

Abstract

American Lightships, 1820-1983:
History, Construction, and Archaeology within the Maritime Cultural Landscape

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In 1820, the United States Government began funding construction and conversion of watercraft for use as lightships. Floating beacons utilized to mark dangerous shoals, reefs, and shifting channels in inland as well as open waters, lightships served where lighthouse construction was unfeasible. This study intends to examine the general history of U.S. lightships, improvements to construction design, technological modifications in illumination and signaling, venue of employment, as well as use, re-use, and the maritime cultural landscape associated with these craft.

American Lightships, 1820-1983:
History, Construction, and Archaeology within the Maritime Cultural Landscape

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By
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CHAPTER 1: INTRODUCTION

Lightships served a vital role in protecting U.S. maritime interests from 1820 to 1983. Employed as navigational aids, lightships were stationed along shipping lanes and intercoastal waterways in the Atlantic, Pacific, Gulf of Mexico, Great Lakes, and various estuarine environments in the Chesapeake, North Carolina, and the Pacific Northwest. Different sources offer brief and assorted lightship histories; however, none are all-encompassing. Existing primarily as epigrammatic segments in books devoted to lighthouses, lightships have very few studies dedicated entirely to their history. Published information on early lightships is scarce and incomplete. Secondary source information is often repetitive, lacks explanation, and fails to cite sources. Archaeological studies on lightships are limited to three individual wreck surveys.

Addressing gaps in the current historical and archaeological record pertaining to lightships, this thesis answers different research questions and discusses the role of lightships in the American maritime cultural landscape. The development of lightship construction is included as well as explaining changes in wooden, composite, iron, and steel techniques. Information regarding changes in the characteristic features of lightships focused on improvements in light and fog signaling equipment. Field notes gathered during the 2010 *LV83* documentation project provided supplementary data describing crew spaces, artifacts, rigging, and electrical components on National Historic Landmark *Swiftsure*. In total, this historical and archaeological study focuses on the use, construction, and meaning of lightships in America.

History

Recorded use of navigational aids began in 907 B.C. with the construction of the first lighthouse (Grupp 1956:30). Seven hundred years later, during the reign of Fabius Maximus, the Romans furthered maritime efforts, structuring a coast guard service intent on protecting

coastlines, ports, and commercial shipping, from enemy attacks and piracy (Grupp 1956:30). In an effort to assist the coast guard, mark dangerous waters, and serve as navigational aids for commerce, galleys equipped with fire baskets fixed to the mast head served in the Roman coast guard as the first lightships (Holland 1972:55). Recreated numerous times on a variety of craft, lightships disappear from the historical record after the Roman period, reappearing in England during the seventeenth-century (Grupp 1956:30).

Issued to Charles I in 1629, from “time-minded Englishmen” lobbying for a lightship at Goodwin Sands, near the mouth of the Thames, the appeal went unanswered (Grupp 1956:30). In 1730, upon receiving a formal request from Robert Hamblin, George II granted a patent for the first English lightship (Grupp 1956:30). Forming a partnership with David Avery, Hamblin and Avery combined their resources and built the *Nore*. Stationed on Goodwin Sands within two years, the single masted sloop served as a beacon for marking currents, whirlpools, and reefs that disappeared during high tide (Adams 1870:255). Serving as a model for future lightships, the *Nore* emphasized the inadequacies of coastal trade, creating a standard that several countries began to adopt.

Less than one hundred years later, in 1820, under Stephen Pleasanton, Fifth Auditor of the Treasury, the United States established their first lightship station (Holland 1972:55). Earlier efforts to light local waterways resided with state and local governments that initiated programs as early as 1789, resulting in building lighthouses and other navigational lights along their coasts and inlets (Corey 1982:2). The ninth law of the United States relieved state governments of the financial burden associated with navigational aids and accepted responsibility by providing federal funding. Partitioned into six lighthouse districts encompassing the original colonies, the

Department of the Treasury, Office of the Lighthouse Board, continued placing craft in American waters through 1954 (Flint 1993:8).

Previous Research

Various forms of media briefly address the history and importance of United States lightships. Willard Flint's *Lightships and Lightship Stations of the U.S. Government*, considered by Coast Guard historians as "the Bible", is the only comprehensive manuscript providing details of all U.S. lightships. Other articles and texts secondly source regional use, life onboard, and tragedies that befell lightships and onboard crews. These include *Lighthouses and Lightships of the United States*, by George Putnam (1917), *Lightships: Floating Houses of the Mid-Atlantic*, by Wayne Kirklin (2007), *Lighthouses and Lightships*, by William Henry Davenport Adams (1891), *Lightships and Lighthouses*, by Frederick Arthur Ambrose Talbot (1913), *America's Lighthouses: Their Illustrated History Since 1716*, by Francis Ross Holland (1973), *Sentinels of the North Pacific: The Story of Pacific Coast Lighthouses and Lightships*, by Jim Gibbs (1955), *Northeast Lights: Lighthouses and Lightships, Rhode Island to Cape May, New Jersey*, by Robert G. Bachand (1993), *Lighthouses and Lightships of the Gulf of Mexico*, by David Cipra (1997), *The Lightships of Cape Cod*, by Frederick L. Thompson (1996), *Lighthouses and Lightships*, by Lee Chadwick (1971), and *Sentinels of the Shore: A Guide to the Lighthouses and Lightships of New Jersey*, by Bill Gately (1998).

Books are not the only previous written material pertaining to lightships. There are currently ten U.S. lightships serving as museum vessels, each with extensive known histories. These lightships are: *Chesapeake* (Baltimore, Maryland), *Nantucket* (Staten Island, New York), *Ambrose* (New York, New York), *Winter Quarter* (Jersey City, New Jersey), *Swiftsure* (Seattle, Washington), *Portsmouth* (Portsmouth, Virginia), *Columbia* (Astoria, Oregon), *Overfalls*

(Lewes, Delaware), *Relief* (Oakland, California) and *Huron* (Pine Grove Park, Michigan). These vessels have all undergone renovations and exist as examples of lightships built in the twentieth century.

Previous Archaeological Research

Archaeological studies on lightships have been conducted in Massachusetts, North Carolina, and Connecticut. In Massachusetts, Underwater State Archaeologist, Victor Mastone, claims knowledge of the whereabouts of at least five lightships (Vic Mastone 2010, elec. comm.). One of these is partially submerged in the Merrimac River. This vessel was documented and described as the subject of a master's thesis by Graham McKay (2007). McKay submitted his study to the University of Bristol, England. Information from the Merrimac River lightship survey remains pending as does identification of the vessel.

Richard Lawrence and the North Carolina Underwater Archaeology Unit (UAB) staff conducted an archaeological survey on a lightship. Located using a magnetometer survey, the UAB identified wreck number 0019ROR, the Mast Wreck, as the likely remains of the Long Shoals Lightship. The vessel lies in 14 to 17 feet of water. The wreck measures 85 feet 9 inches in length, and has 2 masts. Located amidships, the dimensions of the masts are consistent with figures recorded from earlier lightships. Chain plates remain on the vessel as well as other diagnostic features indicating that the wreck may be a lightship (Lawrence 2002:7-11).

In spring 2003, the University of Connecticut at Avery Point and the Northeast Underwater Research Technology and Education Center (NURTEC), surveyed *LV51*, the Cornfield Point lightship. *LV51* was the first lightship fitted with electric lights. It sunk in 1919 after being rammed by a barge. The vessel lies in 170 to 190 feet of water and was surveyed using submersibles and remote cameras. This site is Connecticut's first underwater

archaeological preserve and is located in Old Saybrook. Information regarding the 2003 survey can be found at the Connecticut State Historic Preservation Office and Northeast Underwater Research Technology & Education Center, University of Connecticut at Avery Point (Bellatoni and Poirier 2000).

Research Questions

The author conducted extensive research for this investigation. Amassing numerous primary sources from visits to the National Archives in Washington D.C. and College Park, Maryland, the author gathered newspaper articles, journal and magazine titles, as well as sources suggested by historians at the United States Coast Guard (USCG) Headquarters. Products of archival research also exist in the form of still photographs, contracts, letters, documents, meeting minutes, and receipts for labor, supplies, and repairs. Useful in tracing early lightship history, the information gathered at the archives provided insight into nineteenth century lightship knowledge, a period often ignored in published data. The author made contact with local historians as well as with the curator of the Portsmouth Naval Shipyard Museum, acquiring supplementary resources to aid the study. Using the aforementioned resources, the author developed research questions to guide the investigation. These questions were,

Q #1: What was the process of converting non-purpose built craft into lightships? Although most were purpose built, the U.S. Government purchased several ships that were converted into light vessels. What were these early vessels and what changes were made? How do these changes compare to purpose built craft and how did the vessels hold up to environment and use when compared to purpose built craft?

