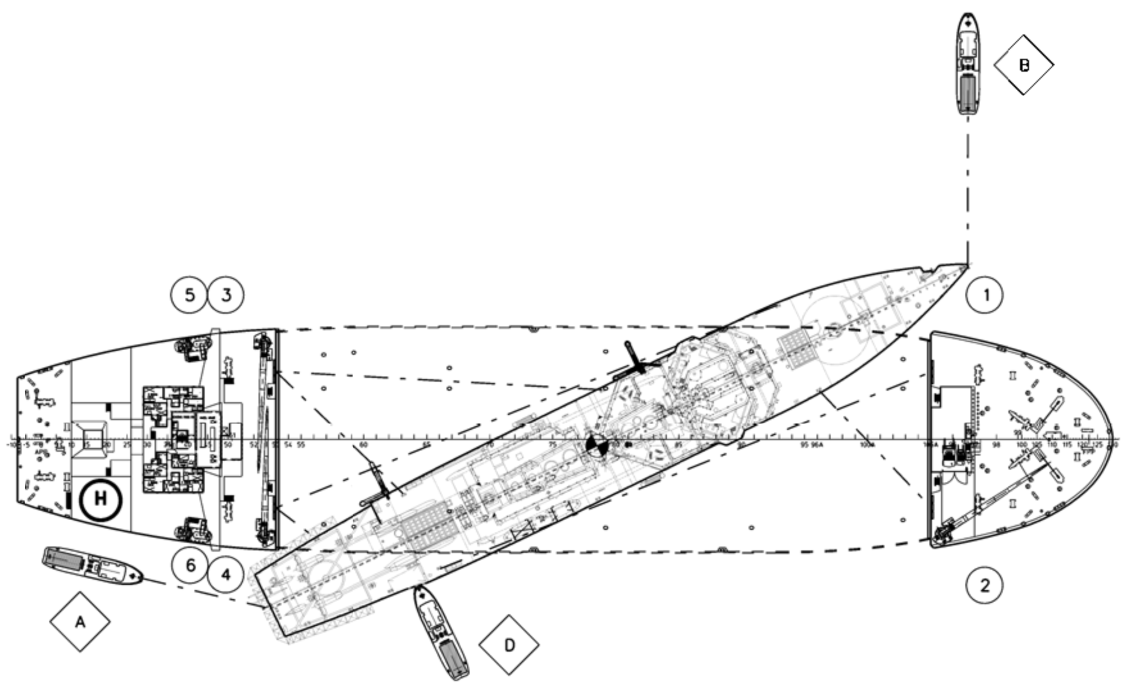
PROJECT: USS JOHN S MCCAIN

SUBJECT: LOADING SEQUENCE
TOP VIEW
STEP 3 – 4

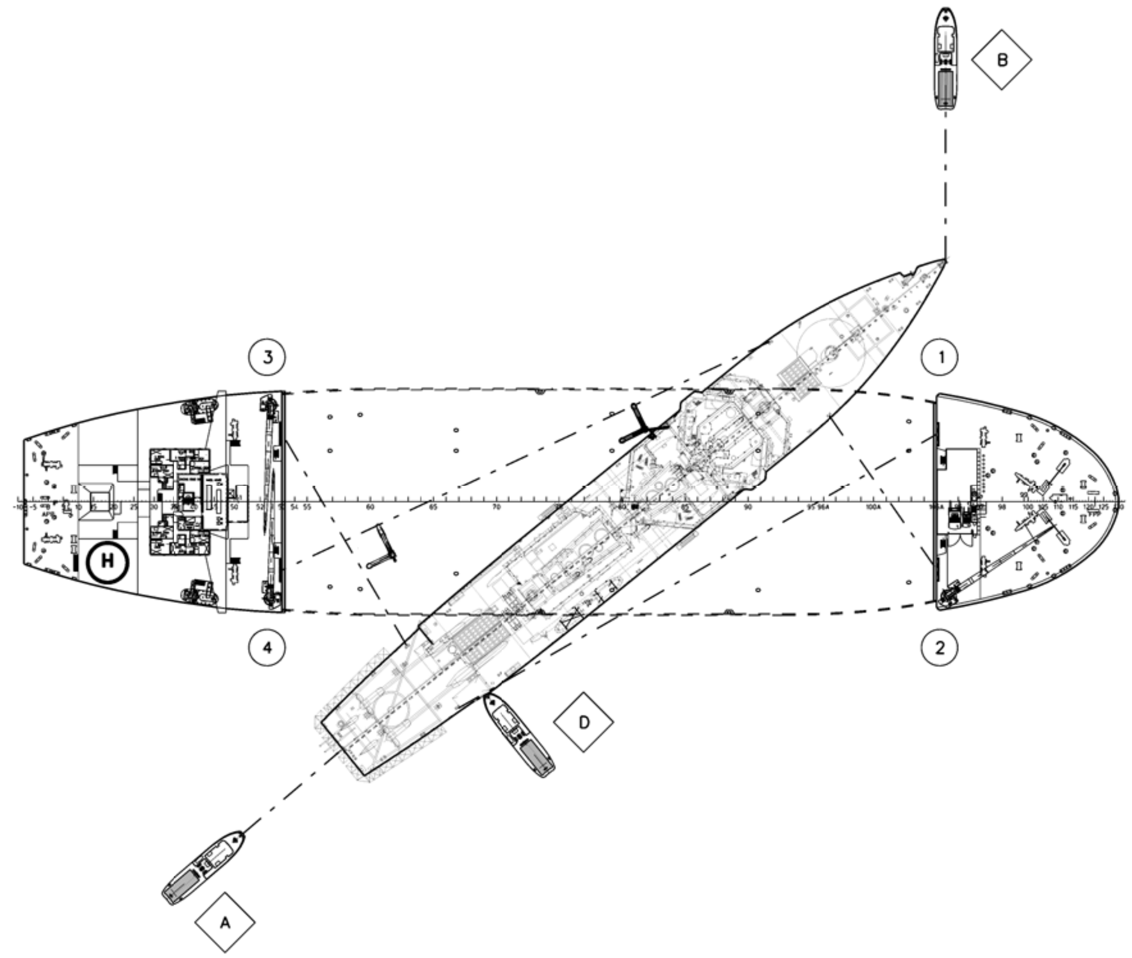
Dockwise Shipping B.V.

SCALE	DOCKWISE DRAWING NO.	SHT.	REV.
1:1,500	DW-0032098-005-02	1	

PREPARED USING DOCKWISE MICROSTATION SYSTEM FORMATS



STEP 1



STEP 2

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					APPROVED AS FINAL
			0	09/24/2017	ISSUED FOR TRANSPORT MANUAL

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED – TRANSPORT ENGINEERING	YRPO
CHECKED – TRANSPORT ENGINEERING	YASO
CHECKED – DISCIPLINE	YJPA
CHECKED – ORIGINATOR	YHHO

CLIENT: SMIT SALVAGE

CLIENT 2 REF — REV.

CLIENT 1 REF — REV.

DEVELOPMENT

PROJECT: USS JOHN S MCCAIN

SUBJECT: DISCHARGING SEQUENCE
TOP VIEW
STEP 1 – 2

Dockwise Shipping B.V.

SCALE	DOCKWISE DRAWING NO.	SHT.	REV.
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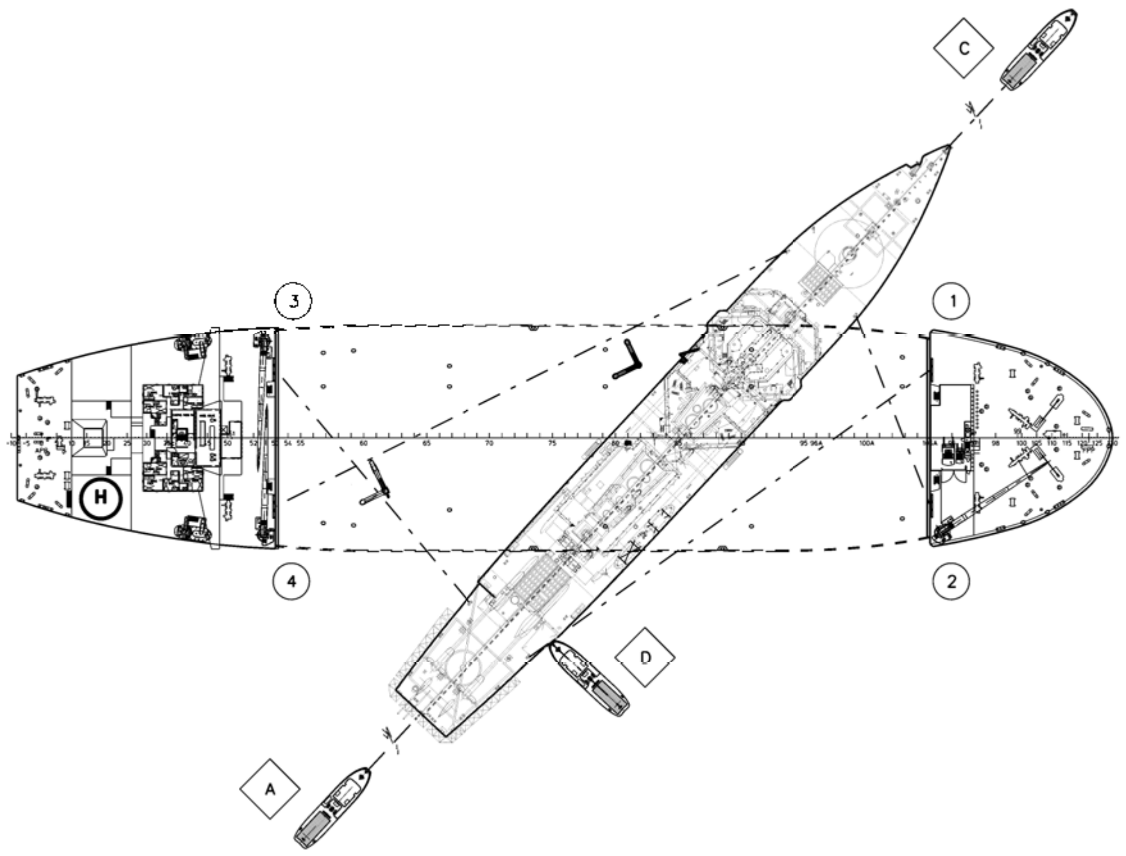
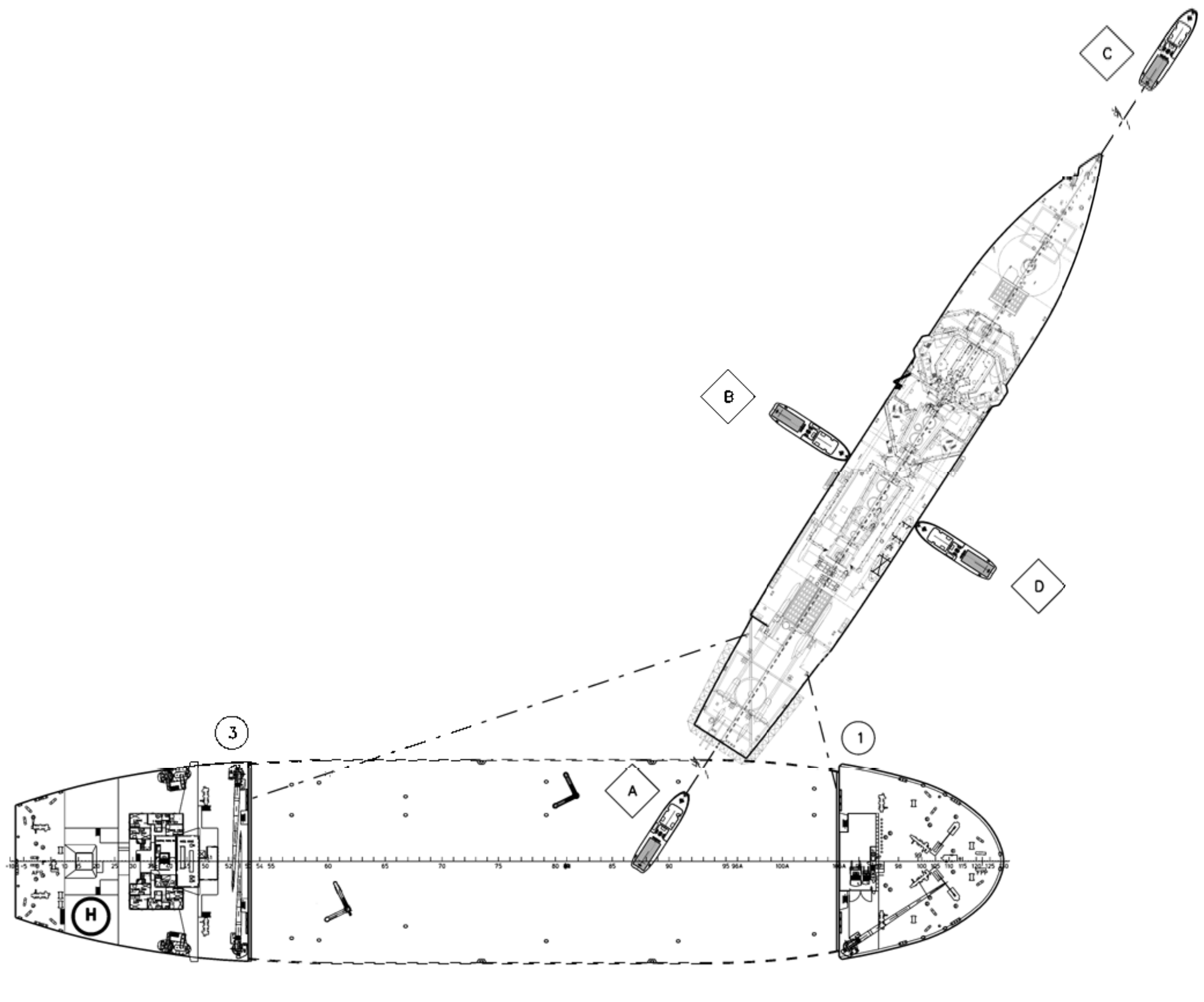


STEP 3



STEP 4

NOTES	REFERENCE LIST		REV	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
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			0	09/24/2017	ISSUED FOR TRANSPORT MANUAL

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED – TRANSPORT ENGINEERING	YRPO
CHECKED – TRANSPORT ENGINEERING	YASO
CHECKED – DISCIPLINE	YJPA
CHECKED – ORIGINATOR	YHHO

CLIENT: SMIT SALVAGE

CLIENT 2 REF — REV.

CLIENT 1 REF — REV.

DEVELOPMENT

PROJECT: USS JOHN S MCCAIN

SUBJECT: DISCHARGING SEQUENCE
TOP VIEW
STEP 3 – 4

Dockwise Shipping B.V.

