



Herbert Engineering Corp.
Bruce S. Rosenblatt & Associates, Inc.



PREPARED FOR:



U.S. Maritime Administration
1200 New Jersey Avenue
Washington, DC 20590-0001

Contract: DTMA91C1600014

PREPARED BY:

Herbert Engineering Corp.
927 West Street, Suite 202
Annapolis, MD 21401

Rev	Date	Description	Originator	Checked By	Appvd By
1	12/12/16	Modified draft & details to suit development	EVR	CRS	EVR
0	07/18/16	Issued for Information	EVR	CRS	EVR

TITLE:

NSMV Phase 3 Design
Basis of Design

DOCUMENT NO.

2015-017-03-04

File Path & Name:

Total Sheets: 8

This document lists the key requirements, assumptions and regulations that form the basis of the design of the National Security Multi-Mission Vessel (NSMV). For further details refer to the documents NSMV Capabilities and Requirements, Outline Specification and NSMV Applicable Rules and Regulations.

Operating Modes

Training Ship Mode

Up to 600 cadets plus 100 officers, faculty, staff and crew. Operate primarily on summer cruises across one of the major oceans to visit international ports. Vessel will slow steam much of the time so it can remain at sea for training purposes. Balance of the year the vessel is tied up at the State Maritime Academy (SMA).

Humanitarian Assistance / Disaster Response Mode (HA/DR)

Up to 760 persons at sea and possibly 1000 persons onboard in port, berthed in the same spaces as the training ship mode, except many of the faculty, staff and crew staterooms can berth two persons, not the standard one person berthed in training ship mode. Typical voyage lengths will be 5 to 15 days as the vessel goes from SMA pier to loading port for cargo and personnel and then to disaster site at near full speed. It will remain in port at the disaster site for possibly days to months depending on need. It may go to sea periodically to discharge sewage and gray water and to refill freshwater tanks using fresh water generators. Cargo capability for vehicles, trucks, public service vehicles (buses, fire trucks, ambulances), containers, and breakbulk cargo is provided on a RoRo deck with ramp access from shore and a weather deck with cargo crane.

Reduce Operating Mode

While alongside the SMA pier for much of the year the vessel will be in reduced operating mode. In this mode, public spaces, class rooms, workshops, laboratories and machinery spaces will be used for teaching and demonstration purposes. Possibly some of the cabins will be used as dormitory spaces. Basic services including lighting, ventilation, air conditioning, potable water supply, sanitary systems, firefighting, and fire and flooding alarm systems shall be active during this mode. Power shall be provided from shore. Shore gangway shall provide access to the quarterdeck and a secondary gangway shall provide backup means of escape. No food service shall be provided onboard. Side ramp and cargo crane shall be operable.

Service Profile

Annual Usage

1. 60 days at sea per year on average (typical training ship summer cruise)

Training Ship Mode

1. Frequency: 90% of Voyages
2. Typical voyage length: 15 to 30 days at sea per voyage, 60 days at sea (underway) total per summer cruise
3. Draft: 6.3 to 6.5 m, mean draft, trim aft as needed to maintain about 105% propeller immersion or more

4. Deadweight Basis: 700 persons onboard, no cargo
5. Speed:
 - a. 12 to 13 knots: 75% of the time,
 - b. 16 to 18 knots: 20% of the time,
 - c. Manoeuvring: 5% of the time

HA/DR Mode

1. Frequency: 10% of Voyages
2. Typical voyage length: 5 to 15 days
3. Draft: 6.7 to 7.25 m, mean draft, generally even trim
4. Deadweight Basis: Persons onboard up to 760, up to 1529 mt of Cargo (all cargo is aft)
5. Speed:
 - a. 16 to 18 knots: 80% of the time
 - b. 12 to 13 knots: 15% of the time
 - c. Manoeuvring: 5% of the time

Hull Limitations

1. Length Overall: Not to exceed 600 ft - target of 550 ft
2. Beam: Not to exceed 105 ft - target of 90 ft
3. Draft: Not to exceed 25 ft with the ability to reach 22 ft
4. Design Service Speed: 18 kts with 15% sea margin
5. Air Draft: Not to exceed 123 ft