Q #2: What is the evolution of lightship construction? What prompted change?

Q #3: What does the venue of use tell us about the lightship's construction process? For example, low tonnage schooners and scows versus vessels placed off shore. Additionally, how do Great Lakes lightships fit into the grand scenario?

Q #4: How do lightships fit into the evolution of navigational technology?

Q #5: What were alternative uses for lightships? Although meant to serve as navigational aids, lightships were employed for various other uses. What were these?

Q #6: How do lightships tie into the maritime cultural landscape of the United States from 1820-1983?

Research Methodology

This study provides analysis of the lightships used by the United States Government from 1819-1983. It begins with a history of lightships and general aids to navigation, as well as their integration into the U.S. maritime landscape, transitioning into changes in lightship design. Whether purpose built or converted to government specifications, lightships underwent several changes. Early lightships were wooden schooners unable to withstand severe weather in open seas. Modified because of changes in technology, available resources, perceived inadequacies, and venue of use, lightships eventually evolved into durable steel vessels with extended capabilities. Continual repairs, maintenance schedules, and natural decay through use are also paramount and contributed to changes in design. It is possible to trace these changes from at least 1855 through 1952 and in some cases, even earlier, seeking patterns that initiated change.

Initially utilized for navigation, lightships served in various settings. Exploited during the Civil War as weapons, prizes, store ships, as well as river obstructions, lightships also marked mine swept channels outside Boston, New York, Delaware Bay, Chesapeake Bay, and Charleston, from December 1918 through Summer 1919 (Flint 1989). Providing refuge and

rescue to distressed mariners, lightships functioned as target ships, barracks, museums, and provided service to other government and private agencies once retired from the Lighthouse Service. These roles were researched, helping to evaluate the overall importance and flexibility of lightships.

Proven ineffective without a crew (*LV75, LV99*), lightships required dedicated and diligent men to serve for extended periods in hazardous conditions (Flint 1989). Initially local pilots, lightship crews developed into trained personnel and became members of the U.S. Coast Guard in 1939. The subject of research in progress by Atlantic Area Historian for the USCG, William Thiesen, as well as the published text, *Life Aboard a Coast Guard Lightship*, by George E. Rongner (2007), lightship crews have also been the subject of at least two Hollywood movies, *The Lightship* (1985), and *Men of the Lightship* (1940). The previous research conducted on the courageous men who served as lightship crews has predetermined their absence in this investigation.

Historical Methodology

The majority of research for this investigation came from primary sources. Research trips to the National Archives in Washington, D.C., College Park, Maryland, and the United States Coast Guard Headquarters, provided contracts, receipts for repairs, as well as supplementary government records about lightships. Owned and paid for entirely with federal money, an often detailed paper trail regarding lightships exists. Photographs, construction plans, and various illustrations regarding modifications represent alternative documents. Newspaper articles, early American journals, and various microforms held at Joyner Library, East Carolina University, pertaining to the Lighthouse Service, Lighthouse Board, and lightships in general, proved valuable. Some of these sources were: *Harper's Weekly*, *The New York Times*, the database titled

Early American Newspapers, *The Modern Lighthouse Service* microforms, *International Register of Historic Ships*, *List of Allowances to Light Stations* microform, and *Compilation of public documents and extracts from reports and papers relating to light-houses, light-vessels, and illuminating apparatus, and to beacons, buoys and fog signals, 1789-1871* microform. Visits to the Port O' Plymouth Museum (Plymouth, Virginia), North Carolina Maritime Museum (Beaufort), the Portsmouth Naval Shipyard Museum (Portsmouth, Virginia), and the Columbia River Maritime Museum (Astoria, Oregon), proved worthwhile sources of background information as well as seeing lightships first hand.

Archaeological Methodology

A theoretical discussion regarding the role of lightships in the maritime cultural landscape was included to draw inferences regarding the importance and overall meaning of lightships in America. Using theories developed by Christer Westerdahl and Ian Hodder, post-processualist ideas were used to describe lightships as “objects of material culture” within America’s maritime cultural landscape (Hodder 1985:1; Westerdahl 1992). Discussed as navigational aids within the transportation corridors of domestic waters, the “active and meaningful” production of lightships was presented as a means of validating lightships as navigational aids but also as “sources” of landscape (Hodder 1985:1; Westerdahl 1992). While classified as shipwrecks, land remains, tradition of usage, study of natural topography, place names, blockages, transit points, and sea routes, lightships contributed to the American maritime cultural landscape in more ways than one (Westerdahl 1992:7-10).

In addition to theoretical contributions, field notes from a lightship survey conducted during the summer of 2010 helped augment physical descriptions of lightships. Objectives of the LV83 survey focused on recording crew spaces, rigging and electrical components, as well as

collecting and accessioning artifacts remaining onboard. The first survey of its kind performed on an American lightship, the 2010 documentation project served as an initial effort in a renovation process planned by the lightship's owner, Northwest Seaport. *LV83* is one of America's last remaining lightships. Information gathered during the survey is presented in part in this thesis. Condensed for relevancy, the full details and report remain on file in the Northwest Seaport Archives, Seattle, Washington.

Analysis and Conclusions

Utilizing the information gathered during the historical and archaeological methodologies, conclusions regarding the overall use and importance of lightships in the United States were hypothesized at the start of the investigation. Initial hypothesis were,

H 1 – Lightships existed in the United States between 1819 through 1984; their employment should show human reliance on maritime exploitation.

H 2 – If lightship construction continued to improve, then humans embraced the use of inland and open waters for a variety of means and sought better ways of managing these resources.

H 3 – If lightships were continually employed, repaired, and modified for 163 years, then lightships were, at the time, irreplaceable aids to navigation in U.S. waters.

CHAPTER 2: HISTORICAL OVERVIEW

Numerous studies of indigenous watercraft from around the globe demonstrate a strong and ongoing reliance on maritime transportation. Worldwide expansion and increasing populations equated to more property and goods traversing bodies of water and thus, a need for alleviating inherent maritime dangers. Marking shoals, shifting channels, dredged lanes, river entrances, obstructions, and the like, navigational aids assisted in providing safe passage and encouraged continued interest in traversing unknown waters. As exploitation of coastlines continued and trade grew, a well-marked coastline and inland waterway system became necessary for economic growth. Navigational aids proved crucial for managing local seaways and successful maritime navigation.

Defined as “a mark or guide for the mariner or navigator,” navigational aids began as controlled fires (United States Coast Guard 1946:101). Displayed on towers, mountains, and sand bars, the use of light as a signaling device spread through necessity. Recreated as mobile beacons to mark areas not conducive to permanent structures, buoys and lightships became supplementary navigational aids. Referred to as a light boat, lightship, or light vessel, the craft is designed or adapted for displaying a light assisting in navigation. Generally equipped with audible signaling devices, bells and eventually, horns, for use during inclement weather, lightship crews guided mariners in high and low visibility conditions.

Despite the lack of current archaeological findings regarding construction, use, and evolution of lightships, historians hypothesize that employment began during the Roman Empire. Interpreted as armed galleys with metal frames on mastheads for wood or oil fires, the first lightships served as pirate warnings as well as friendly signaling devices (Grupp 1956:30). Adamson suggests a similar idea, claiming that Roman galleys displaying fire in an iron basket

on top of a short mast served as the first lightships, guiding mariners into port and pirates away from shore (1955:50). Despite interpretive theories, an accurate heritage of early lightships remains unknown.

The *Nore* is the first lightship documented in the historical record. Two lanterns were mounted 12 feet apart when launched in 1731. The lights were raised and lowered along the mast (Figure 1). Mariners relied on the *Nore* for direction and safe keeping at the entrance to the Thames River (Cairo 1975:4). The *Nore* was developed from a floating beacon moored in the Thames Estuary in 1713, and became a recognized aid prompting construction and use of similar craft, eventually, throughout Europe and the United States (Talbot 1913:241). The English continued to build and convert ships into lightships, developing methods of construction that other nations employed.

Lightship placement increased by 1740. A lightship moored in Dublin Harbor served local and English mariners in the Irish Sea. In 1807, in an effort to protect British warships outside territorial waters, a fireship was converted into a lightship and used near Scaw, Shetland Islands (Cairo 1975a:4). The English stationed additional lightships in Finland in 1812, and India in 1817. The Germans began employing lightships in 1815 and the United States in 1820 (Cairo 1975b:39).