DOCKWISE

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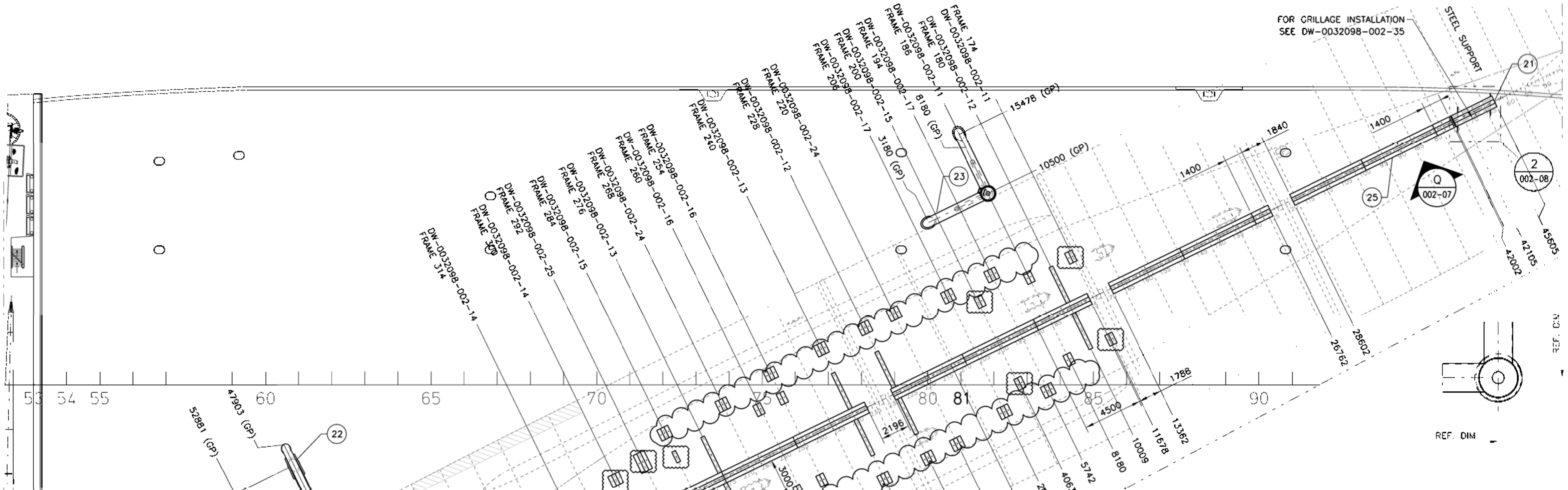
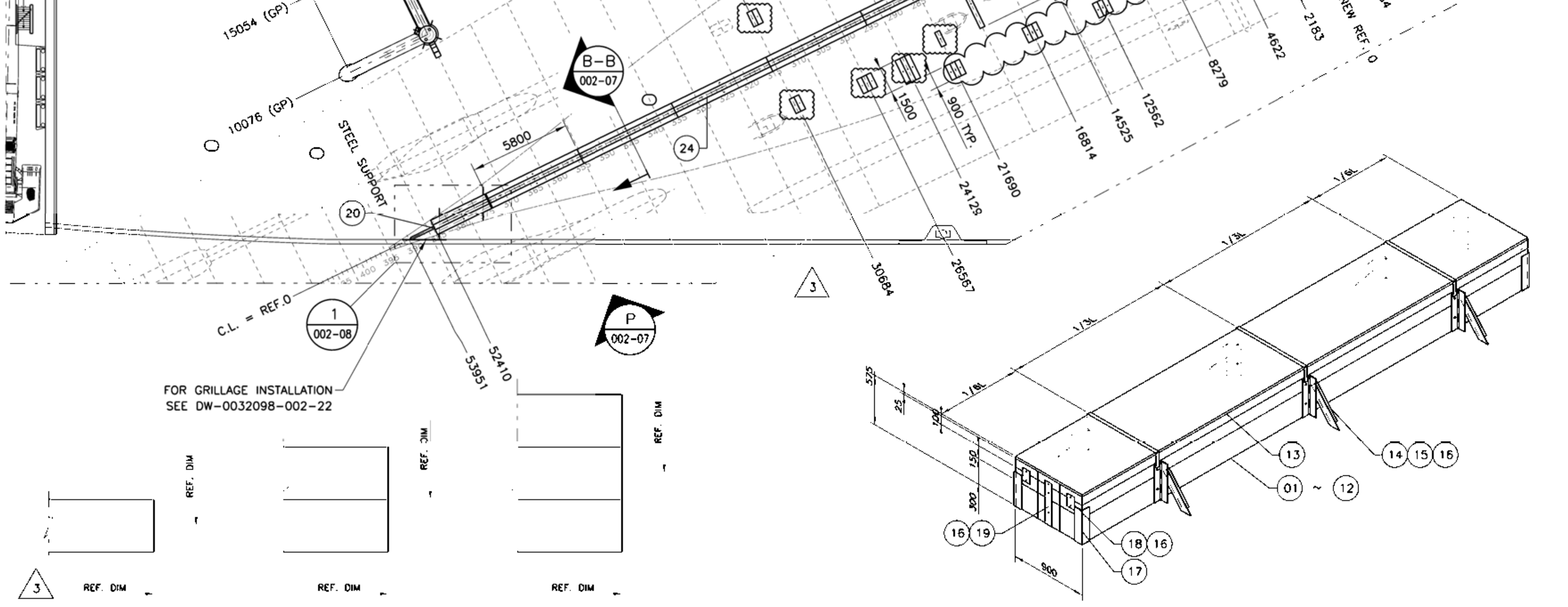
PREPARED USING DOCKWISE MICROSTATION SYSTEM FORMATS



ALL SIDE BLOCKS INSTALLED BEFORE LOADING



ITEM	REQ.	DESCRIPTION	DIMENSIONS/DRAWING REFERENCE	WEIGHT
01	36	HARDWOOD	300x300 L=6000	
02	3	HARDWOOD	300x300 L=5800	–
03	3	HARDWOOD	300x300 L=4500	–
04	6	HARDWOOD	300x300 L=1400	
05	36	HARDWOOD	150x300 L=6000	–
06	3	HARDWOOD	150x300 L=5800	–
07	3	HARDWOOD	150x300 L=4500	
08	6	HARDWOOD	150x300 L=1400	
09	36	SOFTWOOD	100x300 L=6000	–
10	3	SOFTWOOD	100x300 L=5800	
11	3	SOFTWOOD	100x300 L=4500	
12	6	SOFTWOOD	100x300 L=1400	
13	35	PLYWOOD	25x900 L=2440	–
14	92	CRIBBING SUPPORT	DW-0032098-002-04	–
15	46	FLAT BAR	3x40 L=1275	
16	226	LAG BOLT	DIA. 10x100 DIN571	–
17	12	ANGLE BAR	100x100x10 L=450	–
18	12	NAIL CHIP 5x100 L=150	DW-0032098-002-05	–
19	6	NAIL CHIP 5x100 L=500	DW-0032098-002-06	
20	1	CRIBBING SUPPORT AFT	DW-0032098-002-20	
21	1	CRIBBING SUPPORT FWD	DW-0032098-002-21	–
22	1	GUIDEPOST	DW-0032098-004-03	
23	1	GUIDEPOST	DW-0032098-004-06	
24	1	STEEL PLATE	DW-0032098-002-22	–
25	1	STEEL PLATE	DW-0032098-002-23	
			TOTAL WEIGHT (KG)	

NOTES

MATERIALS [UNLESS NOTED OTHERWISE]
ALL STEEL YIELD STRESS 235 N/MM2 OR EQUIVALENT

WELDING [UNLESS NOTED OTHERWISE]
TO BE IN ACCORDANCE AMERICAN WELDING SOCIETY CODES
ALL WELDING PREPARATIONS TO BE MADE BY FABRICATOR
TO BE FULLY PENETRATED UNLESS NOTED OTHERWISE

PLYWOOD TO BE SECURED WITH NAILS

FOR TRANSVERSE CRIBBING SEE DRAWINGS:
DW-0032098-002-11 ~ DW-0032098-002-25

REFERENCE LIST	
DW-0032098-002-02	CRIBBING PLAN MARKING LINES
DW-0032098-002-07	CRIBBING PLAN DETAILS

REV	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
3	10/27/2017	ISSUED FOR TRANSPORT MANUAL REVISED AS INDICATED
2	09/28/2017	ISSUED FOR TRANSPORT MANUAL APPROVED AS FINAL
1	09/24/2017	ISSUED FOR TRANSPORT MANUAL REVISED AS INDICATED
0	09/22/2017	ISSUED FOR TRANSPORT MANUAL

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED – TRANSPORT ENGINEERING	YRPO
CHECKED – TRANSPORT ENGINEERING	YASO
CHECKED – DISCIPLINE	YUPA
CHECKED – ORIGINATOR	DBMN

CLIENT: SMIT SALVAGE

CLIENT 2 REF — REV.

CLIENT 1 REF — REV.

DEVELOPMENT

PROJECT: USS JOHN S MCCAIN

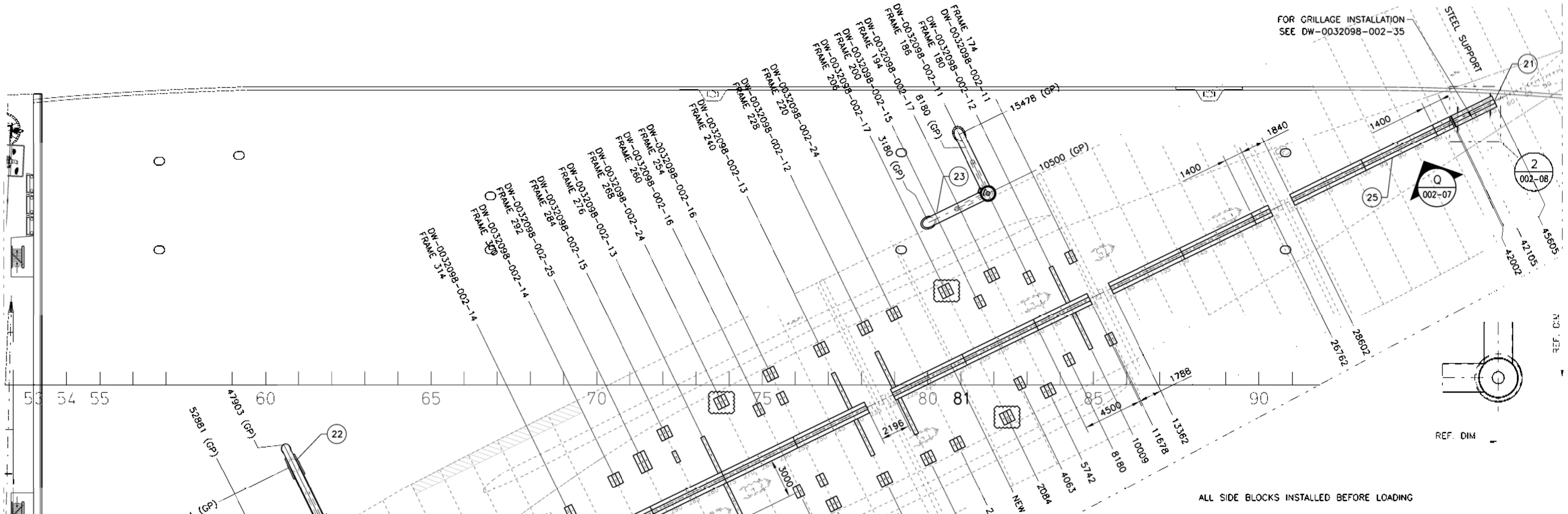
SUBJECT: CRIBBING PLAN
TOP VIEW

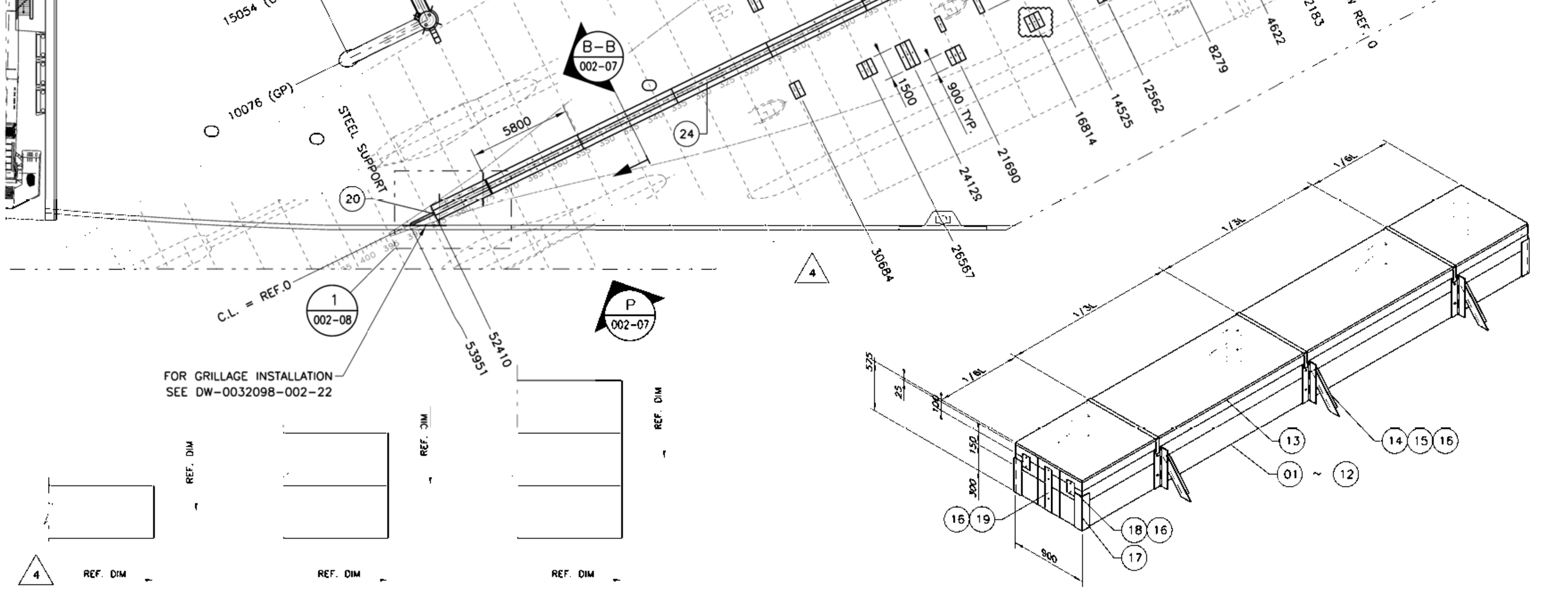
Dockwise Shipping B.V.

DOCKWISE

SCALE	DOCKWISE DRAWING NO.	SHT.	REV.
1:300	DW-0032098-002-01		3

PREPARED USING DOCKWISE MICROSTATION CAD SYSTEM





ALL SIDE BLOCKS INSTALLED BEFORE LOADING

ITEM	REQ.	DESCRIPTION	DIMENSIONS/DRAWING REFERENCE	WEIGHT
01	36	HARDWOOD	300x300 L=6000	
02	3	HARDWOOD	300x300 L=5800	-
03	3	HARDWOOD	300x300 L=4500	-
04	6	HARDWOOD	300x300 L=1400	
05	36	HARDWOOD	150x300 L=6000	-
06	3	HARDWOOD	150x300 L=5800	-
07	3	HARDWOOD	150x300 L=4500	
08	6	HARDWOOD	150x300 L=1400	
09	36	SOFTWOOD	100x300 L=6000	-
10	3	SOFTWOOD	100x300 L=5800	
11	3	SOFTWOOD	100x300 L=4500	
12	6	SOFTWOOD	100x300 L=1400	
13	35	PLYWOOD	25x900 L=2440	-
14	92	CRIBBING SUPPORT	DW-0032098-002-04	-
15	46	FLAT BAR	3x40 L=1275	
16	226	LAG BOLT	DIA. 10x100 DIN571	-
17	12	ANGLE BAR	100x100x10 L=450	-
18	12	NAIL CHIP 5x100 L=150	DW-0032098-002-05	-
19	6	NAIL CHIP 5x100 L=500	DW-0032098-002-06	
20	1	CRIBBING SUPPORT AFT	DW-0032098-002-20	
21	1	CRIBBING SUPPORT FWD	DW-0032098-002-21	-
22	1	GUIDEPOST	DW-0032098-004-03	
23	1	GUIDEPOST	DW-0032098-004-06	
24	1	STEEL PLATE	DW-0032098-002-22	-
25	1	STEEL PLATE	DW-0032098-002-23	
			TOTAL WEIGHT (KG)	

NOTES

MATERIALS [UNLESS NOTED OTHERWISE]
ALL STEEL YIELD STRESS 235 N/MM2 OR EQUIVALENT

WELDING [UNLESS NOTED OTHERWISE]
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ALL WELDING PREPARATIONS TO BE MADE BY FABRICATOR
TO BE FULLY PENETRATED UNLESS NOTED OTHERWISE