Propulsion

1. Diesel Electric Integrated Drive with twin engine rooms to meet SOLAS requirements for redundant propulsion and for the large hotel loads
2. Ability to operate at least 12 knots on one engine room during summer cruise to allow training to take place in the other engine room.
3. Maneuverability to dock without assisting tugs.
4. Single fuel for ease of operation and considering significant operation within an ECA and the upcoming requirements for low sulfur fuel use worldwide starting in 2020.
5. Single screw, fixed pitch propeller for lower construction cost and for training purposes so ship handles like most other vessels (single screw vessels are predominant)
6. Other types of propulsion are not required for reasons of cost.

Endurance

1. 10,000 nautical mile range with full fuel onboard for extended voyages in HA/DR mode.
2. Gray water storage tanks for 7 days and sewage holding tanks for 14 days with full complement of about 750 persons in HA/DR mode onboard for operation in ports with restricted discharge of waste water.
3. Frozen and Dry Provision food storage for 60 days and for Chilled Provisions for 30 days with full complement of 700 persons in training ship mode onboard.
4. Freshwater storage for 14 days for 700 persons and daily freshwater generating capacity for 1000 persons

Regulations

The NSMV is planned for documentation as a public nautical school ship without certification (because it is a government owned vessel), but it will be issued certificates of voluntary compliance showing it does meet the following requirements. Having the certificates of voluntary compliance makes it easier to travel to foreign ports since compliance with international regulations applicable to this type of vessel can be demonstrated and it does not require so much government to government negotiation to obtain permission to enter foreign ports.

USCG

1. Subchapter R – Public Nautical School Ship – applies and invokes portions of following CFR sections:
 - a. Stability requirements (Subchapter S): For damage stability purposes a Public Nautical School Ship is treated as a passenger vessel with fewer than 400 passengers (regardless of the number of persons aboard the school ship). This is a one compartment deterministic standard.
 - b. Lifesaving requirements (Subchapter W): A Public Nautical School Ship is treated as a passenger vessel with regards to number of life boats, etc.
 - c. Machinery and electrical engineering requirements (Subchapters F and J)
2. Subchapter H – In the past USCG has applied Subchapter H to School Ships in areas where Subchapter R was silent. Discussion with USCG during CLIN 2 phase indicated that the application of IMO SPS code (see below) would be acceptable in lieu of Subchapter H in these areas as it is considered more up to date. A gap analysis between IMO SPS code regulations and Subchapter H should be prepared for USCG guidance.
3. Subchapter O – Pollution – applies with regard to vessel equipment
4. Subchapter E – Load Line - applies

IMO Requirements

1. Special Purpose Ship (SPS) – in lieu of SOLAS the IMO SPS code can be applied as agreed with USCG Marine Safety Center (discussions during CLIN 2 phase). The SPS Code directly references nautical training ships as one of the applicable types of vessels. A nautical training ship is different from a passenger vessel in that all the persons onboard are able bodied and have some training in seamanship. The SPS Code invokes much of SOLAS, most notable of the requirements are:
 - a. Subdivision and Stability: as if a passenger ship with special personnel treated as passengers. Damage stability is a probabilistic method, with the requirement generally consistent with a two compartment standard.
 - b. Fire Protection: as if a passenger ship carrying more than 36 persons
 - c. Redundancy: redundancy of critical functions required in event of flooding or fire in any one compartment
 - d. Lifesaving: as if a passenger ship, but with some reduction in requirements
 - e. Machinery and Electrical: as if a passenger ship with a few modifications
 - f. Radio communications – should comply as a cargo ship
2. Evacuation shall be in compliance with MSC Circular 1238 – Guidelines for Evacuation Analysis for New and Existing Passenger Ships

3. Requirements of MARPOL will be applied

ABS Class

1. ABS Class primary notation per guidance received from ABS is as follows: +A1, Training Vessel, SPS (E), +AMS.
2. Statutory review will be based on SPS Code, 46CFR Subchapter R and 46CFR Subchapter H (for reference)
3. ABS Rules Part 5C – Chapter 7 – Vessels Intended to Carry Passengers - HEC will apply as reference for the passenger portions of the vessel. As the vessel will be a special purpose ship and not a true passenger ship the vessel will not have a Passenger Ship Safety Certificate issued by the Administration, which is a requirement for full compliance with this section of the Rules.
4. ABS Rules for Cargo type vessels (Parts 2, 3 and 4) will be used for guidance for other parts of the vessel, such as the cargo spaces.