Although the first American lightships appeared in 1820, the use of navigational aids began much earlier. The Little Brewster Island lighthouse became the first recorded navigational aid in America when ignited 14 September 1716 (Cairo 1975a:4). The lighthouse was inadequate during fog or inclement weather. A cannon, installed in 1719, next to the Boston lighthouse, alerted mariners of the imminent shoreline if the beacon from the lighthouse became indiscernible (Adamson 1955:363). The cannon served so effectively, other colonies along the

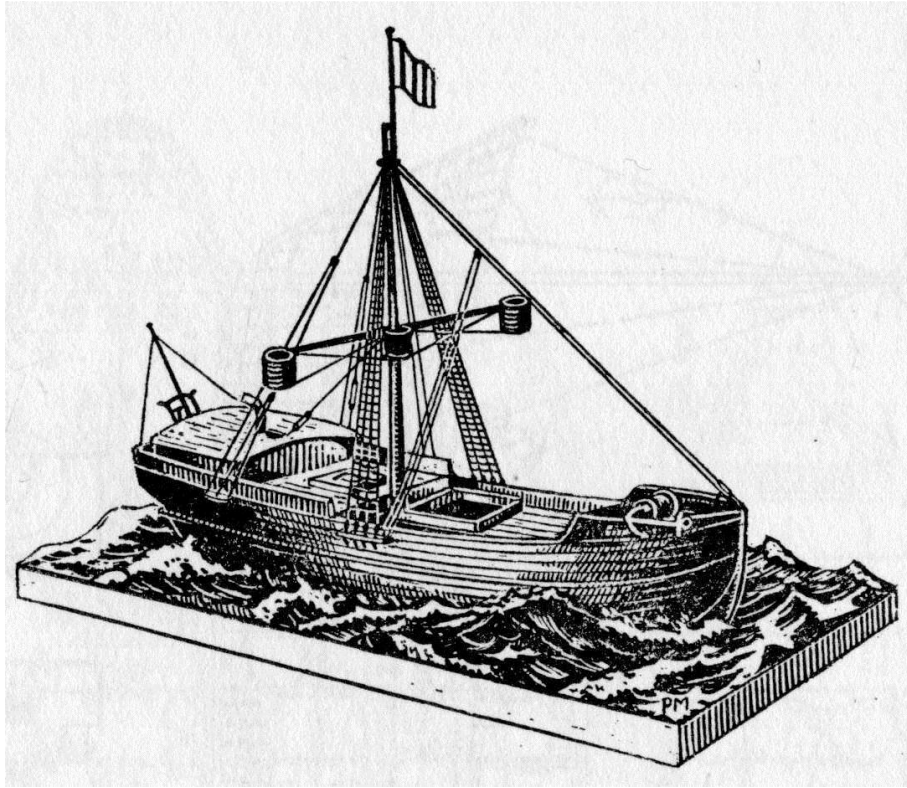


FIGURE 1. The Nore. Photo Courtesy of Lee Chadwick, *Lighthouses and Lightships*. (London, UK: Dennis Dobson, 1971:109.)

Atlantic followed suit, establishing similar fog signals at harbor entrances down the eastern seaboard. In 1767, barrels or lengths of thick lumber served as buoys in Delaware and Boston Harbors (Adamson 1955:350).

Early aids to navigation remained insufficient. Insurance firms based in Philadelphia, as well as foreign and domestic merchants, pleaded with the English Parliament and eventually, the Continental Congress, for more navigational aids (Tilp 1978:90). The British seemingly ignored the requests, failing to provide navigational aids for colonial waters (Hornberger and Turbyville 1997:3). Despite continued trade with Britain, local efforts facilitated maritime commerce in colonial America, leading to a more productive economy and transportation network.

The importance of continued commerce did not escape the newly organized American government. On 7 August 1789, the ninth law passed by Congress placed fiscal responsibility for

navigational aids under Federal jurisdiction (Noble 1997:5). The first decree providing public works for Americans, the ninth law stated,

That all expenses that shall accrue from and after the 15th day of August, 1789, in the necessary support, maintenance and repair of all lighthouses, beacons, buoys, and public piers erected, placed, or sunk, before the passing of this act, at the entrance of or within any bay, inlet, harbor, or port of the United States, for rendering the navigation thereof easy and safe, shall be defrayed out of the Treasury of the United States (Cairo 1975a:6).

The following year, Congress created the Revenue Cutter Service, which evolved into the United States Coast Guard. The Revenue Cutter Service sent ships on regular coastal patrols between Cape May, New Jersey, and Hog Island, Virginia, in an effort to protect American shores and help marooned sailing craft (Adamson 1955:27).

Efforts to improve coastal navigation were still lacking. Local pilots continued experiencing problems from obstructions. The USS *Constitution*'s log states that it took a period of two weeks to traverse the Potomac from Smith's Point to the Navy Yard due to obstructions (Tilp 1978:90). During the late 18th century, the government erected 24 lighthouses (Adamson 1955:24). These aids did little to help mariners with shifting shoals or obstacles. The Commissioner of Revenue managed the initial lighthouses from 1789 to 1802 and from 1813 to 1820. The Treasury Department was responsible from 1802 through 1813. In 1820, responsibility for navigational aids changed again, to the Fifth Auditor of the Treasury (Tilp 1978:91).

Constant shifting of responsibility did little to resolve the need for navigational aid improvements. Fishermen and mariners continued to plead for more beacons and markers. While American mariners suffered, the perilous and scantily marked waterways served as a natural defense against British attempts to retake the colonies. During the 1814 British expedition to take Washington, DC, Charles Napier stated,

The River Potomac is navigable for frigates as high up as Washington, but the navigation is extremely intricate, and nature has done much for the protection of the country by placing, one-third of the way up, very extensive and intricate shoals, called ‘Kettle Bottoms’. They are composed of oyster banks of various dimensions, some not larger than a boat, with passages between them (Napier 1862:76).

In August 1814, at least 23 British ships ran into various obstructions. In addition to British groundings, local captains and shipping companies also sustained damages (Tilp 1978:90).¹

Constant requests to Congress for day markers and floating lights finally proved successful. The first American lightship was approved 15 May 1820. Stationed later that summer off Willoughby Spit, Virginia, the ship helped mark hazardous waters in Chesapeake Bay. The Light-House Board moved the lightship to a more sheltered location due to the inability of the ship to withstand exposure at sea. The new mooring was located in the Elizabeth River, near Craney Island. This site, marking the approaches to Norfolk and Portsmouth, Virginia, became the first established lightship station in the United States (Flint 1889). Due to heavy commercial

¹ Tilp is known for using secondary sources as the basis from which to write his books. Tilp does not use in-text citations and it is difficult, if not impossible, to locate his sources.

traffic plying the Potomac and Chesapeake, the waters in and off Virginia and Maryland received preference (Hornberger and Turbyville 1997:23).

Early coastal surveys, conducted during the beginning of the 19th century, identified additional localities in desperate need of floating lights. After the Louisiana Purchase in 1803, Congress commissioned a reconnaissance of their newly acquired territory to locate potential lighthouse sites. The first, Frank's Island on the Mississippi Delta, proved an important site for directing craft into the river. New Orleans Customs Collector Hore Brouza Trist suggested placing a floating light instead of a lighthouse, claiming it would be difficult to build on the soft delta terrain. Trist eventually changed his mind, claiming ocean conditions would be too much for a stationary vessel. Two years later, Secretary of the Treasury Albert Gallatin suggested a floating light for the Gulf but was unsure regarding overall feasibility. In 1820, Congress authorized the first lightship for New Orleans and the Mississippi Delta, awarding a contract to New York shipwright Christian Bergh. The *Aurora Borealis* arrived at New Orleans in December 1820 as the second U.S. lightship (Cipra 1997:205-206,219).

In 1806, a coastal survey focused on the North Carolina coast. Known as the Graveyard of the Atlantic, the waters off North Carolina are notorious for shifting shoals and sand banks (Cairo 1975a:11). Cape Hatteras, Cape Lookout, and Frying Pan Shoals, well known distress locations, remained unmarked. Located at the collision of the southbound Labrador Current and northbound Gulf Stream, shoals constantly shifted and posed serious risks to mariners attempting passage. Despite the 1806 survey, North Carolina waters remained without lightships until 1820 and even then, the perilous outer stations remained unmarked through 1824.

Utilizing appropriations set aside by Congress specifically allotted for funding a lighthouse or light vessel near Shell Castle Island, North Carolina, Fifth Auditor of the Treasury

Stephen Pleasanton chose a vessel. Responding to reports that a stationary beacon already in place was ineffective due to extensive channel shifting, Pleasanton decided that a mobile warning light better suited the environment. Entering into contract with William Doughty in August 1820, Pleasanton agreed to pay \$6,400 for a 41 ton, purpose built vessel. Pleasanton required that Doughty deliver the newly constructed lightship to the Inspector at Ocracoke no later than 15 December 1820. Doughty succeeded, building the lightship in less than four months (McGuinn 2000:218-219).