PLYWOOD TO BE SECURED WITH NAILS

FOR TRANSVERSE CRIBBING SEE DRAWINGS:
DW-0032098-002-11 ~ DW-0032098-002-25

REFERENCE LIST	
DW-0032098-002-02	CRIBBING PLAN MARKING LINES
DW-0032098-002-07	CRIBBING PLAN DETAILS

REV	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
4	11/06/2017	ISSUED FOR TRANSPORT MANUAL REVISED AS INDICATED
3	10/27/2017	ISSUED FOR TRANSPORT MANUAL REVISED AS INDICATED
2	09/28/2017	ISSUED FOR TRANSPORT MANUAL APPROVED AS FINAL
1	09/24/2017	ISSUED FOR TRANSPORT MANUAL REVISED AS INDICATED
0	09/22/2017	ISSUED FOR TRANSPORT MANUAL

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED - TRANSPORT ENGINEERING	YNVE
CHECKED - TRANSPORT ENGINEERING	YASO
CHECKED - DISCIPLINE	YLPA
CHECKED - ORIGINATOR	DBMN

CLIENT: SMIT SALVAGE

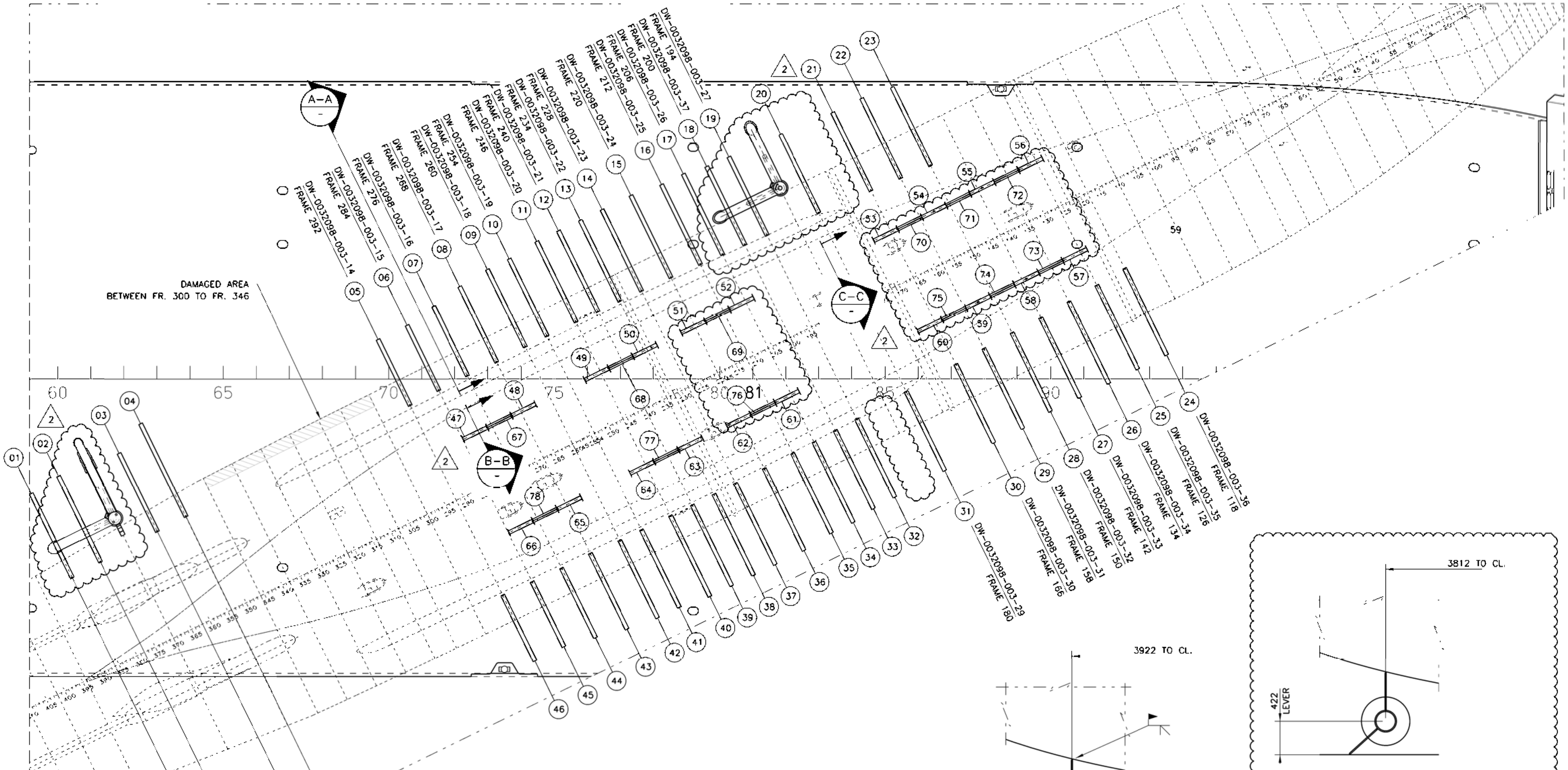
PROJECT: USS JOHN S MCCAIN

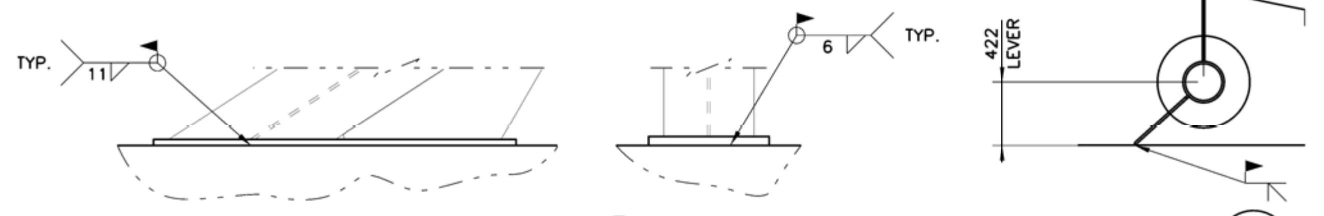
SUBJECT: CRIBBING PLAN TOP VIEW

Dockwise Shipping B.V.

DOCKWISE

SCALE	DOCKWISE DRAWING NO.	SHT.	REV.
1:300	DW-0032098-002-01		4





SECTION A-A TYPICAL
1:25

SECTION B-B
1:50

ITEM	REQ	DESCRIPTION	DIMENSIONS/DRAWING REFERENCE	WEIGHT
01-46	46	SEAFASTENING	DW-0032098-003-10~37	
49-80	32	STRONGBOX	DW-0032098-003-02	
			TOTAL WEIGHT (KG)	

NOTES

MATERIALS [UNLESS NOTED OTHERWISE]
ALL STEEL YIELD STRESS 235 N/MM2 OR EQUIVALENT

WELDING [UNLESS NOTED OTHERWISE]
TO BE IN ACCORDANCE AMERICAN WELDING SOCIETY CODES
ALL WELDING PREPARATIONS TO BE MADE BY FABRICATOR
TO BE FULLY PENETRATED UNLESS NOTED OTHERWISE

REFERENCE LIST

REV.	MM/DD/YYYY	FORMAL REVISION/CHANGE SUMMARY
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1	09/28/2017	ISSUED FOR TRANSPORT MANUAL APPROVED AS FINAL
0	09/24/2017	ISSUED FOR TRANSPORT MANUAL

APPROVAL/REVIEW STATUS	RESPONSIBLE PERSON
APPROVED - TRANSPORT ENGINEERING	YRPO
CHECKED - TRANSPORT ENGINEERING	YASO
CHECKED - DISCIPLINE	YJPA
CHECKED - ORIGINATOR	YHHO

CLIENT: SMIT SALVAGE

CLIENT 2 REF
CLIENT 1 REF

DEVELOPMENT
PROJECT: USS JOHN S MCCAIN
SUBJECT: SEAFASTENING PLAN TOP VIEW

Dockwise Shipping B.V.

SCALE	DOCKWISE DRAWING NO.	SHT.	REV.
1:300	DW-0032098-003-01		2

USS MCCAIN Heavy Lift Onload Action List - Appendix M.

ITEM	TASK	RESPONSIBILITY	STATUS
Transport Manual Review	Provide Dockwise with NAVSEA comments	Ruth	On going
	Block build - Determine if contractor used the inner surface of the hull plating, or some other surface for side blocks	Ruth / Jarecki / Ferris	Complete
	Seafastening technical issues	Ferris / Jarecki	In process
	Ask Dockwise whether Bill of Lading needed to leave port	Ruth / Walters	In process
Alignment Catcher	Masker system and possibility of welding to not interfere with masker.	Jarecki/CTF73 Salvage/Glova	Complete
	HY80 welding requirement?	CTF 73 salvage	Complete
	Verify correct alignment with blocking arrangement.	Jarecki/Ferris	Complete
	Explore option of removable softwood to refine placement.	Jarecki/Ferris/Ruth	Closed
	Remove lagging from the forward part of Access Trunk (2-183-2-T) and all of the Test Lab (2-174-8-Q) for catcher installation	McLaughlin/Glova/Roman	Complete
	Dockwise confirm/demonstrate location will not impact guide post	Dockwise/Jarecki/Ferris	Complete
Coordinate services info with Dockwise	Electrical - confirm with Dockwise connection compatibility.	McLaughlin/JSM/DW	complete
	Grounding - Fabricate/connect ends for cable (welding tab with 20mm hole)	Dockwise/McLaughlin/ Ruth	Sybren confirmed would/could execute
	Water - international conections	McLaughlin/JSM/Coronado/Emge	Complete
	Air - connect compressor electrically and test	Dockwise/McLaughlin/ Ruth	Complete
	Air - fit hoses to JSM (already confirmed compatible)	Smit/McLaughlin/JSM	Complete
Berthing	Meet with JSM CO to discuss berthing/extremely limited internet access	Ruth	Complete
	Coordinate with Dockwise about riders early arrival (3 days)	Ruth	Complete
	provide rider details (name/DOB/SSN) to Dockwise	Ruth/ JSM XO	Complete
Communications for onload evolution	Identify primary and secondary communications channels for all HL team members.	Washington	Complete
	Operationally verify interoperability of SUPSALV, SF, and other comms; coordinate frequencies	Named stakeholders	Complete
	Verify B2B with all parties.	Washington / XO	Complete
	Ask MPA for comms channels (Confirmed CH 72)	Ruth	Complete
Appendix R preps	Collect all personal electronics in damaged/flooded spares	CHENG/Roman	Complete
	Secure loose items in Gyro room and weight room	CHENG/Roman	Complete
	Certify JSM is secured for lift	Roman / Gantt	Complete
	Gas-free requirement during transit	DCA/McLaughlin	Complete
	Pump out Sonar Dome	Ship Force	Complete
Desiccant	Re-package and distribute throughout compartments - 30 Sep-1 Oct	Glova/Ship force	In process
Towing	Develop towing plan/transit plan	Ruth/CO JSM/XO JSM	Complete
	Tow rigging inspection	Ruth/Roman	Complete
	Determine tow limits	Ruth/Roman	Complete
	Coordinate Force Protection with Singapore Navy	CO JSM	Complete
	Provide pumping plan	DW/Ruth/Gant	Complete
Stakeholders Meeting	Prepare presentation of HL evolution	Roman/Ruth	Complete
	Promulgate GO/NO GO criteria	Roman/Ruth	Complete
External Meetings	Heavy Lift brief to CTF-70	Emgee/Roman/Ruth	Closed
Weather	Obtain weather forecast for load week	Washington/Fleet Weather San Diego	Ongoing
Hydraulic plant mounting (flight deck)	Verify complete	McLaughlin / Roman	Complete
Reporting	Define SITREP format for Dockwise and distribution list	Ruth	pending
Sharing photos and other documents	Establish online workspace.	00C	requirement to be validated/assigned

Appendix N.

Hull Analysis of USS John S. McCain (DDG 56) During Heavy Lift Operations

Author: **CAPT Phillip H. Burnside, USN**
Technical Contributor: **CAPT William Roth, USN**
Technical Editor: **CAPT Brandon J. Larson, USN**
Naval Sea Systems Command – Reserve Technical Authority Support

The USS JOHN C MCCAIN (DDG-51) Class Guided Missile Destroyer experienced cracking of the Hull while being transported on a heavy lift ship from Singapore to Japan for repairs following a collision with civilian cargo ship. During heavy weather cracks in the hull where detected coming out from under the docking blocks at two locations. This paper analyzes the heavy lift docking block loading to the hull based on rolling Heavy lift ship to determine the root cause of the cracking of the hull of the USS JOHN C MCCAIN. Recommendations are made for the modification of the US Naval Tow Manual.

INTRODUCTION

On August 21, 2017, the USS John S. McCain (DDG 56) was involved in a collision with the Liberian-flagged Motor Vessel (MV) MV Alnic MC off the coast of Singapore and Malaysia, east of the Straits of Malacca.

The collision resulted in a hull breach that "resulted in flooding to nearby compartments, including crew berthing, machinery, and communications rooms." Ten US Navy sailors died as a result of the collision.

After the incident, the ship was able to sail under her own power to Changi Naval Base in Singapore. By August 27th, U.S. Navy and Marine Corps divers had recovered the remains of all 10 sailors. This damage is shown in Figure 1. (Fig. 1).

Fig 1 - Damage to USS John S. McCain (DDG 56)

On 6 September 2017, the Supervisor of Salvage awarded a contract to Dockwise, Inc., a marine transport company to heavy lift the damaged the USS John S. McCain in late September from Singapore to a US repair facility in Yokosuka, Japan, where the damage is to be repaired.

This move was accomplished by placing the USS John S. McCain on the heavy lift ship MV Treasure. The placement of the docking blocks relative the transverse frames and stringers was done in accordance with the ships docking plan, as would be used to place the ship in dry-dock. This is shown in Figure 2 (Fig. 2).

Fig. 2 – Starboard side view of USS John S. McCain loaded aboard the MV Treasure

However due to general arrangement of the MV Treasure, the USS John S. McCain would need to be lifted with the destroyer's bow and stern cantilevered off the port and starboard sides of the MV Treasure. This is shown in Figure 3 (Fig. 3), and the docking plan is shown in Figure 4 (Fig. 4).

The problem with this arrangement of the MV Treasure is that it could impart significant rolling periods of the heavy lift ship while the USS John S. McCain is loaded. These rolling periods were proposed by the Heavy Lift Teams to cause a cyclic loading on the destroyer.

During the loaded transit to Japan, the MV Treasure had to heave-to for five days in the Philippine Sea to allow a typhoon to pass ahead of it. During the five days, the side shoring along the hull of the destroyer was periodically observed to be visibly away from the hull. The voyage data recorder system showed a constant roll of six degrees with a ten-second period.

On the fifth day, the crew observed seeing a linear indication under the support block of frame 286 adjacent to a butt-weld in the hull plate. This block was located on a longitudinal but was about 24-inches from the closest transverse frame of the destroyer. The rolling would place a cyclic bending load into the hull weld. This condition would not have occurred during normal operation of the ship in average weather conditions, or during a standard dry-docking.

Fig 3 – Bow view of the cantilevered USS John S. McCain loaded aboard the MV Treasure

The location of the linear indications found after five days of heavy seas are shown in Figure 5 (Fig. 5). The indications were found to emanate from under a docking block is shown in Figure 6 (Fig. 6).