Safety

Safety of the persons onboard the NSMV is a primary consideration in the design process. The applicable rules and regulation provide for a basic level of safety for the vessel and the personnel aboard. Where appropriate additional features will be provided to enhance the level of safety. Several key safety considerations are as follows:

1. The level of redundancy in ship propulsion, safe return to port, and vessel controls required of passenger vessels by SOLAS will be incorporated into NSMV.
2. Fire safety requirements will match those in SOLAS for passenger vessels and industry best practices will be adopted.
3. Means of escape and evacuation safety will be primary considerations.
4. Vessel stability shall have sufficient margins to ensure stability in excess of requirements in all normal operating conditions.

Arrangement

1. Control spaces, communication spaces, and senior officer and faculty accommodation spaces should be able to be secured separately from the other accommodation spaces including use of separating doors.
2. Medical spaces should be able to be expanded in case of HA/DR mode.
3. Ability to load and provide basic services to office, medical and other service modules to be provided on the main and RoRo decks.
4. Training bridge with duplication of primary bridge functions to be provided.
5. Food Service spaces (including food stores) shall all be on one deck
6. RoRo space shall be capable of carrying a wide variety of vehicles and trailers including trailers up to 53 ft long and heavy vehicles, such as fire trucks, buses, ambulances, panel trucks, bulldozers, flatbed trucks, mobile cranes, large pickup trucks, and conventional autos and light trucks. Breakbulk cargo may also be loaded on the RoRo deck not in vehicles, but loaded using forklift trucks.
7. On main deck aft can stow and secure containers.
8. Cargo crane shall be provided for loading cargo, including containers up to 30 mt, on the main deck and for training. Outreach is 26 m to reach most parts of the weather deck aft.

9. Helicopter landing capability shall be provided on the aft deck, but no helicopter refueling or storage.
10. All officers, crew, faculty and staff for normal training ship summer cruises shall be in private cabins. Surge capability for a minimum of 60 more persons shall be provided by doubling up some of the crew and staff cabins.
11. Upper class cadets (min. half the cadet complement) shall be in smaller cabins of no more than 6 persons with private or shared toilet shower units.
12. Lower class cadets can be in mass berthing areas with 12 to 36 persons in each space. Each space shall have access to its own dedicated toilet shower spaces with no more than 6 cadets per toilet shower unit. Cadet laundries shall be provided on each deck with cadet berthing.
13. Cadet mess rooms shall be able to serve at least 40% of the cadets at a single seating. No separate mess rooms for upper and lower class cadets shall be provided. Sufficient room shall be provided for cadets to line up waiting for food service.
14. Non-cadets shall eat in separate mess spaces from cadets and have their own serving area.
15. Class rooms, workshops and laboratories shall be provided as described in the combined SMA list of requirements.
16. Office space shall be adequate for the number of faculty and staff onboard.
17. Access by disabled persons shall be available on the public spaces from 3rd deck up to main deck and to at least one deck of cabins above (01 Level cabins in Fire Zone 3). This is allow some mobility by persons in wheelchairs coming onboard through the RoRo deck or quarterdeck while in HA/DR mode and some capability for them to use a cabin. No special provisions shall be provided in the cabins for disabled persons except access to the cabin.