By the end of 1820, the United States Government had funded and stationed three lightships. Survey efforts expanded to include Florida, acquired the previous year from Spain. Commercial shipping interests in New York and Louisiana pleaded with Congress to implement navigational aids in the Straits of Florida. On 7 May 1822, Congress authorized construction of two lighthouses, one on Cape Florida and the other in Dry Tortugas. The initial sites were promising but neglected several problem areas in between them. Carysfort Reef, an extensive coral system extending east off North Key Largo, remained unmarked. Named for the wreck of the HMS *Carysfort*, a British frigate that grounded 23 October 1770, the Carysfort Reef served as the location for the first lightship in Florida (Taylor 2004:18).

The acquisition of Louisiana Territory and Florida did not constitute the only regional growth in the United States during the early 19th century. By 1800, the Great Lakes were developing into an industrial, commercial, and residential region. The Erie Canal, completed in 1825, marked the beginning of tremendous growth in the Great Lakes. Steamships, plying the Lakes since 1816, and other sailing craft, were aided by lighthouses beginning in 1818, but did not see the first lightship until 1832. Stationed at Wangoshance Shoals, west of the Straits of

Mackinac and serving every shipping season through 1851, the Mackinaw Straights lightship was the first of 20 stationed in the Great Lakes (Hyde 1995:14-16).

Lightship use continued to grow, peaking in 1909 with 56 stations. Population expansion led to increases in shipping and commerce. Requisites set by foreign countries and insurance companies mandated navigational aids as basic necessities of maritime travel within domestic waters. These factors contributed to strengthening of the American lightship fleet. In 1898, the Light-House Board stationed lightships off San Francisco, California, and Umatilla Reef, Washington, completing initial placements on both coasts and in the Great Lakes. Table 1 offers a chronological listing of lightships stations in United States waters, describing the progression of placement as well as locations. Established in response to inquests and appeals, the total number of lightship stations in American waters totaled 116 (Flint 1989).

TABLE 1
CHRONOLOGICAL LISTING OF DOMESTIC LIGHTSHIP STATIONS

Year Established	Station Name
1820	Craney Island, VA, Northeast Pass, LA
1821	Willoughby Spit, VA, Wolf Trap, VA, Smith Point, VA, Upper Cedar Point, MD
1823	Sandy Hook, NY, Brandywine Shoal, DE, Upper Middle, DE
1824	Cape Hatteras, NC
1825	Lower Cedar Point, MD, Long Shoal, NC, Carysfort Reef, FL
1826	Royal Shoal, NC, Wades Point Shoal, NC
1827	Nine Foot Shoal, NC
1828	Neuse River, NC, Tuckernut Shoal, MA
1831	Brant Island Shoal, NC
1832	Mackinaw Straights, MI
1833	St Helena Bar, SC
1834	Windmill Point, VA
1835	Bowlers Rock, VA, Bartlett Reef, CT, Roanoke River, NC, Roanoke Island, NC, Harbor Island, NC
1837	Stratford Shoal, CT, Five Fathom Bank, NJ

Year Established	Station Name
1838	Northwest Passage, FL
1839	Martins Industry, SC
1846	Sand Key, FL
1847	Vineyard Sound, MA, Merrills Shell Bank, LA
1848	Tybee Island Knoll, GA
1849	Pollock Rip, MA, Eel Grass Shoal, CT, Ship Shoal, LA, Atchafalaya Bay, LA, Galveston, TX
1851	Minots Ledge, MA, Horseshoe Shoal, NC
1852	Shovelful Shoal, MA, Cross Rip, MA, Ocracoke Channel, NC
1853	Brenton Reef, RI, Janes Island, MD
1854	Rattlesnake Shoal, SC, Frying Pan Shoal, NC, Nantucket New South Shoal, MA, Succonnessett Shoal, MA
1855	York Spit, VA, Calibouge Sound, SC
1856	Bishop and Clerks, MA, Cornfield Point, CT
1857	Dames Point, FL
1858	Handkerchief, MA
1859	Combahee Bank, SC
1863	Fishing Rip, SC
1865	Wreck of Weehawken, SC
1866	Hen and Chickens, MA
1868	Wreck of the Scotland, NJ
1870	Choptank River, MD
1874	Wreck of the Scotland, NJ, Winter Quarter Shoal, VA
1876	Fourteen Foot Bank, DE
1881	Trinity Shoal, LA
1882	Northeast End, NJ
1883	Ballard Reef
1886	Hog Island, RI, Ram Island, CT, Wreck of the Oregon, NY
1887	Grosse Point, MI
1888	Fenwick Island Shoal, DE, Cape Charles, VA
1890	Great Round Shoal, MA
1891	Scotland, NJ, Bush Bluff, VA, White Shoal, MI, Simmons Reef, MI, Grays Reef, MI
1892	Nantucket Shoals, MA, Columbia River, OR
1893	Wolf Trap, VA, Bar Point Shoal, Lime Kiln Crossing South, Lime Kiln Crossing North, Lake Huron, MI, Poe Reef, MI, Eleven Foot Shoal, MI
1894	Boston, MA, Charleston, SC, South Pass, LA

Year Established	Station Name
1895	Smith Point, VA
1896	Fire Island, NY
1897	Diamond Shoal, NC
1898	Overfalls, DE, San Francisco, CA, Umatilla Reef, WA
1900	Lansing Shoal, MI, Tail of the Horseshoe, VA
1901	South East Shoal, OH
1902	Pollock Rip Shoals, MA
1903	Cape Elizabeth, ME
1905	Cape Lookout Shoals, NC, Heald Bank, TX
1905	Blunts Reef, CA
1906	Peshtigo Reef, WI
1907	Brunswick, GA
1908	Thirty Five Foot Channel, VA, Hedge Fence, MA, Ambrose Channel, NY
1909	Swiftsure Bank, WA, Martin Reef, MI
1910	North Manitou Shoal, MI
1912	Milwaukee, WI, Lake St Clair, MI, Buffalo, NY, Southwest Pass, LA, Portland, ME
1913	Pollock Rip Slue, MA
1916	Stonehorse Shoal, MA
1922	Savannah, GA
1927	Barneгат, NJ
1928	Chesapeake, VA
1929	St Johns River, FL
1954	Buzzards Bay, MA
1960	Delaware, DE
1965	New Orleans, LA

Source: (Flint 1989).

As mariners grew more reliant on lightships, the responsibility of crews maintaining stations became more demanding. The first half of the 19th century exhibited substandard maintenance of lightships as well as problems sustaining station locations. Derelict crews often left posts abandoned for weeks at a time without punishment or loss of remuneration. Inclement weather caused removal of lightships from stations and broken moorings, setting vessels adrift

and susceptible to destruction. Great Lakes lightships did not serve from mid to late December through April, alleviating the possibility of damage from ice flows. Annual repairs and maintenance served as an additional cause of removal but in these situations, relief lightships usually replaced those under repair. The increasing number of relief vessels, coupled with mooring changes and the addition of steam propulsion helped maintain lightships on station. Improvements helped strengthen the ability of crews to stay on post; however, none of these accomplishments prevented removal during war.

Lightships in American Wars

Amphibious operations proved fundamental to the success of American campaigns during the Civil War, World War I, and World War II. Accustomed to using markers, charts, and pilots, to navigate within domestic waters, U.S. Navy captains relied on markers placed by the Lighthouse Establishment to guide crew, cargo, and craft safely. Lightships, an important component of the American beacon system, functioned in additional roles during war. Lightships proved to be versatile ships, serving in missions not intended for such specifically designed craft. Lightships were reassigned and reconfigured to fill voids in the American navies. Serving as river obstructions, prizes of war, quarantine vessels, store ships, troop transports, rescue vehicles, armed examination vessels, as well as navigational beacons, lightships during American wars served minor but significant roles.

The Civil War marks the first domestic war employing lightships. Lightships succumbed to destruction under Union and Confederate activities and declined in number throughout the war. A letter written 2 May 1866, by Chairman of the Lighthouse Board W.B. Shubrick, discussed navigational aids in place prior to the rebellion. American navigational aids included 365 lighthouses, light vessels, and lighted beacons. Of 365 beacons, 44 were lightships stationed

along the eastern seaboard and Gulf of Mexico (Flint 1989). One hundred and seventy seven of these lights were located within seceding states and were either damaged, destroyed, or extinguished by June 1862 (Shubrick 1866).

Initial reports detailing lightships lost or damaged during the Civil War appear in the *Official Record of the Union and Confederate Navies in the War of the Rebellion*. Matching 137 entries in 25 records, the word “light-ship” yields information relevant to use, recovery, destruction, and crews associated with lightships. The most common reference involves Union sailors observing lightships while underway. Naval crews utilized lightship crews as intelligence sources, stopping to obtain information regarding passing ships and provincial war operations. Providing details relevant to terrestrial operations as well as naval activities, lightship men warned of impending attacks or enemy vessels. As lightships moved off station for security reasons or through capture or destruction, alternative beacons provided needed services. Storing supplies, housing sick soldiers and seamen as quarantine vessels, and ferrying up to 500 Confederate troops at once, lightships demonstrated value beyond navigational use (Macgruder 1861:687).