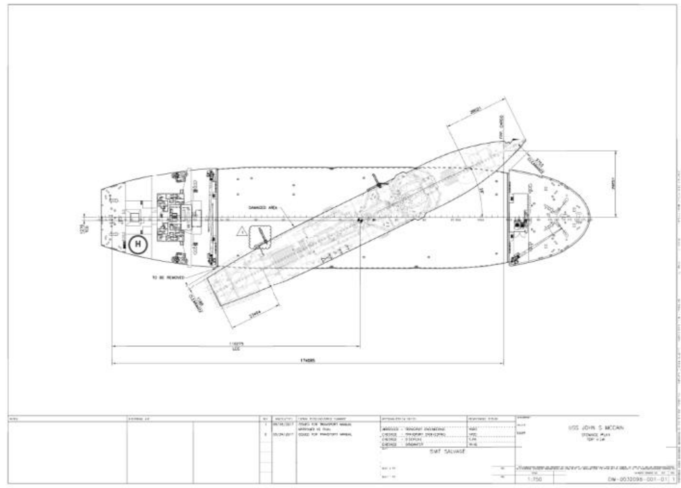


Fig. 4 - Position Layout of USS John S. McCain aboard MV Treasure

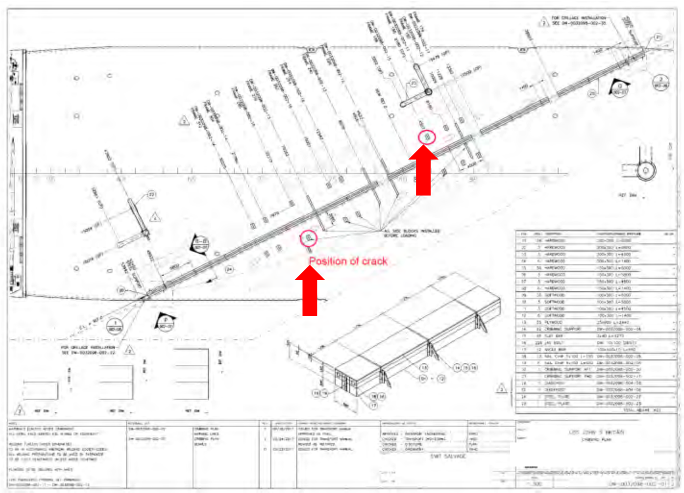


Fig. 5 - Location of liner indications under docking blocks

Fig. 6 – Linear indication under the docking block

The naval architect with Naval Sea Systems Command's (NAVSEA) Supervisor of Salvage and Diving (SEA00C) used the POSSE code to determine loading on the blocks in question. Based on the field observations, the model was run with both the spur shores in good contact and without contact. The resulting load on the blocks into the hull is summarized below:

As-Designed (without spur shores):
Static Load, 0-degree heel: 40.5 long tons (LT) per block
(based on 16 total side blocks (8 per side) and 8 cradles (4 per side) with 15-percent of total displacement)
5-degree heel: 87.6 LT per block
(same as above Static Load with 5-degrees of static heel loading added)
With eight side blocks (without spur shores):
Static Load, 0-degree heel: 54.5 LT per block
(based on 8 total side blocks (4 per side) and 8 cradles (4 per side) with 15-percent of total displacement)
5-degree heel: 117.9 LT per block
(same as above Static Load with 5-degrees of static heel loading added)

Table 1 – Block Loads

Block Loads	
LT	psi
40.5	108
54.5	146
87.6	234
117.9	315

Fatigue properties for DH-36 Marine Steel

BACKGROUND DATA ON WELD FATIGUE FRACTURE

Loading on the Hull was from almost zero to σpeak due to 5-degree roll
Cyclic loading to initiate fatigue is defined from experimental data
DH-36 maximum stress for infinite life is 21,600 pounds per square inch (psi)
This is base material.

Fatigue strength in weld areas is evaluated by:

Type of Weld – Butt Weld
Loading through weld – Bending
Level of Inspection – on DDG's hull welds are only 10-percent non-destructive testing (NDT) inspected.
Resulting reduction factor is 0.35 = 7,564 psi
Referenced from National Welding institute
Telecom with CAPT William Roth, USN – NAVSEA Reserve welding subject matter expert.
Paper: NSWCCD-65-TR-2016-18 Chiu Czyryca HTS-HY Fatigue Tanks

WELDED JOINTS

Weldments, by their very nature are problematic. Their geometric shape is difficult to control, and the part-to-part variations can be high. The resulting weld material and region local to the weldment exhibits varying properties which are difficult to quantify. The amount of heat required to achieve a satisfactory weld causes not only local distortions, but distortions in adjacent features such as flanges, pilots, etc. In addition, the weld material shrinks as the molten metal solidifies resulting in a part-shape change.

The designer can choose factors of safety or permissible working stresses with more confidence if he or she is aware of the values of those used by others. One of the best standards to use is the American Institute of Steel Construction (AISC) code. The permissible stresses are based on the yield strength of the material instead of the ultimate strength.

Table 2 - Stresses Permitted by the AISC Code for Weld Metal

Type of loading	Type of weld	Permissible stresses
Tension	Butt	0.60 Sy
Bearing	Butt	0.90 Sy
Bending	Butt	0.60-0.66 Sy
Simple compression	Butt	0.06 Sy
Shear	Butt or Fillet	0.35 Sy

HIGH CYCLE FATIGUE (HCF):

For welded features subjected to high-cycle, low-load conditions, the criteria for HCF life should be handled in the following manner.

The stress intensity factor for the high cycle stress component should remain below the threshold level for the material throughout the intended design life of the part. The cyclic fatigue in the stress-strain (S-N) Curve for DH-36 is shown in Figure 7 (Fig. 7) with the butt weld knockdown overlaid by the lower curve. The allowable bending stress for infinite life (in bending) of the base material is 21,610 psi.

For a weld, the base material properties must be multiplied by the knockdown factor of 0.35 to obtain the maximum cyclic stress. For bending in a butt weld for infinite life, the resulting calculation is 7,564 psi.

This is the cycle stress level that will cause linear indications to be initiated. For any cyclic stress above 7,564 psi, the bending stress in a butt weld has the potential for a linear indication to be initiated in the area of the weld.

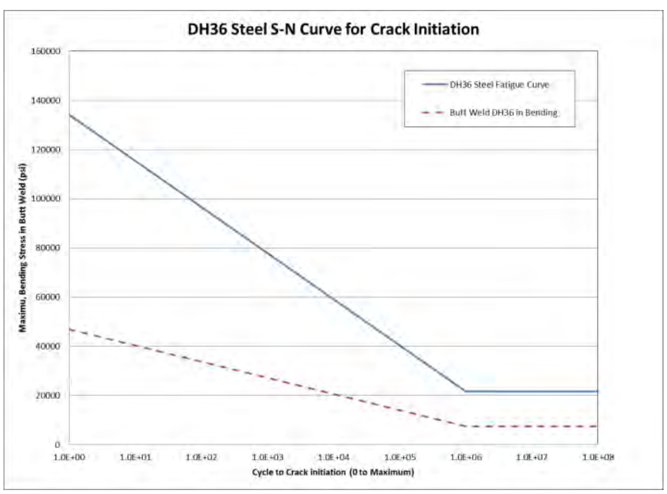


Fig. 7 – S-N Curve for DH-36 Plate and DH-36 Welds

Modelling of the hull structure for USS John S. McCain was developed from the as-built drawings from Bath Iron Works, Inc. These drawing defined the plate material type, thickness and location of welds. This data was then used to develop a three-dimensional solid model in the AutoCADTM Inventor software. The resulting model of the hull in the area supported by the docking block is shown in Figure 8 (Fig. 8).

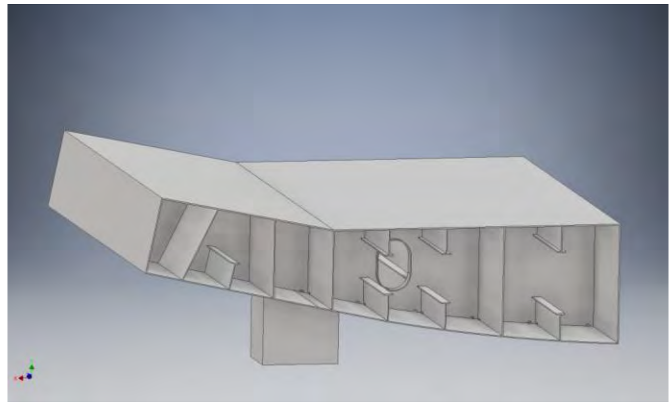


Fig. 8 - AutoCADTM Model of Frame 286 Hull Structure

This model was then pulled into ANSYSTM finite element analysis (FEA) modeling software and laid out so that the structure could be meshed with higher-order elements with at least three elements through the thickness of each plate, so the bending stress could be accurately calculated. To develop the understand of the location of the docking blocks relative to the stringers and transverse frames, the docking block was moved forward and aft, and inward, toward the ship's keel. This is shown in Figure 9 (Fig. 9).

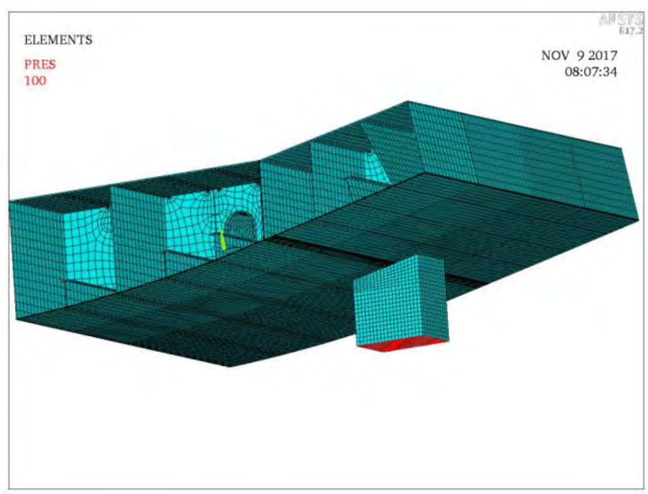


Fig. 9 - ANSYS Model Mesh of Frame 286 Hull Structure

Results of the FEA models for each of these cases defined previously are solved in the ANSYSTM finite element program. The original location of the docking block where the hull linear indications appeared is shown in Figure 10 (Fig. 10). From this, it can be seen that the stresses are focused in the base material under the stringer. However, these stresses are high enough to cause linear indications in the base material.

The stresses in the weld area are shown in the right side of Figure 10 (Fig. 10). The bending stresses in the weld cycles as shown in Figure 11 (Fig. 11). When the block is moved to be centered on a transverse frame, the resulting stresses in the base metal and the butt weld area are shown in Figure 12 (Fig. 12). These stresses are significantly higher in fatigue stresses that that which can be handled for infinite life of a butt weld in a bending condition. To illustrate how the cyclic loading can affect any butt weld, based on the amount of cyclic loading in a given docking block can cause in the butt weld is shown in Figure 13 (Fig. 13).

As previously calculated, any cyclic stress above 7,564 psi would cause linear indications and is therefore colored red. The numbers that make up Figure & (Fig. 7) are shown Table 3. Table 3 also shows that the maximum pressure load on the hull, when not on a transverse frame, is equal to 174 psi. The 174 psi peak pressure is equal to a peak load of 147,779 pounds of loading on a given docking block. This process was repeated for a six-foot-on-center transverse frame hull structure. This is summarized in Figure 14 (Fig. 14) and Table 4. The peak cycle load on a given docking block was 177 psi for this spacing. When the block is centered on a transverse frame but moved inboard, the stress does not result in cyclic stress values that would cause hull linear indications.

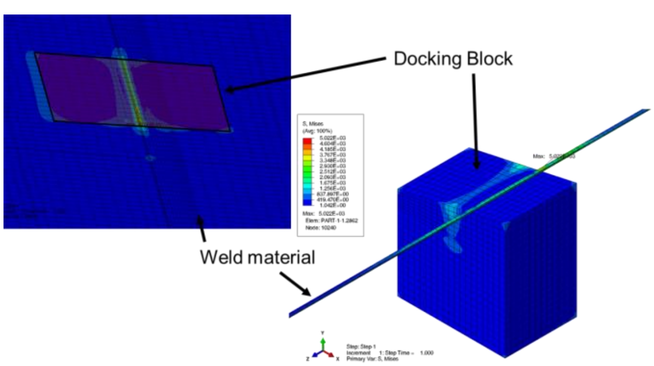


Fig. 10 - Block Centerline Positioned 24-inches from a Transverse Frame

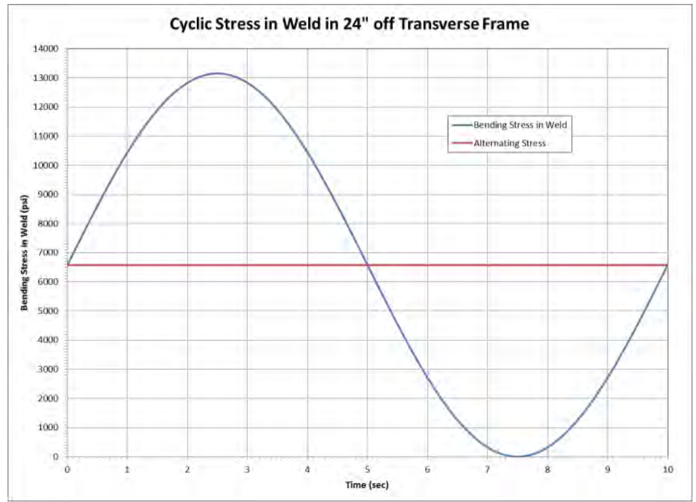


Fig. 11 - Cyclic Stress in a Weld under Docking Block

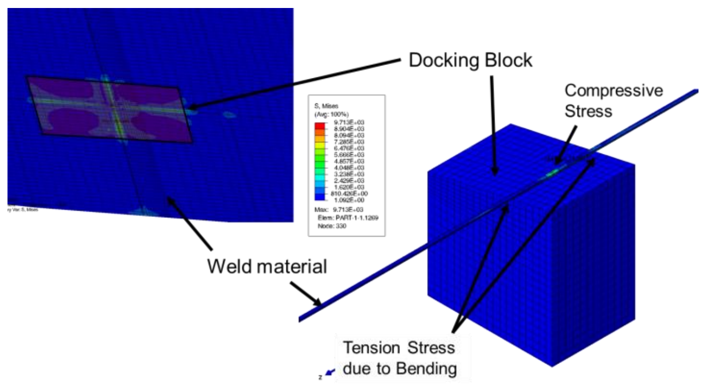


Fig. 12 - Block Centerline Positioned at a Transverse Frame

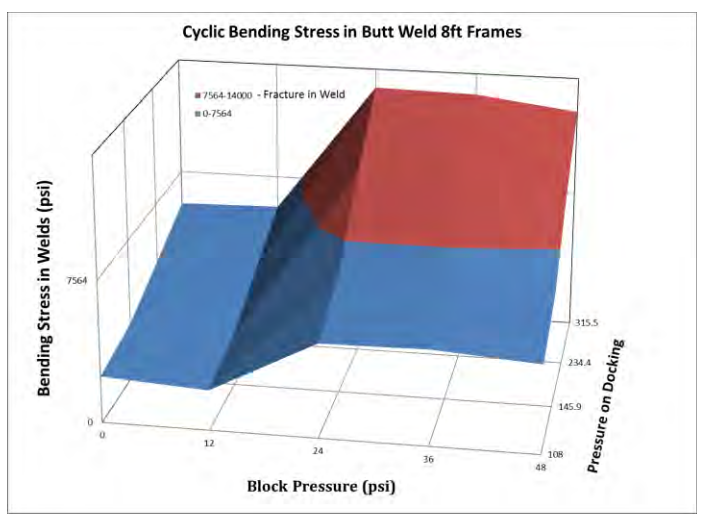


Fig. 13 - Combined Results based on Block Pressure (8-foot frame spacing)

Table 3 – 8-foot Hull Transverse Frame Spacing

8 ft Transverse Frames					
	Bending Stress in Weld Material (psi)				
Center line of Block to Center line of the Transverse Frame (in)	Mean Stress (psi) with Side Support	Mean Stress (psi) without Side Support	5 deg roll Stress (psi) with Side Support	5 deg roll Stress (psi) without Side Support	
	108	145.9	234.4	315.5	
0	2484	3013	4329	5700	
12	2145	2769	4311	5812	
24	5022	6395	10000	12970	
36	5096	6397	10049	12850	
48	4724	6038	9488	12150	
				Allowed Cyclic Stress (psi)	Block Pressure (psi)
			Block Between Frames	7564	174.2
			Block at Frame	7564	370

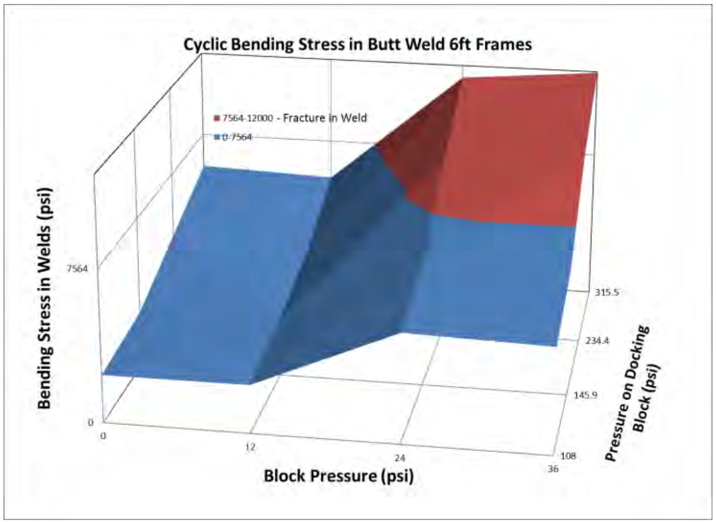


Fig. 14 - Combined Results based on Block Pressure (6-foot frame spacing)

Table 4 – 6-foot Hull Transverse Frame Spacing

6 ft Transverse Frames					
	Bending Stress in Weld Material (psi)				
Center line of Block to Center line of the Transverse Frame (in)	Mean Stress (psi) with Side Support	Mean Stress (psi) without Side Support	5 deg roll Stress (psi) with Side Support	5 deg roll Stress (psi) without Side Support	
	108	145.9	234.4	315.5	
0	2373	2760	4311	5812	
12	2387	2887	3809	5556	
24	5414	6363	9038	11362	
36	5231	6290	9847	11947	
				Allowed Cyclic Stress (psi)	Block Pressure (psi)
			Block Between Frames	7564	177.6
			Block at Frame	7564	370

CONCLUSION

The following recommendations should be incorporated in a revision to the heavy lift section of the US Navy Tow Manual.