Environmental Enhancements

The following class notations will be applied:

1. Green Passport
2. Enviro

The following environmental and efficiency features and enhancements will be included in the design:

1. Ballast Water Treatment System
2. Variable speed motors and fans
3. LED lights
4. Regenerative air heaters to reduce HVAC heating and cooling load
5. Engine waste heat for accommodation heating
6. All tanks that can contain oil shall be at least 760 mm away from the shell.
7. Low sulfur fuel only
8. Rudder bulb for reduced resistance
9. Gray and black water storage tanks to be provided to avoid discharge in port
10. Hull design optimized for low fuel consumption based on CFD analysis and model testing.
11. Electric ramp and deck machinery to avoid use of hydraulic oil
12. Water lubricated stern tube
13. Drains from RoRo space not to go directly overboard except for deck drains for dewatering if sprinkler system activated.

Structure Design

1. Structure design in accordance with ABS Rules Part 5C, Chapter 7, based on FEA analyses, both global and detail.
2. Sea Loads are based on standard requirements and spectra for ABS approval for unlimited ocean service.
3. Standard fatigue life requirements will be assumed where required.
4. Minimum plate thickness applied for longer life and longer corrosion life.
 - a. Shell plate 12 mm min
 - b. Structural decks in hull 10 mm min
 - c. House structure 7 mm min interior and 8 mm exterior deck
 - d. Water tank structure 11 mm min for primary and 10 mm min for secondary structure
 - e. 5 mm additional shell plate thickness in anchor rub area
5. 5% margin on envelope of still water bending and shear for any expected loading conditions
6. Mild steel used except where use of high strength steel is cost effective (cost of steel considering lesser thickness is lower than mild steel) and complying with minimum steel thickness guidelines

Lightship & Stability

1. Lightship weight breakdown shall be based on US Navy SWBS system for better understanding of the weight calculations by MARAD.
2. Intact Stability is based on passenger ship requirements IMO Intact Stability code
3. Damage Stability is based on latest SOLAS requirements for passenger vessel (per IMO SPS code requirements).
4. No active stabilization system will be incorporated into the design, but bilge keels shall be provided.
5. Operating GM levels will be less than 3 m where possible to keep the roll period from becoming too low for comfort (reduce "snap" rolling).
6. Vessel seakeeping characteristics shall be analyzed including parametric rolling and counter measures taken where needed. Intent is for mid-level motions compared to similar ships.

Machinery & System Design

1. Redundant machinery systems to be provided in both engine rooms so vital systems are available in case of fire or flooding in one of the engine rooms.
2. Engine room spaces and control spaces should be large enough for training purposes (groups of students can move about the space and compartments)
3. Sanitary drains in accommodation spaces shall be oversized with cleanouts on each deck to reduce clogging.
4. Essential piping systems shall be inboard of B/5 and above innerbottom where practical
5. Consideration will be made to providing ventilation and air conditioning for spaces used while alongside the SMA pier without use of a sea chest as a safety measure against flooding while in reduced operating status at the pier (no nighttime engine room watch).

Electrical Design

1. Electrical power and lighting distribution systems shall be sufficiently separated so casualty in one space does not prevent operation in other spaces per regulations.
2. IT and communications equipment shall support a ship wide computer network with outlets at all berthing, office, teaching and control spaces; satellite broadband, cell phone access throughout the ship when in port, closed circuit TV and video teaching capability. Sufficient space shall be provided for separated servers for redundancy.
3. Shore power connections will be sufficient for supplying power needs from shore while alongside the SMA pier in reduced operating status.

Margins

1. Design Lightship Weight Margin:
 - a. Steel Weight: 5% after FEA, scantling plan and other structure drawings prepared and container support deck structure design, 10% prior to that.
 - b. Overall Weight: 5%
 - c. KG: 3%
2. Weight Growth Margin in Service
 - a. Lightship Weight: 3%
 - b. KG: 0.10 m
3. Service Margin on GM
 - a. 0.4 m for all operating conditions based on ballast tanks at desired level and consumables with free surface per USCG requirements for largest tanks.
 - b. Vessel capable of emptying the largest full SW ballast tank, with the exception of permanent FW ballast tanks, while underway at any point in the voyage and retaining stability above required values.
4. Sea Margin on Propulsion Power: 15%
5. Electric Loads, excluding propulsion motor loads: 5% margin for design, 10% margin for growth
6. Diesel engines: 90% of MCR is maximum operating load.
7. Machinery System design margin: Varies by system