Despite their flexibility and varied uses, the majority of lightships taken off station during the Civil War were destroyed. Ten days after the start of hostilities, the first of at least 24 lightships lost burned. On 22 April 1861, the crew of the USS *Mount Vernon* saw the Lower Cedar Point Lightship ablaze. Aware of the location and status of the ruined vessel, the USS *Mount Vernon* passed the news to the USS *Pocahontas*, alerting northern forces to new navigational charting information (Welles 1861:425).

April 1861 was an especially bad month for lightships. Eleven lightships were captured, sunk, or burned by Confederate and Union forces within the first month of the war. This total

represented 25% of the American fleet and roughly half of all lightships affected during the conflict (Flint 1989). Eight months after the incident in the Potomac, a report from the USS *Mount Vernon* indicated further lightship losses. After being converted into a defensive vessel, lightship *D* was removed from the Frying Pan Shoals station and repositioned at Fort Caswell, 20 miles outside Wilmington (United States Treasury Department 1889).

Commander Oliver S. Glisson, captain of the USS *Mount Vernon*, noted that the Confederates added additional berths, two after guns, and gun ports for six broadside cannon. “Having observed that the rebels made use of a light-ship as a beacon for guiding vessels in and out of the harbor, and for the purpose of annoying us by hoisting lights at night, I determined to take advantage of a hazy night, with the wind offshore, to affect her destruction” (Glisson 1861:493). Glisson dispatched Union seamen to destroy the lightship. Leaving the lightship after setting it on fire, Union ships moved away from the reach of shore guns and escaped (Glisson 1861:494).

Confederate and Union forces burned two more lightships by the close of 1861. During the 1861 attack on Fort Ocracoke, the lightship marking the passage between Ocracoke and Hatteras Islands was destroyed. Rebel forces salvaged the mooring cable and anchor, leaving other remains on the beach (Rowan 1861:270). The following month, Union forces set the Portsmouth, Virginia, lightship ablaze before Confederates could equip, arm, and re-station her as a war ship (Maxwell 1861:224).

The arson at Fort Caswell, Fort Ocracoke, and Fort Portsmouth, did not constitute the only damage to lightships within Confederate waters. Fort Lowry, located on the Rappahannock River, below Tappahannock, Virginia, was another site of lightship destruction. The lightship

was sunk in the water just off the fort, with its masts visible during daylight (Figure 2). Union vessels used the sunken lightship as a day mark (McCrea 1862:36). Keeping track of sunken

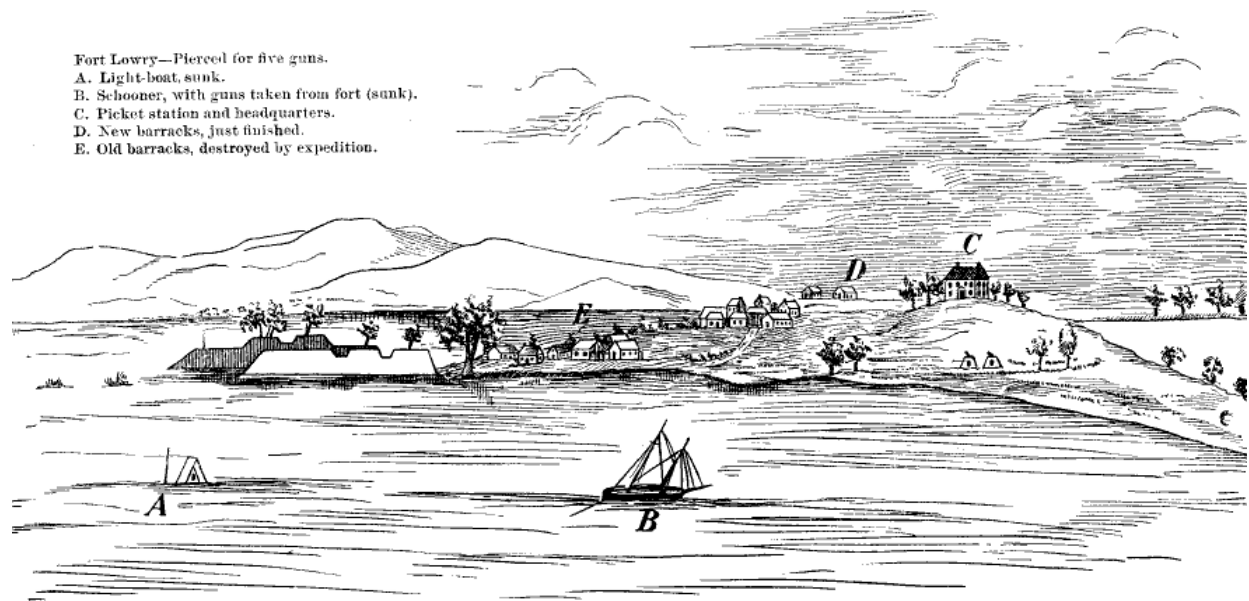


FIGURE 2. Lightship sunk in the Rappahannock River. (Photo courtesy of the *Official Records of the Union and Confederate Navies in the War of the Rebellion*, Series I – Volume 5, Operations on the Potomac and Rappahannock Rivers (December 7, 1861 – July 31, 1865). Government Printing Office, Washington, DC.)

vessels served as an important tool for navigating in southern waters. In addition to lightships lost at forts, lightships stationed on points were also removed. Union forces removed the lightships at Windmill Point and Smith’s Point, Virginia (Glasson1861:335).

Controversy exists over the Smith’s Point light vessel. Despite reports of withdrawal under Union orders, an article published in the *New York Times* claimed otherwise. In a letter written by a member of Company G, Thirteenth New York Infantry, a soldier claimed Union forces found the Smith’s Point light vessel in Mill Creek, off Wicomico River (E.M.B. 1861). A reconnaissance led by Captain Charles Flusser confirmed location of the missing lightship in Mill Creek. Captain Platt Marvin Thorne piloted the *Wm. Woodward* towards the lightship.

Despite fire from Confederate forces near the vessel, Union soldiers successfully attached tow lines to the lightship, reclaiming the Federal vessel (*New York Times* 1861).

Reports from the USS *Mercury* dated 17 October 1864, revisited the Confederate capture of the Smith Point lightship. The lightship crew was held as prisoners of war and had waited rescue since August. Union forces, intent on capturing locals to exchange for the imprisoned lightship crew, encountered “stout resistance” during shore incursions (Nelson 1864). The ship and the equipment remained at large. The long boat from the vessel materialized on 26 October, in possession of Confederate Captains John Woody and James Parks. The long boat sold for \$3,000 Confederate at a public auction held at the Lancaster Court House, 19 August 1864 (Arthur 1864:489-490).

Generally unarmed and often without protection, lightship crews could not protect their lightships. Several lightship sites required replacement for those sunk, captured, or destroyed. In North Carolina, the Brant Island Shoals, Neuse River, and Long Shoals lightships were destroyed. The Treasury Department, funding replacement of some vacant stations with alternative and cost effective screw-pile lighthouses, no longer needing to repair damaged lightships. Instead of repairing ships and returning them to station, the government purposely scuttled three ships in the Neuse River as barriers against ironclads. Three more lightships were sunk in the Neuse River during 1862, as the Union again sought to blockade ironclads. A letter written to the Naval Secretary from J.R. Soley, U.S. Navy, indicates that the Royal, Brant Island, and Roanoke River lightships served as obstructions (1889).