- If the block is not located at a transverse frame, the maximum pressure load that a block should take and not cause linear indications in the hull welds is 174 psi.
- If the block is located on a transverse frame, the maximum block pressure can be 370 psi.
- These block pressures should be calculated for a given roll of the heavy lift ship and with the worst-case loss of support from the side supports.

Appendix O – Proposed Changes to Chapter 8

Based on the lessons learned from the heavy lift of USS John S. McCain and of USS Fitzgerald, several changes have been proposed to Chapter 8 of the US Navy Tow Manual. The list below is not exhaustive, but covers the major findings:

- Compressive load on the blocks too large – change 800 psi to 370 psi.
- Longitudinal acceleration too large – consider Chapter 8 treatment of surge acceleration.
- Place blocks on the frames of the lifted ship – consider using docking blocks for onload and additional blocks located at frames for transit.
- When installing sea fastening (shoring), list ship at least 1 degree to the opposite side of installation to allow pressing blocks or shoring tight. Alternate port and starboard and blocking and then shoring.
- Include example calculations for various HLV to cargo alignments.

Appendix P : Instrumentation Report

1. INTRODUCTION

NAVSEA 00C deployed a strain monitoring system on the USS FITZGERALD and the USS JOHN S MCCAIN to collect strain, acceleration, and displacement data and evaluate the effects of static and dynamic forces on the ships and heavy lift vessels during the heavy lift operations and transport. The strain monitoring system was installed on the USS JOHN S MCAIN at Subic Bay, Philippines, after the blocking modifications were completes on the MV TREAUSURE. It was installed on the USS FITZGERALD at Yokosuka, Japan, immediately after the onload to the MV TRANSSHELF. In addition to the sensor monitoring system, NAVSEA 00C also installed the Smart TOW system on the USS FITZGERALD.

The Navy Reserve Heavy Lift (NR HL) unit provided support for the testing of the strain monitoring system at the Emergency Ship Salvage Material (ESSM) facility at NWS Yorktown Cheatham Annex and for the system deployment at Subic Bay and Yokosuka.

2. SYSTEM DESCRIPTION

The strain monitoring system includes a computer monitoring station, a data collection module, a battery/power module, strain gauges, accelerometers, displacement sensors, and repeaters.

The computer monitoring station is installed within communication range of the deployed sensor, preferably inside the heavy lift vessel. The battery/power module is enclosed in a weather resistant case and can be installed outside of the heavy lift vessel, provided there is available conduit routed to the computer monitoring station. The data from each deployed sensor is sent to the computer monitoring station via RF link. The sensor network configuration can be direct (single hop) or through a repeater (multi hop) depending on the distance and obstructions between the deployed sensors and the monitoring station. The data collection module can also be paired with the sensors and continuously record data during transport. The system also accommodates an optional satellite communication module and antenna to transmit the data to shore operators during transit. When installed, the communication antenna also needs a conduit or path to route to connect to the computer monitoring station.

The number of sensors of each type of sensor included for a specific deployment depend on the number of locations to be monitored to obtain relevant information on the effects of static and dynamic forces on the ships being transported as well as the dimensions and type of ships. Figures 2.1 and 2.2 show the sensor configuration used for the USS FITZGERALD. In this case, the following was used:

- 3 accelerometers on the weather deck of the ship.
- 3 accelerometers on the pontoon deck of the heavy lift vessel.
- 6 strain gauge sensors on the weather deck of the ship.
- 16 strain gauge sensors on the hull of the ship (next to selected side blocks).
- 4 displacement sensors between the hull of the ship and the selected side blocks.
- 2 displacement sensors between the hull of the ship (fore and aft) and the pontoon deck of the heavy lift vessel.

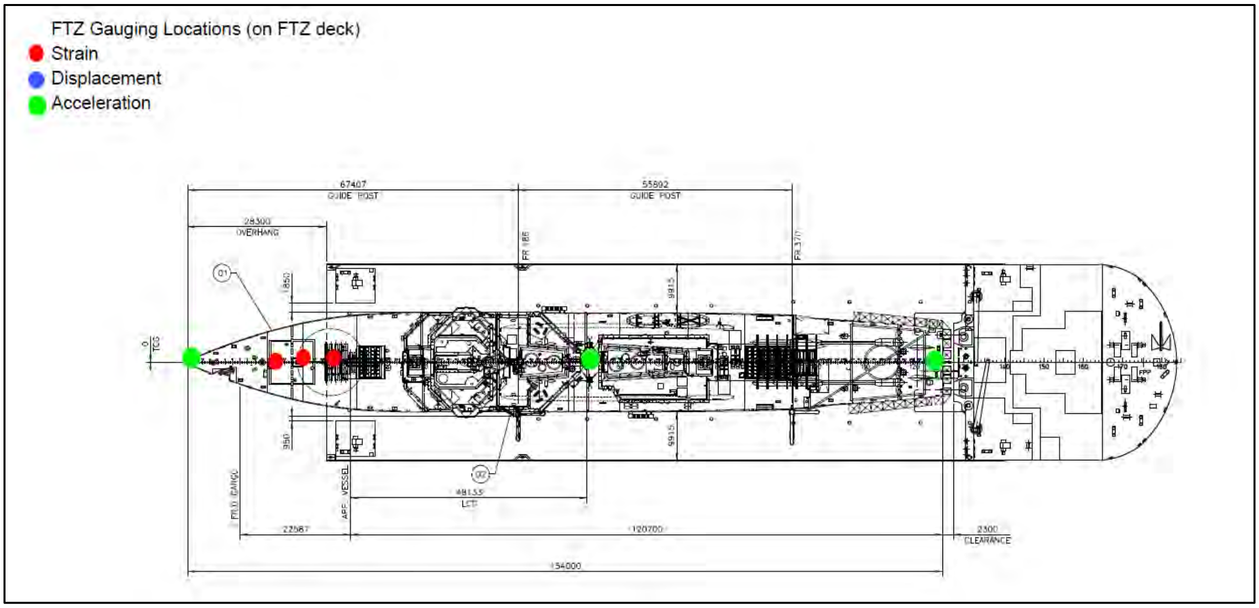


Figure 2.1 – Sample sensor deployment on weather deck of a DDG prior to transport.

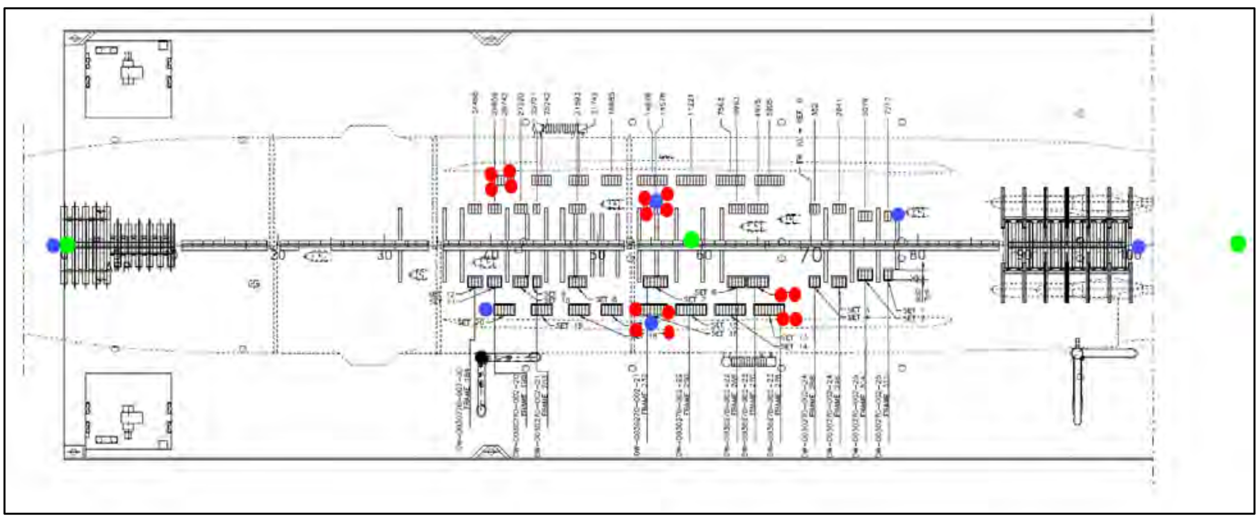


Figure 2.2 – Sample sensor deployment on hull and blocking system of a DDG prior to transport. The accelerometers (green dots) are located on the heavy lift vessel pontoon deck.

3. DEPLOYMENT AND INSTALLATION

3.1. SYSTEM DEPLOYMENT ON USS JOHN S MCCAIN (Subic Bay, Philippines)

The deployment and installation of the strain monitoring system on the USS JOHN S MCCAIN took place between 16 Nov and 26 November 2017 by NAVSEA 00C, ESSM, and USNR personnel.

The computer monitoring station for the sensor system was installed in and operated from the Ballast control room of MV TREASURE (aft of the vessel) with the RF antenna link facing forward of the heavy lift vessel of the heavy lift vessel and facing the USS JOHN S MCCAIN as she laid on the blocks. The strain gauges, accelerometers, and displacement sensors were configured in a single hop network communication directly to the data collection module collocated with the computer monitoring station.

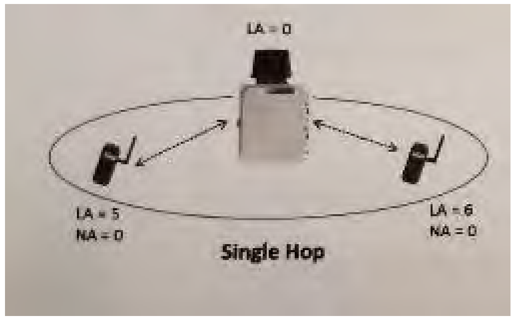


Figure 3.1 – Sample single hop network configuration as used on the system deployment on the USS JOHN S MCCAIN.

The individual sensors were mounted to the deck or the hull of the ships with strong magnets which provided flexibility in the selection of location of the measurement points. This is advantage in regards to the challenges of balancing the requirement for proximity to the points of interests (blocks, stressed deack areas) and the requirement for optimal location for RF network connectivity. The following figures show samples of the sensor system installation.

Figure 3.2 – Accelerometer installed at the fore section of the MV TREASURE pontoon deck.

Figure 3.3 – Displacement sensor installed on the hull of the USS JOHN S MCCAIN

Figure 3.4 – Accelerometer installed on the bow of the USS JOHN S MCCAIN

3.2. DEPLOYMENT AND INSTALLTION (Yokosuka, Japan)

The deployment and installation of the strain monitoring system and the Smart TOW system on the USS FITZGERALD took place between 18 Nov and 26 November 2017 by NAVSEA 00C, ESSM, and USNR personnel.

The computer monitoring station of the sensor system was setup on the bridge of the heavy lift vessel (forward of the vessel) near the ballast control console with the RF antenna facing aft toward the USS FITZGERALD as she laid on the blocks. The sensor system was configured in a multi-hop network configuration with one repeater deployed as a relay between some of the obstructed sensors and the data collection module collocated with the computer monitoring station. The smart TOW system was also installed with the smart TOW sensors inside the USS FITZGERALD and its control station also on the bridge of the MV TRANSSHELF.

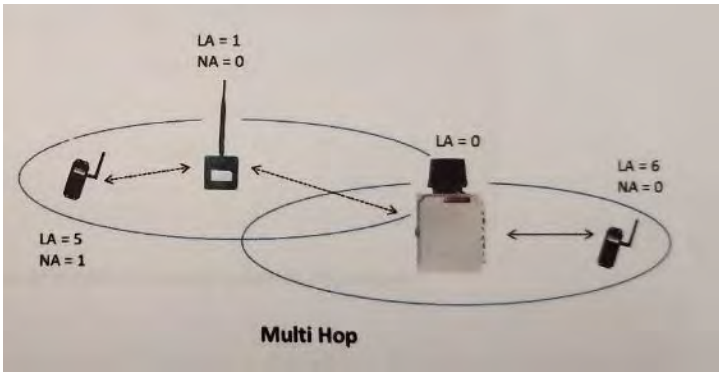


Figure 3.5 – Sample single hop network configuration as used on the system deployment on the USS FITZGERALD.


Figure 3.6 – Control station setup on the bridge of the MV TRANSSHELF for the strain sensor system and smart TOW deployed for the USS FITZGERALD heavy lift transport.


Figure 3.7 – Strain gauges installed on the hull of the USS FITZGERALD.

4. FOLLOW-ON

The installation of these first of a kind sensor system was completed in parallel with onload and blocking activities that presented logistical challenges and risks. However, there is no known impact on the evolution schedule, personnel, or ships involved. It would be beneficial for future heavy lift evolutions to include and set aside time on the schedule for the sensor system installation after the completion of the blocking system and sea fastening on the heavy lift vessel.

Additionally, it will improve the quality and continuity of data collection to have an engineer ride on the heavy lift vessel, at a minimum, for the first few days of transit to complete the optimization of the system and confirm the system health status.

The data collected b with the deployed sensor system is under evaluation by NAVSEA 00C and ESSM personnel and will inform future evolutions as well as provide updated information of impact of heavy lift transport on US NAVY ships and assets.

Appendix Q: Lessons Learned

NAVSEA 00C Lessons Learned

1. Title: Salvage Engineering Standards

Observation: Shipbuilding specifications are not appropriate for salvage operations.

Discussion: NAVSEA 05 analysis and approval of salvage engineering decisions caused delay. Real time salvage responses do not always allow time for extensive deliberation or the need of ship building standards and specifications.

Recommendation: A clear distinction between salvage authority and repair authorities is needed.

2. Title: Heavy Lift Detachment Communications

Observation: The heavy lift team could have been more efficient if there was someone dedicated to managing their internal reporting and external communications.

Discussion: Having an individual dedicated to receiving and compiling each day's reports and forwarding them to NAVSEA 00C and preparing engineered reports or tracking down technical data to support the team's analysis efforts would make the engineers on site more effective and help keep NAVSEA 00C management apprised of developments and accomplishments.

Recommendation: NAVSEA 00C Heavy Lift Detachment assign someone to manage communications and develop visual graphic communications on major salvage/heavy lift operations.

3. Title: Heavy Lift Marketplace

Observation: Heavy lift operations are subject to platform availability and market forces.

Discussion: Fleet Commanders had incorrect expectations with respect to heavy lift platform availability. This perceived urgency expedited the schedule and increased technical risk, resulting in the selection of a suboptimal heavy lift platform for USS John S McCain.

Recommendation: Conduct a thorough survey of commercial heavy lift assets to understand the market availability of platforms ideally suited to lift the damaged vessel and optimize the schedule of the repairing shipyard. Brief the results of this survey to Fleet and NAVSEA leadership prior to selection of the lift asset. Where possible, Fleet and NAVSEA Commanders should plan based on the availability of the best-suited platform available in the required window.

4. Title: Contracting for Heavy Lift

Observation: At NAVSEA direction, SMIT mobilized Dockwise to conduct the heavy lift of USS John S McCain from Singapore to Yokosuka. Once on contract, Dockwise began billing the U.S. Navy for MV Treasure.

Discussion: This accelerated mobilization resulted in a cost-plus contract instead of a negotiated fixed-price contract, which substantially increased costs. This is in conflict with the standard procedure to commence billing after approval of the Transport Plan. SMIT did not follow NAVSEA 00C heavy lift team direction to establish a fixed-price contract for the lift.

Recommendation: NAVSEA 00C should specify fixed-price terms for subcontracting.

5. Title: Blocking for Heavy Lift

Observation: U.S. Navy Towing Manual prescribes using the Ship's Docking Plan to identify the location of side blocks supporting the load. That support was inadequate for the angled lift and sea state combination, resulting in hull plate fatigue failure during USS John S McCain's transit.

Discussion: It was determined that blocks should be located at intersection of frames and longitudinal members to support the predicted load. Section 4-3 discussed damage and lessons learned and Appendix N addresses block loading and the maximum pressure that should be on a ship's hull.

Recommendation: Complete changes to U.S. Navy Towing Manual to prescribe the location of blocks that will provide proper support to a ship during heavy lift and transit. (Intersection between longitudinals and frames and sufficient number to reduce potential for overloading blocks).

6. Title: Securing the Load

Observation: During the transit to Yokosuka, inspection of the damaged vessel revealed a crack in the USS McCain hull above the sideblock on frame 286 and multiple spur shores were no longer in contact with the hull.

Discussion: It was determined that the hull of MV Treasure flexed either while drifting as waves from Tropical Depression Lan passed to the east or while ballasting after installation of seafastening. After diverting to Subic Bay, Philippines and conducting enhanced seafastening, the procedure for tightening the blocks and shore spurs was changed. In Subic Bay, the cargo ship was healed to starboard and port blocks tightened (with hydraulic jacks) and then the ship was healed to port and the starboard side blocks were tightened. Then the process was repeated to tighten the shore spurs (both port and starboard).

Recommendation: Document the enhanced seafastening procedures in the U. S. Navy Towing Manual to ensure all future heavy lifts have their blocks and shore spurs tightened using this technique.

7. Title: Timely Receipt of Transport Manual

Observation: Dockwise delivered the final USS Fitzgerald Transport Manual on 4 November, 21 days after its scheduled delivery date. This delay resulted in limited time to conduct the review, limited time for Dockwise to respond to noted deficiencies, and limited time to evaluate the readiness of MV Transshelf as the teams worked to prepare for the onload. (Section 5-5) During the review and evaluation, the NAVSEA Heavy Lift team conducted many measurements and calculations verifying the block and guides posts were properly prepared for USS Fitzgerald, but did not physically measure the installed grillage where upon loading and deballasting, it was discovered the grillage had punctured USS Fitzgerald's hull at frame 346. (Section 5-5.6)

Discussion: The Heavy Lift team would have time for a more thorough evaluation of the sea fastening components if the Transport Manual was delivered on time.

Recommendation: Do not proceed to onload until all ship to seafastening interfaces are completely validated. Recommend changing Towing manual to specify suitable period for this evaluation.

8. Title: USS Fitzgerald Shore Removal

Observation: Shore removal plan was not followed during offload of USS Fitzgerald. Too many shore spurs were removed before MV Transshelf was moved to the ballasting pit.

Discussion: NAVSEA Heavy Lift Team members needed to be onboard and monitoring the removal of seafasteners to ensure the plan published in the Transport Manual was being followed.   After arrival of the Heavy Lift Team, it was determined the required number of shore spurs were not installed to permit the ship's movement from its anchorage to the ballasting pit. A number of spurs had to be reinstalled to permit movement.

Recommendation: Having Navy Heavy Lift team on board will ensure the plan as established by the Transport Manual is followed.

9. Title: Monitoring Hull Movement During Transit

Observation: After the initial transit of USS John S McCain and under-block damage, SUPSALV tasked ESSM to develop a kit to instrument vessel's movement during the remaining passage to Yokosuka. The instruments were installed in Subic Bay and allowed documentation of measured movement of the lifted ship within the seafastening for the second half of the transit.

Discussion: This quantitative measurement of movement provided feedback to the heavy Lift team and the heavy lift carrier on the effectiveness of the installed seafastening.

Recommendation: Continue to use the seafastening instrumentation on future heavy lift evolutions to validate seafastening effectiveness.

Lessons Learned relating to USS Fitzgerald (DDG 62) from WestPac Salvage Team

1. TITLE: Emergency Ship Salvage Material (ESSM) Site Location(s)

OBSERVATION: ESSM Site Sasebo equipment that was mobilized from Sasebo was critical to the success of the operation. It was convenient that trucking items from Sasebo to Yokosuka is a common occurrence.

DISCUSSION: When incidents like this occur, it is critical to begin moving salvage capability as soon as possible. This operation had the advantage of being in close proximity to the ESSM warehouse. In a more austere environment, the logistical challenges will be greater and will likely require senior leadership involvement to prioritize salvage material movements.

RECOMMENDATION: Recommend C7F N4 and N5 staffs assess whether current C7F AOR ESSM sites meet operational needs given the logistical challenges; provide assessment to Supervisor of Salvage (NAVSEA 00C)

2. TITLE: Emergency Ship Salvage Material (ESSM)

OBSERVATION: ESSM equipment lacked a few key components which would have improved salvage response.

DISCUSSION: All ESSM pumps shipped lacked the ability to integrate to ships threaded over board discharge lines. This capability would shorten discharge hoses and gain the use of full capability of the pumps during operations as discharge head would decrease. The ESSM underwater cutting equipment did not contain welding/cutting lenses or shields for the KM-37.

RECOMMENDATION: Recommend Supervisor of Salvage (NAVSEA 00C), coordinating with C7F Salvage Officer and Salvage Master Diver, assess the inventory of particular ESSM kits based on FTZ salvage operation.

3. TITLE: Battle Damage Repair (BDR) Pre-positioned Kit

OBSERVATION: The BDR equipment pre-positioned in Singapore was not utilized because it was deemed unnecessary for the operation.

DISCUSSION: The BDR Pre-positioned Kit inventory was reviewed but deemed unnecessary to mobilize in support FTZ salvage operations. This assessment was partially due to the work being done at Fleet Activities Yokosuka with Ship Repair Facility Yokosuka collocated. This assessment was also partially due to the lack of utility of the equipment. The contents of this gear, aside from the surface supplied dive system, do not greatly enhance capability for salvage/BDR. Additionally, in a more austere environment, items like ventilation and temporary power, which are not currently in the kit inventory, would be critical to support salvage operations. The BDR Pre-positioned Kit is currently funded and maintained by Southwest Regional Maintenance Center (SWRMC).

RECOMMENDATION: Recommend the C7F Salvage Officer evaluate the BDR Pre-positioned Kit inventory and provide recommended changes to SWRMC via CPF with Supervisor of Salvage informed. Recommend C7F Salvage Officer, in conjunction with C7F N5, evaluate the numbers and location(s) of BDR Pre-positioned Kit(s) and provide recommendation to CPF.

4. TITLE: Salvage Operation Site Conditions

OBSERVATION: FTZ salvage operations located at Fleet Activities Yokosuka, with Ship Repair Facility Yokosuka collocated, eliminated or reduced challenges which would exist in nearly every other port within C7F AOR.

DISCUSSION: Had the ship been in a more austere port there would have been significant challenges to supporting the salvage operation. Additionally, if this had been an actual BDR mission in a Phase II environment, there would likely be other salvage requirements throughout the AOR which would require prioritization and pushing responsibility for execution to lower levels. It is also uncertain if contracted divers would be able to access a semi-permissive environment to conduct the repair work which will put the responsibility squarely on Navy Divers (i.e., Mobile Diving and Salvage Units).

RECOMMENDATION: Recommend C7F N5 and subordinate unit staffs develop plans/concepts of operations for large ship salvage operations in more austere environment. Recommend including plans into existing exercises to identify what additional support for personnel and material is needed and from where it can be provided.

5. TITLE: Salvage Patch Design

OBSERVATION: The patch design had to be changed after installation was already in progress. Additionally, the patch design was very conservative due to a lack of analytical tools to rapidly assess the ability of the patch to meet the requirements.

DISCUSSION: The initial patch design did not call for stiffeners. Further design review identified a critical calculation error in the initial assessment that stiffeners were not required. Stiffeners were added to the design but the welding of plate on the hull was already in progress; increasing the time required to install the patch significantly. Additionally, it was difficult to analyze the patch as anything but a flat patch in the short time available. This analysis led to an overly conservative design which did not account for the additional stiffness afforded by the curvature of the hull. The only way to analyze the patch with curvature would be to do FEA. While FEA is highly capable, it takes time which is often the constraint.

RECOMMENDATION: Request NAVSEA, through NAVSEA 05 and NAVSEA 00C, develop tools and/or procedures for rapidly assessing strength and stiffness of complex (non-flat) patches.

6. TITLE: Salvage Operation Command and Control

OBSERVATION: The operational command and control structure of the salvage was complicated by the location of the salvage operation.

DISCUSSION: Since the ship salvage operation was at Fleet Activities Yokosuka, collocated with Ship Repair Facility (SRF) Yokosuka, there was heavy SRF, CPF N43, and NAVSEA involvement while the salvage team remained under C7F and CTF 73. The supported/supporting relationships were not clear during the phases of the operation. The C7F Salvage Officer concurred with the actions of CPF N43 and SRF due in large part to the capability available at Fleet Activities Yokosuka with SRF. However, in other locations or with other personnel/personalities, significant command and control issues could arise.

RECOMMENDATION: In future salvage operations, C7F issue a TASKORD or other order delineating Salvage Operation Command and Control or submit request for assistance to CPF in accordance with OPNAVINST 4740.2.

7. TITLE: Lack of Immediate Knowledge of Damage Control Status

OBSERVATION: During the first 72 hours, ships' force unable to report to C7F Salvage Officer and Salvage Team the damage control actions taken and the status of the ship.

DISCUSSION: Ship's Force personnel were removed from the ship shortly after arrival at Fleet Activities Yokosuka and replaced with standby crews of sailors from various ships on the waterfront. Removing the crew made it extremely difficult for the C7F Salvage Officer and Salvage Team to understand the damage control status of the ship. Salvage Team was unable to understand current valve line-up, verify suctions, verify discharges, and other key information required for safe diving operations.

RECOMMENDATION: Recommend ISIC retain key Damage Control personnel with the ship in the immediate days following an incident to ensure sufficient information exchange with C7F Salvage Officer and Salvage Team, ensure proper Damage Control actions, and to ensure proper turnover with relief. Recommend any reliefs of Damage Control personnel should acquire and maintain situational awareness of the casualties and maintain a log which details the casualties and DC efforts.

8. TITLE: Tactical Command and Control of Salvage

OBSERVATION: Robust communication framework between the C7F Salvage Officer/Salvage Team and key Ship's Force Damage Control personnel was not in place

DISCUSSION: Ship's Force personnel were removed from the ship shortly after arrival at Fleet Activities Yokosuka and replaced with standby crews of sailors from various ships on the waterfront. The crew appeared to lack clear direction once they returned to the ship creating additional communication challenges for the Salvage Team. Multiple incidents occurred where spaces were re-flooded by crew after the spaces were dewatered by the Salvage Team.

RECOMMENDATION: Recommend C7F Salvage Officer or Senior Salvage Team Representative immediately link with the Commanding Officer or empowered designated representative to establish tactical command and control and communication plan. Recommend C7F Salvage Officer or Senior Salvage Team Representative immediately obtain information regarding:

- Extent/Assessment of damage
- Actions taken to mitigate worsening of casualty
- Material condition of the vessel
- Primary/Secondary/Tertiary areas of concern

Recommend ISIC retain key Damage Control personnel with the ship in the immediate days following an incident to ensure proper turnover with relief.

9. TITLE: Damage Control Material Condition

OBSERVATION: Damage Control Material Condition issues were identified during the salvage operation which were pre-existing to the incident.

DISCUSSION: Main Machinery Room (MMR) escape trunk hatches discovered to be welded shut or removed and bolted shut. Inoperable escape hatch discovered in Berthing 1 and 2. During de-flooding efforts divers discovered port side watertight hatch unable to be opened by single person below the hatch. Watertight door connecting VCHT and IC Gyro found with loose fittings, resulting in flooding of adjacent compartment.

RECOMMENDATION: Recommend ISICs conduct increased oversight of assigned ships' damage control material conditions focusing on escape hatches and watertight doors.

10. TITLE: Damage Control Knowledge, Skills, and Abilities

OBSERVATION: Inadequate knowledge, skill, and ability of Basic Damage Control

DISCUSSION: Shoring located on starboard side above and forward of Berthing 1 and 2 was found to be improperly placed, resulting in caving in of bulkheads. Deck drains in Berthing 1 and 2 not secured, resulting in flooding of adjacent compartments.

RECOMMENDATION: Recommend reassessment of “Buttercup” and follow-on training regarding shoring. Recommend ISICs conduct increased oversight of assigned ships’ damage control readiness in setting other conditions in addition to ZEBRA.

11. TITLE: Berthing Logs

OBSERVATION: Inaccurate berthing logs meant Ship’s Force was unable to verify number of personnel living in spaces adding challenges to recovery operations.

DISCUSSION: See observation.

RECOMMENDATION: Recommend ISICs conduct increased oversight of assigned ships’ berthing assignments.

12. TITLE: Ship Mooring Location

OBSERVATION: FTZ was moored at the only berth in Yokosuka with adequate water depth for an aircraft carrier.

DISCUSSION: While the mooring location had benefits for the salvage operation, the potential of the ship sinking pierside was not considered. Fouling the only aircraft carrier pier in Yokosuka could create significant logistical and maintenance issues for the aircraft carrier.

RECOMMENDATION: Future decisions about where to moor a heavily damaged ship should take into account the implications if the ship were to sink at the pier and render that berth unusable. This would be of particular importance in a battle damage/wartime situation.

Lessons Learned relating to USS John S McCain (DDG 56) from Westpac Salvage Team

1. TITLE: Dive and Salvage Team Berthing

OBSERVATION: The lack of organic berthing at Changi Naval Base required 24/7 manned operations due to excessive travel/response times from lodging.

DISCUSSION: A team of divers was required to be able to respond in case one of the patches failed. There was no lodging close enough to Changi Naval Base to comfortably allow for an on-call response so 24/7 dive team manning at the ship was required.

RECOMMENDATION: Investigate ESSM staging berthing boxes and C2 vans at all ESSM locations. Also consider utilizing another vessel for berthing divers (e.g. EPF).

2. TITLE: ESSM Warehouse Organization

OBSERVATION: ESSM warehouse in Singapore does not have an adequate inventory labeling system.

DISCUSSION: The inventory system made it difficult for the civilian support contractor to determine what is required and its location when a request is made.

RECOMMENDATION: Evaluate the current inventory and develop a standardized inventory list and labeling scheme to make an easy-to-understand inventory.

3. TITLE: Contaminated Water Diving

OBSERVATION: Diving operations were conducted in fairly hazardous conditions with inadequate protective gear. Dry suits were not available but even if they had been available divers would have rapidly become overheated due to the warm water temperatures.

DISCUSSION: There was a large amount of fuel and human waste in the water that divers were in. A decontamination station was set up but divers still had issues with skin rashes and dermatitis.

RECOMMENDATION: Expand ESSM inventories to incorporate contaminated water diving kits. A best practice was adjusting the shaving for divers to ensure they are not clean shaven on their diving day. Also evaluate the possibility of warm water contaminated water diver's dress.

4. TITLE: USS AMERICA (LHA 6) Assistance

OBSERVATION: AMERICA's on-site assistance was extremely beneficial providing food, water, tooling, and consumables to diving and salvage team. Without this support, operations would have been delayed while acquiring the needed items.