In 1863, following the Neuse River blockade, a similar plan to block the Roanoke River came to fruition. Threatened by the CSS *Albemarle*, Union forces attempted to halt passage of the new ship from above Plymouth, North Carolina (United States Treasury Department, Office

of the Lighthouse Board 1862). Re-floated, moved, and then sunk again, the Long Shoals Lightship, accompanied by one other lightship and five or six “other hulks”, comprised the Union blockade near Plymouth (Figure 3). The blockade proved ineffective; on 19 April 1864,

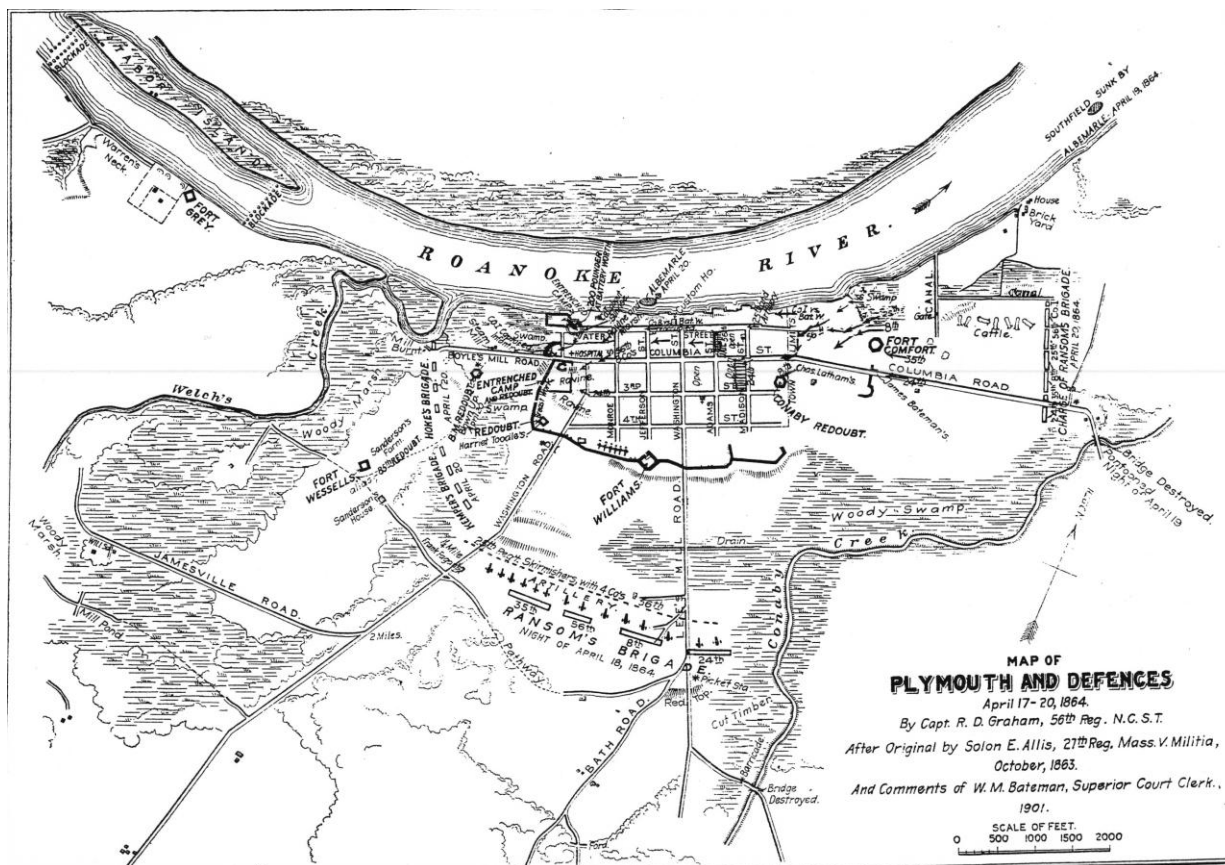


FIGURE 3. Union blockade near the town of Plymouth utilizing scuttled lightships. (Image courtesy of the Underwater Archaeology Branch, Fort Fisher, North Carolina.)

the CSS *Albemarle* reached Plymouth, sank the USS *Southfield*, and forced the Union out (United States Treasury Department, Office of the Lighthouse Board 1862).

In 1990 and 1991, the North Carolina Underwater Archaeology Branch (UAB) examined the blockade area in the Roanoke. This site is referred to as the Broad Creek Blockade. The UAB located the likely remains of the Long Shoals Lightship using a Magnetometer Survey. The “Mast Wreck” (#0019ROR) lies in 14 to 17 feet of water. Eighty-five feet nine inches in length, the wreck had two masts. The amidships mast positions are consistent with figures specified on

earlier lightships. Chain plates remain on the vessel as well as other diagnostic features indicating the wreck is a probably a lightship (Lawrence 2002:7-11).

The Mast Wreck serves as a reminder of lightship destruction during the Civil War. Of the 24 lightships lost between 1861 and 1865, the Treasury Department funded only 8 replacements. Valued at \$139,203 for all 8 ships combined, the government opted to replace only 9 missing lightships (Flint 1989). The ramifications of not replacing removed or destroyed navigational beacons had tragic and lasting effects. Between 1860 and 1865, 2,864 American vessels wrecked (Figure 4). These numbers continued to increase. From 1866 to

*** TABLE OF WRECKS OF AMERICAN VESSELS
FROM 1858 TO 1868.**

<i>Year.</i>	<i>No.</i>	<i>Value.</i>
1858.....	355	\$8,897,665
1859 (9 months)	300	8,889,271
1860 (11 months)	405	12,011,030
1861.....	558	17,367,100
1862.....	452	12,765,060
1863.....	452	20,531,800
1864.....	495	20,449,850
1865.....	502	33,794,300
1866.....	571	31,056,100
1867.....	536	21,742,200
1868 (9 months)	257	11,698,500
Total, 10 years 5 months.	4883	\$198,702,876 *

FIGURE 4. Table listing shipwrecks per year, 1858-1868. Image courtesy of *Harper's New Monthly Magazine*. (Shanks 1868:440.)

1868, an additional 1,364 ships went down, totaling \$181,415,940 in losses during the 8 years. Not entirely related to the mismanagement of navigational beacons during the war but definitely

a factor, the slow return of the signals increased maritime hazards. An article titled, “Policemen of the Sea”, published in the March 1869 issue of *Harper’s New Monthly Magazine*, criticized the Lighthouse Board. Claiming the Board lacked organization and numbers, Shanks argued that the United States Government did little to organize means for saving life and property (Shanks 1869:433-440).

The article continued, offering 45 instances of lights remaining extinguished since the Civil War. Shanks declared, “under our incomplete system, our harbors and coasts are as dark as the boldest river-thief and smuggler could wish; the line of coast between the lights is never patrolled and no lookout at sea is ever kept for endangered vessels” (Shanks 1869:435). Citing instances when a station went abandoned for a period of two weeks, Shanks implored the reader to consider the dangers and think about the unnecessary loss of life. Providing statistics relative to the deaths from shipwrecks between 1858 through 1868, Shanks argued that 14,649 persons perished during this period, approximately 1,500 per year (Shanks 1869:440).

In response to letters and official reports compiled throughout the war concerning uncharted river obstructions, new shipwrecks, and vacant light stations, the Treasury Department initiated appropriations for re-establishing navigational aids. In letters sent from the Light House Board to the Treasury Department, the board requested funds for reinstituting aids in place prior to the rebellion as well as constructing new lightships and lighthouses to meet present conditions (Jordan 1866). The Treasury Department denied financing new beacons but granted funds for repairing navigational aids existing before the war. Accurately recharting American waterways to account for all of the changes incurred during the Civil War proved lengthy. A survey performed by the Corps of Engineers offered estimates for removing all vessels sunk during the rebellion. Including an additional \$13,117 added for “contingencies and superintendence twenty

percent,” the total cost for dredging and snag removal just within the Roanoke River reached \$78,702 (Manning 1872:733).

In addition to monies spent post-war on salvaging lightships, replacing navigational markers, and clearing waterways of obstructions, the Treasury Department allocated funds for new lightships. In the 10 years following the war, 5 new lightships, totaling \$225,040 joined the fleet. By the turn of the century, the Treasury Department had spent over \$1,273,348, adding 33 lightships across American waters. Expansion of navigational markers, combined with annual maintenance, did much for maritime navigation. Commerce expanded, trade increased, and inland waters became accessible to mariners unfamiliar with local bathymetry (Flint 1989).

Despite efforts to improve navigational aids, the beacon system, once again, succumbed to change during war. Prominent by design and stationed at off shore locations where shoaling or currents proved dangerous to sea travel, lightships served as targets for German U-boats during World War I and II. In addition to targeting the lightships, U-boat captains sought to destroy Allied merchant vessels utilizing the ships as navigational aids. The first involvement of lightships during World War I began prior to official American involvement. The Nantucket lightship functioned as an indicator for all coastwise and trans-Atlantic traffic, marking the southern extremity of shoals extending south and east of Nantucket Island, Massachusetts. Moored to the seafloor by mushroom anchors and mooring chains, the Nantucket lightship functioned alone, unable to outmaneuver U-boats (Flint 1989).

U-53, the submarine responsible for the majority of damage in the Nantucket locality, targeted enemy ships, destroying supplies and the vessels carrying them. The height of these attacks culminated in the rescue of 115 survivors set adrift by 6 separate torpedo attacks in one

day. Trailing 19 fully loaded lifeboats behind the Nantucket lightship, the crew departed station and steamed to shore (Lincoln 1980:75).

The crew of the Nantucket fared better than those aboard the Diamond Shoals lightship. Stationed off the Outer Banks of North Carolina, marking shoals created by the converging Gulf Stream and Labrador currents, the Diamond Shoals lightship directed all coastwise shipping on the eastern seaboard. During the afternoon of 6 August 1918, the crew aboard *LV71* (Figure 5),



FIGURE 5. *LV71* prior to sinking by a German U-boat. (Photo courtesy of the USCG Historian's Office Archives, Box 18, Washington, DC.)

witnessed an attack on a merchant vessel. Immediately dispatching warnings via wireless communication, the lightship crew alerted area craft to the U-boat's presence. *U-140* rose from the sea within 150 yards and aimed 4 in. guns at the lightship (Toole 1953:28). Warned of impending fire and offered adequate time to launch life boats and abandon ship, the crew left the lightship (Bureau of Lighthouses, Department of Commerce 1919:69). As the crew fled *LV71*, shells struck the lightship and sunk her (Toole 1953:28).

World War I ended within a few months of the *LV71* attack. The navy set up 7 temporary lightship stations 30 miles off shore, between December 1918 and summer 1919 to guide troop transports back to American soil. The U.S. used five *Lapwing* Class minesweepers, a commercial ocean-going tug, and a former offshore trawler as provisional lightships. By marking the entrance to channels leading into Boston, New York, Delaware Bay, Chesapeake Bay, and Charleston, lightships offered safety and guidance to troops returning from Europe (Flint 1989).

Events involving lightships during World War I helped shape overall duties and re-outfitting for World War II. Initially, the Coast Guard contemplated removing all outer lightships from service; alone and unarmed, they served as easy targets. Instead of overall removal, the Coast Guard reassigned 22 lightships to the navy for use as examination vessels, net tenders, and guard ships, keeping 9 vessels in place as navigational beacons. The lightships transferred to the Navy underwent renovations that included changing the hull color from red to grey, adding berths to accommodate larger crews, and, in at least twelve lightships, the addition of guns. Mounted on the bridge wings or aft, the addition of guns helped deter enemy attacks (Figures 6, 7) (Flint 1989).

Torpedoes and sea mines were sensitive to magnetic disturbances, so degaussing coils were added to selected lightships. Degaussing coils, installed longitudinally, vertically, and

athwartship, reduced a ship's magnetic disturbance, diminishing the chances of triggering magnetic mines or torpedoes. Typically installed on mine sweepers and controlled by regulating currents passing through different coils, degaussing installations aboard lightships offered protection against enemy munitions during World War II (Figure 8) (Northwest Seaport 1940s:579-591).



FIGURE 6. LV83 armed for WWII. (Photo courtesy of USCG Historian's Office Archives, Lightship Subject Files, Box 2, Washington, DC.)

Aside from changing features on selected ships and reassigning half the fleet to Naval command, other duties included rescue operations and foreign assignments. Similar to events occurring during World War I, lightship crews recovered victims from torpedoed ships. The

Blunts Reef lightship, off Cape Mendocino, California, rescued the crew of a Japanese tanker sunk by German U-boat fire (Lincoln 1980:75). Contact with foreigners did not end with rescue operations. *LV115*, previously stationed off Frying Pan Shoals, NC, transferred to the Panama Sea Frontier in 1944 for service as a Coast Guard patrol vessel (Strobridge 1975).

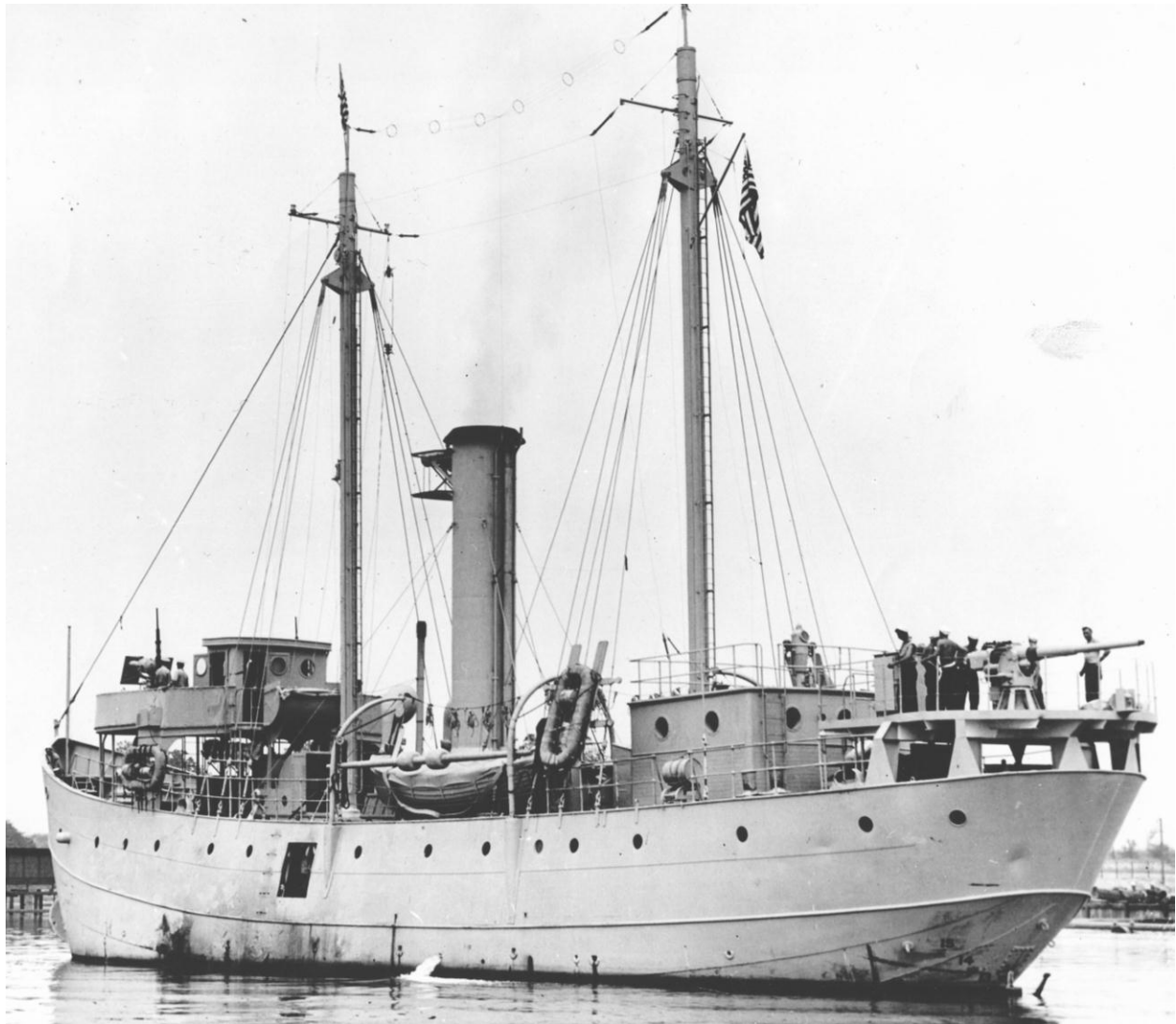


FIGURE 7. A lightship armed for WWII. (Photo courtesy of the USCG Historian's Office Archives, Lightship Subject Files, Box 2, Washington, DC.)

Managed by exceptionally brave men bound to domestic service through enrollment in the United States Coast Guard, lightships helped foreign and national civilians as well as military

personnel during three wars. By serving in a variety of roles at preselected locations, lightships proved their worth. Redesigned and reconfigured for a range of uses, technicians transformed lightships to meet war time needs. Maintaining a constant light whenever possible, lightship crews did not cower during the perils of war. Lightships were originally navigational beacons but became effective vessels when armed for defense.



FIGURE 8. Degaussing coils onboard *LV83*. Photo shows the main distribution panel and coils. The coils on the starboard side have been severed but are intact on the port side. Scale bar is in inches. (Photo courtesy of the author, 2010.)

CHAPTER 3: LIGHTSHIPS IN THE AMERICAN MARITIME CULTURAL LANDSCAPE

Archaeologists utilize scientific theory to interpret cognitive behaviors in the past. One way is to study artifacts or objects of material culture. It is not enough to simply find artifacts and record data but rather understand what was going on in the society that created the artifact. There are several archaeological concepts that can be applied in the field; however, it is the responsibility of the archaeologist to choose appropriate techniques. As this investigation deals with lightships, it is important to use theory that focused on maritime venues, more specifically, navigational aids. In this chapter, the implications of lightships within the American maritime cultural landscape will be discussed using concepts developed by Christer Westerdahl and Ian Hodder.