RECOMMENDATION: During future salvage operations continue to utilize other fleet assets for support.

5. TITLE: ESSM Skimmer Kits

OBSERVATION: ESSM inventory does not have a small scale skimmer kit.

DISCUSSION: The ESSM POL control box is designed for large spills. To skim fuel off the water in the flooded spaces a contractor was hired. It would have been useful to have small skimmers that could be thrown into a space to skim the fuel off.

RECOMMENDATION: Investigate the feasibility of a procuring small scale skimmer kits and include in the ESSM inventory.

6. TITLE: Dive and Salvage Team Gas Free Engineer (GFE) Support

OBSERVATION: There was a lack of organic GFE support for diving/salvage teams.

DISCUSSION: The ship was able to provide this support without much issue but had they been unable to access some of the compartments without a full diving rig even after water was removed.

RECOMMENDATION: To prevent full reliance on the ship, evaluate the possibility of incorporating GFE certification into Joint Diving Officer (JDO) curriculum or possibility of sending fleet salvage officers and MDSU personnel to GFE certification course.

7. TITLE: HY-80 Welding

OBSERVATION: An area of HY-80 was inadvertently welded by SMIT who was not qualified to weld that material.

DISCUSSION: Areas of HY-80 were identified and this information was passed to SMIT to ensure Phoenix International welders performed welds in these areas due to their qualifications. An area of HY-80 was missed and later determined that SMIT had performed welding in this area. While not a short term concern, that area would be more likely to show cracking due to the improper weld technique used.

RECOMMENDATION: Use multiple levels of verification to identify material locations and ensure appropriate welders and filler materials are used.

8. TITLE: Differences in Designed and As-Built Patch

OBSERVATION: The patch alignment catchers were installed in the wrong location due to the difference between the designed and as-built patch.

DISCUSSION: Due to the complexity of the hull curvature in the area to be patched, there were some differences between the designed and as-built patch. Structurally the patch was stiffer than designed, but the alignment catchers had to be moved due to variation in the locations of the stiffeners due to hull curvature.

RECOMMENDATION: Utilize 3D modeling (CAD) software in design of patches for complex hull curvature. Additionally, take measurements of the as-built patch early so that items can be installed in the proper locations on the hull.

9. TITLE: Bintsuke Performance

OBSERVATION: Bintsuke deteriorated rapidly in the fuel/water mixture.

DISCUSSION: Bintsuke installed as a patching material deteriorated rapidly in the fuel water mixture. This caused reflooding of a dewatered space. To ensure reflooding did not happen again, the bintsuke patch had to be monitored daily to ensure adequacy.

RECOMMENDATION: When using Bintsuke for patching material ensure that extra is on hand and ensure patches are monitored regularly for deterioration.

10. TITLE: Shipboard Work Requirements

OBSERVATION: The salvage contractor (SMIT) did not have an understanding of some of the requirements to do work onboard active Navy ships.

DISCUSSION: Salvage contractors commonly conduct work on abandoned or partially abandoned vessels. This presented an issue on an active Navy ship in regard to fire watches for contractor hot work. The issue was resolved and the contractor provided the required fire watches but there was excessive churn due to the contractor not expecting it.

RECOMMENDATION: Ensure the contractor is aware from the outset of the project that there are additional requirements in doing work on Navy ships and it should be accounted for in estimates and plans.

11. TITLE: Contractor Engineering Support

OBSERVATION: Neither SMIT nor Dockwise (heavy lift contractor) had adequate engineering support for the work that was being done.

DISCUSSION: The contractors for the salvage and heavy lift (SMIT and Dockwise respectively) did not provide adequate engineering support. Engineering deliverables were often delayed and those that were produced did not appear to be based on engineering analysis but were templated from previous work. These issues led to USN personnel doing the engineering work rather than reviewing the contractor’s completed work in order to minimize delays.

RECOMMENDATION: Ensure the contractor is aware of the expectation for them to provide adequate engineering support and completed engineering products.

12. TITLE: ESSM Hydraulic Powered Pumps

OBSERVATION: Hydraulic powered pumps were essential in dewatering spaces.

DISCUSSION: Shipboard installed damage control equipment is inadequate to move the large volumes of water found in fully flooded compartments. Hydraulic powered, 800 GPM and greater pumps were essential in drawing enough suction to assist in seating the patch fully, and overcoming any residual leaks that were not found. Shipboard DC equipment is insufficient in this task.

RECOMMENDATION: Continue to maintain ready equipment at the ESSM warehouses and mobilize this equipment as soon as possible to support a salvage casualty.

13. TITLE: Hydraulic Powered Tools

OBSERVATION: Hydraulic powered tools were essential to success during the recovery phase.

DISCUSSION: The Jaws of Life (cutter/spreader) and cutting wheels greatly expedited the recovery of human remains. These tools were well suited for cutting through and removing berthing debris.

RECOMMENDATION: Include the Jaws of Life in the ESSM warehouses and ensure there are adequate cutting discs in the ESSM warehouses as well.

14. TITLE: Pumping Compensating Water Tanks

OBSERVATION: A list was inadvertently induced when pumping seawater from a compensated fuel tank.

DISCUSSION: When pumping initially started on fuel oil storage tank 5-354-0-F (a tank that runs all the way from port to starboard), only one side of the tank was vented, and the ship began to list because the tank's baffles did not allow the non-vented side of the tank to lower its level.

RECOMMENDATION: When pumping out a compensated fuel tank to empty, ensure that all the vent valves are open.

15. TITLE: ESSM Pumping Kit Connection Fittings

OBSERVATION: Connections had to be fabricated for pumping out of seawater compensated fuel oil storage tanks and for connecting ESSM hoses to through hull discharges on the Damage Control Deck.

DISCUSSION: Any salvage job on a cruiser or destroyer will likely require pumping compensating water (and possibly fuel) from the fuel storage system as these tanks can have a large impact on ship's characteristics. These connections are not common outside of shipyards that typically work on these vessels. Additionally, the through hull overboard discharges do not fit the connections that come in the ESSM pumping kits. Utilizing the through hull discharges for dewatering spaces can reduce the static head the pumps must overcome by 10 ft which increases pump efficiency and effectiveness.

RECOMMENDATION: Utilize the fabricated fittings from John S McCain to create similar fittings and distribute to the ESSM warehouses worldwide.

NAVSEA Reserve Detachment Heavy Lift Unit Lessons Learned

1. Title: Heavy Lift Kit Upgrades

Observation: Upgrades to the heavy lift kit are recommended prior to the next operation.

Discussion: Having additional/upgraded equipment will make the team more effective during future heavy lift operations.

Recommendation:

- Life jackets: The life vests included with the heavy lift kits were complicated to assemble and wear. Recommend providing approved personal flotation devices.
- Provide laser measuring tools to more efficiently determine dimensions and establish baselines.
- Provide weather proof laptop with POSSE installed. Ship models should be pre-loaded onto this computer.

2. Title: Personnel Orders

Observation: Because of the emergent nature of heavy lift missions, Active Duty Special Work (ADSW) orders would make sending Reserve personnel to theater and keeping them there much easier.

Discussion: The amount of time dealing with various funding sources and follow-on orders is a major distraction for heavy lift team members. Also, if constant presence is requested on-site, a single person on ADSW would provide better continuous support while relieving the administrative burden.

Recommendation: Future emergent operations will be covered primarily with long term Additional Duty Training (ADT) funding. This funding will be secured through the NAVSEA Military Programs Office (MPO). Funding through Active Duty for Special Work (ADSW) funding is not feasible given the short-fused nature of emergent operations; ADSW requires significant lead-time to plan and fund. For the same reason, involuntary mobilizations via Title 10 USC 12306 would not be feasible.

In order to simplify and streamline the process of mobilizing reservist for emergent heavy lift operations, the Heavy Lift unit has received additional billets to field 2 seven-person teams. Each team would alternate through longer periods of duty (ideally no less than 30 days) until the heavy lift mission is complete. This will provide a consistent presence, rather than a “revolving door” where new faces arrive at the project every two weeks. Qualified Heavy Lift Project Officer’s (HLPOs) will augment the team once the actual lift and/or offload is imminent.

3. Title: Letters to employers

Observation: A letter from the Commanding Officer of the HL unit personally addressed to employers would go a long way in building the relationship between Reservists and their employers. A follow-up letter of appreciation from NAVSEA 00 or Fleet leadership, would reap additional rewards.

Discussion: This letter would be especially true for HL operations that may be emergent and take officers away from work for long periods. Some unit members have civilian employers who allow them significant flexibility, but many do not. The type of officers required for this mission are typically important to the operation of their civilian employers, who resist losing them for long periods without demonstrated good reason.

Recommendation: Proactive communications are key to mitigating this issue.

4. Title: Data repository

Observation: Dealing with electronic and hard copy data is a significant challenge during operations.

Discussion: The HL team requests a dedicated email address and/or shared location for organizing data in real time. This shared drive should be accessible from personal machines. When established, the shared location should be used by all HL team members.

Recommendation: The HL Unit should research data storage and email options and specify a recommendation to leadership. Care must be used in decisions regarding public storage of limited distribution information.

5. Title: Excepted Mission Status

Observation: A mission that crosses FY or in a period of budget uncertainty should be assigned Excepted Mission Status to avoid fiscal shutdown issues that would affect conduct of the mission.

Discussion: if the operation falls near the end of the FY or before the Authorization Bill is signed, preparing the paperwork for "Excepted Mission Status" is recommended. This status allows continued operation for critical personnel in the event of a government shutdown

Recommendation: Use the template found with the MPO and CoC for routing this request in time to avoid a potential the shutdown period.

6. Title: Enlisted Support Team

Observation: A Corpsman and either PS or YN supporting the operation would simplify the administrative burden currently assumed by each of the deployed reservist.

Discussion: Alternatively, an additional Heavy Lift team member could be assigned to help with the documentation and administrative duties. That person could be based in the US and make trips to the Operating Theater when needed.

Recommendation: Identify funding and personal to staff a support billet.

7. Title: Navy Ship Incident Response Center (NSIRC)

Observation: Navy Ship Incident Response Center (NSIRC) is a key player in during casualty response.

Discussion: Maintaining the contact list for NSIRC would aid in reaching key NAVSEA team and collecting data to support HL operations

Recommendation: Develop Contact list and make it a pass down.

Appendix R – ESSM Summary of Operations

USS FITZGERALD ESSM Support Operations in 2017

June 17th, 2017 USS Fitzgerald collides with container ship, MV ACX Crystal. On the 19th of June, ESSM shipped 2ea. S26200 Underwater Kerie Cutting Kits and 2 ea. S33000 Magnetic Patch Kit systems to Yokosuka, Japan, for use by Navy Dive/Salvage teams. Two S18000, 6" pumping systems and one S18850, Dual 4" pumping system were deployed on board the ship for emergency use in strategic locations. A complete list of the casualty response equipment is provided in the following section.

At CAX, preparations were being made to ship Smart Tow Alarm system to Japan. ESSM personnel from Williamsburg, Va., traveled to US Naval Ship Repair Facility in Yokosuka, Japan, arriving on Friday, 25 August. The team immediately began installation of 3rd Generation Smart Tow System. Installation of the system was completed by Sunday, 03 September, with the ESSM team returning to Williamsburg, Va. the next day. Approximately 30 days later, ESSM was tasked with sending personnel to NSRF Yokosuka to adjust and test smart Tow monitoring system. Due to limited access during the allotted time frame, this trip was extended through October 27th, 2018, at which time ESSM personnel returned to Virginia.

A third and final trip for ESSM team to Yokosuka was undertaken on or about November 15th, 2017. Final adjustments were made on the Smart Tow system while a complete tension monitoring system was installed, under NAVSEA supervision, after the USS Fitzgerald was loaded onto the heavy lift ship, MV Transshelf. After all work was completed and tested, ESSM team returned to Virginia on or about December 10th, 2017.

After trans-pacific trip, USS Fitzgerald arrived in Pascagoula, Mississippi during the week of January 15th, 2018, at which time ESSM team disassembled and retrieved both the Smart Tow system and the tension monitoring system, along with the 3 pumping systems that were deployed on board the ship, and returned the equipment to the ESSM bases at Port Hueneme, Ca., and Cheatham Annex in Williamsburg, Va. ESSM personnel then returned to their respective bases.

ESSM Equipment supporting immediate salvage response.

S26100 - Underwater Cutting and Welding Kits - 2 each
S29100 - 400 AMP Welders - 2 each
S26200 - Kerrie Cable Cutting - 1 unit issued
S18900 - 6" Submersible Hydraulic Pumping 1800 GPM – 1 unit issued
S18250 - 2" to 4" Submersible Hydraulic Pumping 1500 GPM – 1 unit issued
S18000 - 6" Submersible Hydraulic Pumping 2200 GPM - 2 each

Emergency Pump installation for HL transit

TRIP REPORT: Yokosuka visit in Support of USS Fitzgerald On-Load of pumping systems.
Delivery Order: 4A96
a. Executive Summary: The primary purpose of this trip was to install emergency pumping systems on board USS Fitzgerald in support of heavy lift transportation back to the United

States. The USS Fitzgerald was located at the Ship Repair Facility (SRF) at Fleet Activities Yokosuka (FAY) in Yokosuka Japan
A team of ESSM personnel (4 from Port Hueneme) accomplished the installation of pumping systems during the period of October 11-20, 2017.
Support services in the way of cranes was provided by SRF.
The objectives of this visit were to:

1. Install components of 2 each S18000 systems forward and 1 each S18850 system aft.
2. Test systems as applicable.
3. Conduct training on systems operation for ships force.

b. Chronology of Events:

10/11/17: Four ESSM Port Hueneme personnel arrived from Sasebo Japan. Pumping systems shipped from ESSM Complex Sasebo Japan arrived.
10/12/17: All pumping system components loaded on board.
10/13/17: S18850 pumping system installed aft in shaft alley.
10/14/17: Crane unavailable until afternoon due to inclement weather. Two S18000 pumps lowered into ship, one in Auxillary Machinery Room 1 and one in IC Gyro. Began installation of S18000 systems.
10/15/17: Completed installation of two S18000 systems.
10/16/17: Crane unavailable due to inclement weather.
10/17/17: Crane unavailable until afternoon due to inclement weather. Offloaded pump baskets and hose reels to pier for staging for shipment back to Sasebo.
10/18/17: Conducted ships force operational training on all pumping systems.
10/19/17: Secured for sea and double checked all tie down components of systems.
10/20/17: ESSM Port Hueneme personnel traveled home.

c. Problems Encountered:

1. Scheduling of crane due to other ships work ongoing.
2. Loss of crane services due to inclement weather.
3. Lack of proper tools.

d. Lessons Learned and Recommendations:

Lesson Learned: Lack of proper tools/materials caused a few delays.

Recommendation: Although we shipped a small quantity of tools with pump systems we needed more. Recommend sending a general mechanics set including items like seizing wire, zip ties, WD-40.

e. Equipment Utilized: 2 each S18000 and 1 each S18850 system.

f. Equipment Evaluation: Equipment performed as designed.

g. GPC/PCCI personnel involved: Mike Pricola, Joe Stewart, Jonathan Hall, Nick Salazar

TRIP REPORT: Un-install Smart Tow System 3rd Gen on the USS Fitzgerald
a. Summary of Project:

b. Chronology of Events:

18 January, 2018

Attended the 1400 Planning Meeting at Ingalls Shipyard in preparation for 19 January ship arrival.

19 January, 2018
We made it onto the ship early afternoon and started checking the gear. We found Tribou who was the person we trained to monitor both systems. He said the Smart Tow loss communication about a week ago. He went to reset the Tow Control Unit but didn't because he thought the antenna was missing. The antenna was not on the mast because I tye-wrapped it to the handrail for better line of sight with the antenna from the Towing Vessel. Once we got to the 05 Level on the Fitzgerald we noticed the Towed Vessel Mast had spun around because the push had vibrated out. When it spun around it got into the path of the wind generator and shattered the ends of the fan blades. The wind generator still works but will need new blades. I placed the mast back into its original position and replaced the push pin. We then reset the Tow Control Unit and communication was restored to the towing system. The Smart Tow is now up and ready to be monitored. We went to on to removing all of the Strain Gauge gear. The repeater for the Strain Gauge System that had the solar panels was still on but the other that did not was dead. All of the sensors were still attached to the hull and the ship so we began removing them.

20 January, 2018
We packed up all the Strain Gauge gear in their cases and had them removed from the ship by the Heavy Lifts crane. Once they were on the ground we loaded them into the rental truck to deliver them back to CAX via FEDEX. We re-adjusted the setup on the bridge of the heavy lift so that the Smart Tow can be monitored for fire while they were removing the ship supports.

21 January, 2018
We moved the Smart Tow Monitoring portion to the quarter deck of the Fitzgerald. Once the setup was complete we tested the system for proper operation with the generator. The system ran successfully for an hour so we shut it down. Vince asked if we would train the crew on the pumping system since the ones that were previously trained have been relieved. When trying to start one of the HPUs it wouldn't start because the battery was dead. Since we didn't have time to charge the battery or check if was even recoverable it was replaced. Once we installed the new battery the HPU started perfectly. We then trained them on how to run the pumps and HPUs that were installed.

22 January, 2018
The heavy lift was being relocated to the offloading site so we were on stand-by

23 January, 2018
Vince asked me to board the heavy lift tonight because the ship will begin its ballasting process.

24 January, 2018
After the go/no go meeting everything was a go so I boarded the Fitzgerald and started the Smart Tow System for monitoring. The Fitzgerald crew and I started all the HPU's again

just to make sure they started. They did and the pumping system is ready if needed. Brad came aboard with the next crew in the morning and started monitoring the system with me. Once the ship was offloaded it was towed to a berthing at the shipyard. After it was secured we shut down the system.

25 January, 2018
Met with Joe Stewart and John Hall at the security office since they don't have a drive on pass. Brad and I started packing up the Smart Tow System. We packed the Towing Vessel Case first and placed the case in the truck. Then went to the 05 level and packed up the Towed Vessel equipment, Wind Generator, Solar Charging System, Battery Packs, Wind Charge Controller and the Tow Control Unit. We place all of this equipment on two pallets and strapped them down so they could be craned off at a later date. We then went into the ship and removed the Tow Systems Repeaters and associated Battery Packs. Placed the Battery Packs in the truck and shipped them and the Towing Vessel Case back to CAX at a local FEDEX.

26 January, 2018
Retrieved all the Flooding and Fire Sensors and placed them back into their cases. We then loaded them and the Battery Charger Accessory Case into the truck and shipped them back to CAX.

27 January, 2018
Met with the crane crew and showed them the tow pallets we needed lowered to the ground. After they lowered them we loaded them into the truck and had them shipped back to CAX.

28 January, 2018
Traveled back to Virginia

c. Lessons Learned/ Recommendations: Find a way to secure the push pins so they don't work themselves out.

d. Equipment Utilized: Smart Tow 3rd Generation and Strain Gauge Monitoring

e. Equipment Evaluation: The equipment was well used and will need repairs

f. GPC/PCCI Personnel Involved: Brian Kurtz, Lead Electrician, Brad Burkhalter, Electrician

USS JOHN MCCAIN ESSM Support Operations 2017

ESSM equipment supporting immediate salvage response

August 21st, 2017 USS John McCain collides with merchant vessel Alnic MC, near Singapore. Within the following 48 hours, multiple ESSM systems were deployed from the ESSM storage facility in Singapore. No ESSM personnel were present at that time as

COMLOGWESTPAC personnel deployed and operated the equipment. Systems deployed and utilized include;
S18250- 2” to 4” submersible pumping system
S18850- Dual 4” submersible pumping system
S12200- 7kw generator system
S12300- 30kw generator system
S15100- Lighting Kit system
S37100- Salvage shop Van system
S26100- Underwater Cutting/Welding system
S34000- Underwater Hyd. Tool Kit system
S18200- 3” trash pump systems
Also purchased and used on location was a Holmatro Inc. Hydraulic Rescue/Cutter system.

ESSM personnel arrived in Singapore on September 20th, 2017 and proceeded with repairs and adjustments to the equipment being utilized. Several 3” trash pumps were rebuilt and made operational. All of the other equipment, besides the 2 submersible pumping systems, was returned to the storage location in Singapore by the 1st week of October, 2017. Those 2 systems, #s S18250 and S18850, were left in emergency deployed/ready status on board the USS John McCain. ESSM personnel departed Singapore on September 25th, 2017.

On or about October 10th, 2017, the USS John McCain was transported from Singapore aboard the Heavy Lift ship MV Treasure on route to Yokosuka, Japan. After a stop in Subic Bay of the Philippines for repairs to the ship’s hull and the installation of a tension metering system by NAVSEA personnel, the USS John McCain was delivered to Yokosuka US Naval Ship Repair Facility on or about December 13th 2017, where she was dry docked for repairs. The ESSM team (already on site for USS Fitzgerald ops.) assisted in the removal of the tension metering system and shipped the system components back to Cheatham Annex in Williamsburg, Va.

Trash Pump Repair
SUBJ: TRIP REPORT, Singapore Visit in Support of USS John S. McCain Delivery Order: A95

a. Executive Summary: The primary purpose of this trip was to attempt to assess, evaluate and repair 4 each 3” Diesel Trash pumps (PU0330) that were used in support of dewatering operations onboard USS John S. McCain. All pumps failed during their use during the operation. The ESSM warehouse in Singapore is an unmanned facility. Supervisor of Salvage and Diving (SUPSALV) through a contract with GPC A Joint Venture has a local civilian sub-contractor as the caretaker/POC of the facility. The facility is in the custody of SUPSALV with support from the US Navy Region Center Singapore (USNRCS), and is located within the British Defence Support Unit Singapore Senoko Fuel Depot at Sembawang, Singapore.
A team of ESSM personnel (3 from Port Hueneme) accomplished the repairs during the period of September 20 through September 24, 2017.
The support from Golden Overseas Engineering Company (GOE) was outstanding. GOE also provided 2 personnel to assist in the repairs and refurbishment. GOE provided on-site

supervision of their personnel, contracted required services such as transportation, and any additional parts/items we needed.
The objectives of this visit were to:

- Attempt to assess the cause of pump failure.
- Evaluate the extent of required repairs.
- Repair and refurbish the failed pumps and place them back into Ready For issue (RFI) status.

b. Chronology of Events:
9/20/17: Three ESSM Port Hueneme personnel arrived. Began evaluating and rebuilding the 4 failed pumps.
9/21/17: Completed rebuild and operational PM on the 4 pumps.
9/22/17: Tested 2 over IO pumps and begin testing IO pumps.
9/23/17: Completed testing of all IO pumps. Began rebuilding all IO and Over IO pumps.
9/24/17: Completed rebuilding all pumps and completed satisfactory re-test of all pumps.
9/25/17: 3 ESSM Port Hueneme personnel traveled to Japan.

c. Problems Encountered:
There were no insurmountable problems encountered.

d. Lessons Learned and Recommendations:
Lesson Learned: All pumps on IO, and 2 Over IO pumps failed a pump test. All pumps required replacement of both volutes and impellers. Pumps used during dewatering operations were not the proper pump for the job. Simulating the conditions onboard John S. McCain at the Singapore warehouse created the same failures.
Recommendation: Ensure the proper pump is used for the job. Determine the factor that caused all impellers and volutes to fail during operational testing.

e. Equipment Utilized: Rebuilt 10 each PU0330 pumps (4 operational failures and 6 from Singapore inventory.

h. Equipment Evaluation: All pumps performed as designed once repairs were made.

i. Person contacted: Richard Thiel, SUPSALV OOC21

j. GPC/PCCI personnel involved: Mike Pricola, Joe Stewart, Jonathan Hall

Propeller blade removal support equipment

Monday September 11th
We were able to received DSM shop van and the end of water CPP boxes. I was able to break out the rigging and assist divers how to put together then we started on the a frame blade fixture harness and it took most of the day to their able to dive.

Tuesday September 12th
We were able to get the harness on the port side 1 Alpha blade unhide torque the bolts and remove blade up topside. Within were able to find out that the covers for cover plate did not fit Portside they were made for starboard we brought it topside. Then we continue to one Jack and the shaft to get to Bravo blade on the port side removed.

Wednesday September 13th
We had some hold up on the port covers of what we need to do to make them work. But we're able to remove the stubborn blade two Bravo topside

Thursday September 14th
We were able to get the tree Charlie on a starboard top side and both one alpha and two Bravo port covers on and torque in place.

Friday September 15th
Two divers were able to finish pulling the rest of starboard blades off. Then we swap lifting fixtures to start pulling Port blades off and got one off. Then we installed one more port cover plate.

Saturday September 16th
The divers go in the water around 8 a.m. And we're able to finish removing the other Portside blades. We shifted 23 Charlie on the port side to start with the cover plates on. We're able do all cover plates and Portside except for one.

Sunday September 17th
Standby

Monday September 18th
The divers got in around 8:30 in begin 2D rig rigging being and change moist and other gear. Would they then got out the water and we're standing by until getting cover plates. We had a very bad thunderstorm lightning and rain for about 3 hours. They were able to install the last cover played on port side but not torque it down.

Tuesday September 19th
When I met with the divers and we were able to get the last port side cover torque into place. Then the divers dive rig Portside installed rigging on starboard side. They began putting on the cover plates on starboard. They were able to finish up all cover plates on starboard side and torque into place. Then they pulled everything dreg travel lines and all the above to topside.

Wednesday September 20th
I begin most of the day doing inventory on the van and packing up the rest of the gear. I got about halfway through inventory. And we begin to install blades in new blade boxes.

Thursday September 21st
I begin today by working on inventory getting about three-quarters of the way done. Then they Carpenter showed up with the rest of the blade box bottoms. Then we're able to get 6 blades installed in boxes. We have four more to do tomorrow in the rest of the inventory.

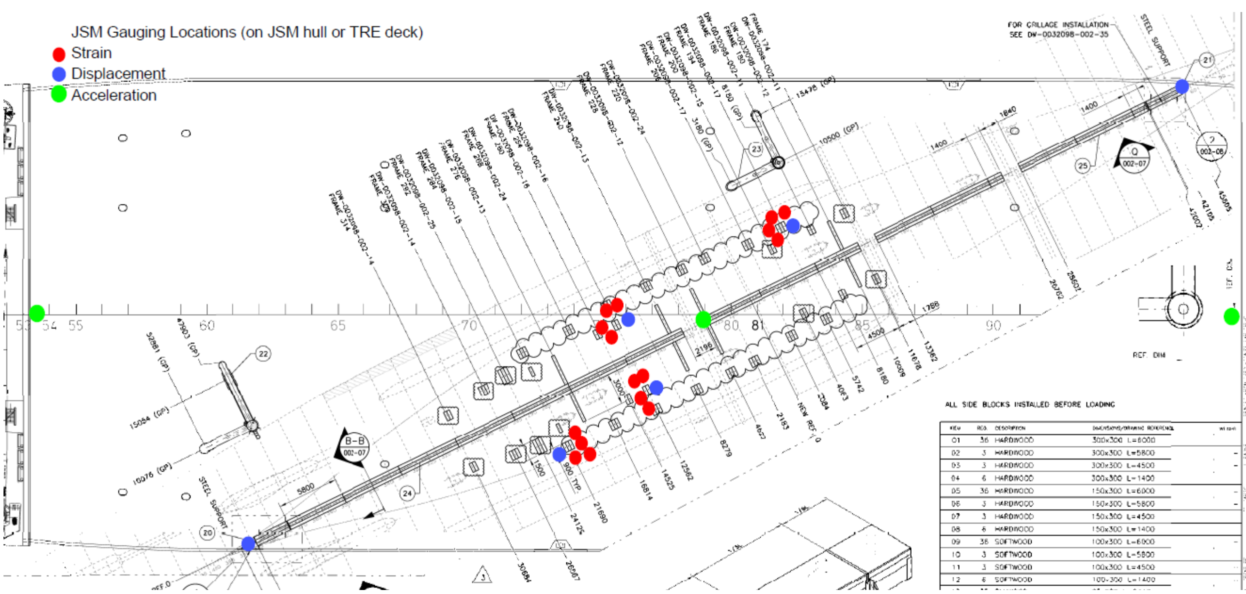
Friday September 22nd

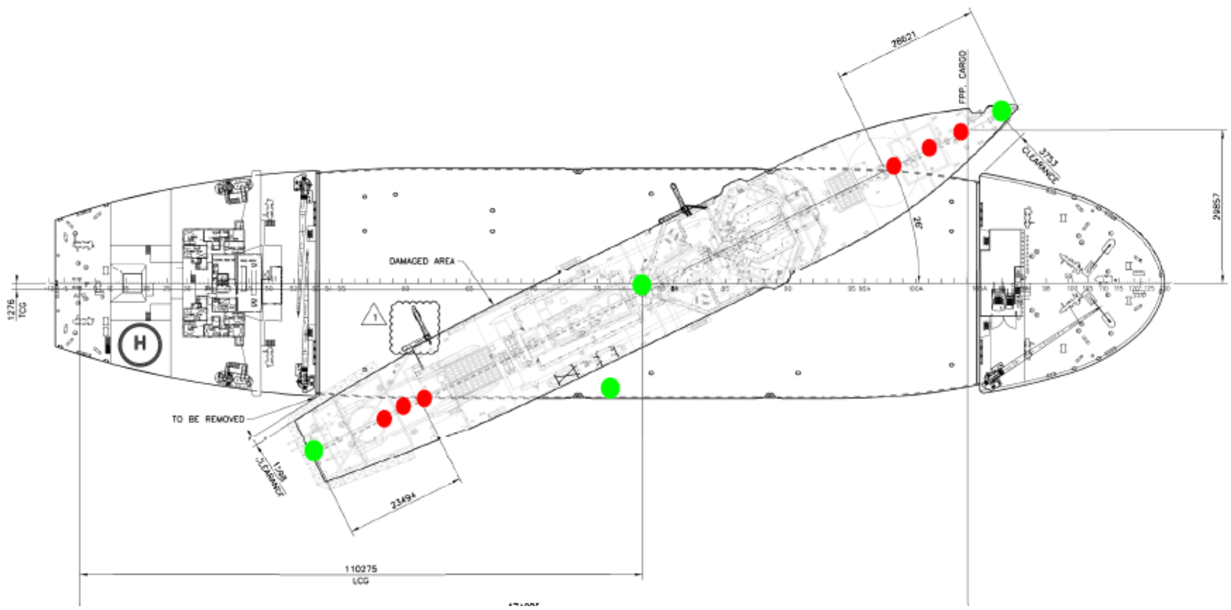
Arrived down at the pier to finish up the inventory on the Conex box. The Carpenter's family showed up and we were able to finish the other four boxes for the blades. And I was able to get everything else packed up and ready for shipment on Monday.

Saturday September 23rd
We went in to finish cleaning up area and making contact with Master diver and the people that were moving the gear and the container. The divers were not diving today just standing by for pump watch.

Tension metering equipment for measuring ship's movement during transport.

After cracks developed on JOHN S MCCAIN during her first week of transport, 00C installed monitoring equipment on the ship in Subic Bay to better understand the motions and stresses on a ship being heavy lifted, especially in an unusual configuration such as JSM. Gauging included accelerometers on both the lifted and lifting ships to measure motions and forces including potential out-of-sync-motions between the two ships. Strain gauges were installed on the hull of JSM around the extreme end, outboard side blocks as well as on JSM's deck located above the overhanging bow and stern. Finally, displacement gauges were installed on the bow, stern, and midship sides of JSM to measure relative motion between the two ships and cyclic compression on the blocks. Appendix P – Instrumentation Report provides a detailed review of the instrumentation installation process on DDG class ships (USS FITZGERALD in particular) and the location of the sensors on MCCAIN is shown below:




78621
FPP. CARGO
3753
CLEARANCE
29857
DAMAGED AREA
1276
TCG
TO BE REMOVED
1308
CLEARANCE
23494
110275
LCG