A maritime cultural landscape is “the whole network of sailing routes, old as well as new, with ports and harbors along the coast, and its related constructions and remains of human activity, underwater as well as terrestrial” (Westerdahl 1992:6). The maritime cultural landscape was introduced by Christer Westerdahl in 1978 as a post-processualist concept that recognized the “marine sector of society” (Cederlund 1995:12). Westerdahl provides a means of scientifically recreating ancient landscapes based on remaining sources of landscape. Sources of landscape can be border zones, transport zones, place names, blockages, transit points, sea routes, shipwrecks, land remains, tradition of usage, and natural topographic features (Westerdahl 1992:7-10). Additional landscape sources are objects of material culture that “signify human utilization of maritime space by boat: settlement, fishing, hunting, shipping, pilotage, lighthouse and sea mark maintenance” (Westerdahl 1992:5).

Westerdahl’s theory is an appropriate concept to study lightships. Lightships are sea marks and can be included as features in Westerdahl’s maritime cultural landscape. Historical

research presented in the previous chapter demonstrates that lightships were used for tasks other than navigation. Thus, it was important to find a theory that provided a means of analyzing additional lightship roles within the American maritime cultural landscape. Westerdahl's theory was still the best choice as lightships can be studied as shipwrecks, land remains, tradition of usage, natural topography, place names, blockages, transit points, and sea routes (Westerdahl 1992:7-10).

Westerdahl considers shipwrecks sources of the maritime cultural landscape, including known and unknown wreck locations. Lightship wrecks are mentioned in previous archaeological reports, documented on navigational charts, and discussed in the *Official Records of the Union and Confederate Navies in the War of the Rebellion* (1861, 1862, 1864). Terrestrial remains are Westerdahl's second category for sources of the landscape. For this study, lightships converted into floating museums can be viewed as land remains. At least nine efforts have been made to preserve lightships, on or immediately adjacent to land. *LV83*, *LV87*, *LV103*, *LV112*, *LV116*, *LV118*, *WLV604*, and *WLV605* are moored wharveside and *LV101* is encased in concrete (Westerdahl 1992:7-8).

Tradition of usage, the third category for sources of landscape, is defined by Westerdahl as, "reflected by the mental map of coastal people in general, based on the existence of well-used havens or routes, and on the influence of local winds and currents" (1992:8). Tradition of usage can be further defined as, "important junctures" or areas, "where there has been a constant need for guidance or pilotage during the centuries," and it acknowledges local maritime experiences or traditions (Westerdahl 1992:8). The Treasurer's Office and, eventually, the Light House Board understood the tradition of usage concept. Navigational aids, specifically lightship stations, were geographically chosen based on recommendations from locals. Lightships were situated over

shoals and shipwrecks, or marked river entrances, inlets, or approaches; problematic localities identified through tradition of usage.

Natural topography and place names are Westerdahl's remaining sources of landscape. Referring to contours on land, depth, and the effects of silting and isostatic uplift, Westerdahl uses the study of natural topography and tradition of usage to identify natural harbor basins (Westerdahl 1992:8). Considering that lightships marked underwater contours, the argument for associating them with natural topography seems fitting. In addition, lightships marked harbor and river entrances and, in World War Two, approaches to major cities. Shoal locations, harbor entrances, and changes in bathymetry (1820 through 1986) were not attainable without tradition of usage. Modern technologies such as LORAN (Long Range Navigation), since replaced by GPS (Global Positioning System), took tradition of usage data and made it widely available worldwide. Prior to these devices, lightships and other navigational marks were the only means of identifying problematic localities when mariners navigated outside of their tradition of usage areas.

Place names serve as the final landscape source defining the maritime cultural landscape. Place names are passed between generations and, like the study of natural topography, are linked with tradition of usage. Lightships were generally named for the features they marked. These names were obtained from locals who designated the features because of a tradition of usage. Westerdahl includes blockages and names of sailing marks in the place name category. Westerdahl used the Skuldelev ships as an example of blockages. During the Civil War in North Carolina, lightships were used to create blockages in the Roanoke and Neuse Rivers. The Union navy constructed barriers to prevent passage of Confederate ships. Blockage locations were chosen because of tradition of usage and proximity to other features in the cultural landscape, in

this case, shipyards. Purposely introduced into the landscape as blockages, sunken lightships are a source for studying America's maritime cultural landscape (Westerdahl 1992:9).

Understanding sources of landscape is one component of Westerdahl's view of maritime cultural landscapes. Traditional zones of transport geography, or corridors, serve as another. Transportation corridors are created as "expressions of social practice" and are chosen "in response to nature" (Westerdahl 1995:213). Referring to the "deeply cultural essence of transport corridors, the routes and the organization of transport," Westerdahl's theory studies transportation routes over water (1995:213). In America, these transportation routes are marked by navigational aids. Westerdahl's theory provides a means of studying America's maritime transportation routes, allowing for the justification or "active and meaningful" production of navigational aids, specifically, lightships (Hodder 1985:1).

Lightships were stationed along both coasts of the United States, in the Great Lakes, and in busy or dangerous estuarine environments such as Chesapeake Bay and in North Carolina. These areas were part of America's traditional zones of transport geography, 1820-1983 (Table 1). The majority of lightships stationed throughout the traditional transport corridors were similar. As naval engineering, shipbuilding technologies, and readily available materials became more accessible in America, lightship construction styles began to vary, depending on environment. Westerdahl's maritime landscape theory attempts to explain these differences by the presence and identification of border zones.

In an effort to describe the importance and meaning of different ocean, coastal, and inland, transportation routes, Westerdahl uses geographic components to explain possible venues and the differences that occur between them. Defined by transverse and longitudinal border

zones, geographical, or political limits, Westerdahl uses different geographical regions of water transport to define differences between ship types,

The boat is a means of transport which is adapted to: transportation requirements; the environment in which it is used; its intended function (such as types of cargo); and the availability of materials. It operates within largely predetermined traffic networks, the transport zones, in vernacular tradition. These enumerated factors can be measured in different degrees in the form (type) of the boat, particularly in the form of the hull (Westerdahl 1995:268).

In America, there are at least two zones of lightship employment, the Great Lakes and coastal transportation corridors. It is possible to differentiate between these environments by studying the differences in lightship construction.

For example, *LV10*, *LV63*, *LV64*, *LV65*, *LV75*, and *LV77* were scow style lightships, specifically built (*LV10* was converted) for use in the Great Lakes. These six scow lightships worked well in lake environments, were smaller, and cost less than the larger, overbuilt models used offshore. Although intentional differences between Great Lakes lightships and coastal lightships will be discussed over the next two chapters, *LV77* and *LV84* will be compared here for theoretical relevancy. *LV77* was built in 1906 by Johnson Boiler Company of Ferrysburg, Michigan, for use at Peshtigo Reef, Wisconsin. *LV77* was 75 feet long, 21 feet 6 inches in beam, 9 feet 3 inches in draft, and displaced 155 tons in fresh water. *LV84* was built in 1907 by New York Shipbuilding Company. *LV84* marked the approaches to Brunswick, Georgia, and was

stationed in the Atlantic Ocean, approximately 14 miles offshore. *LV84* measured 135 feet 5 inches in length, 29 feet in beam, 12 feet 9 inches in draft, and displaced 683 tons (Flint 1989).

LV84 measured 60 feet 5 inches longer, 7 feet 6 inches wider, 3 feet 6 inches taller, and displaced 528 tons more than *LV77*. It cost the government \$13,950 to construct *LV77* and \$99,000 to construct *LV84*, a significant difference of over \$85,050. *LV77* and *LV84* were built one year apart. One way to explain the vast differences in size between the two ships is by studying venue of employment. It was possible for the Light-House Board to order smaller ships for the Great Lakes region because of differing environment or geographical factors. Great Lakes lightships were smaller because wave and weather conditions were less severe than on exposed coastal stations. Great Lakes lightships were employed only from April through December, as they were removed in winter to prevent damage from ice. Coastal lightships remained on station year round and were heavily built to counter weathering and harsh conditions.

Westerdahl's traditional zones of transport geography explain why lightships were constructed differently, depending on venue of employment. The presence of traditional zones of transport geography reasserts that America has or had a maritime cultural landscape, at least while lightships were employed. The fact that lightships classify as numerous sources of the landscape indicate that not only were they shipwrecks, land remains, evidence of tradition of usage, place names, blockages, and navigational aids, but also artifacts or objects of material culture remains.

To assign the term "object of material culture" to an artifact, it is important to understand the phrase's definition. Material culture is "actively and meaningfully produced" in an environment where "the individual actor, culture, and history are central" (Hodder 1985:1). Hodder's principles consider variation when interpreting material culture. Deviations in

perception based on, “evocation” and, “context” are attached to objects of material culture, and can be used to explain the culture that “meaningfully produced” the artifact in question (Hodder 1985:1, 14). In this investigation, Hodder’s artifact theory was applied to lightships.

“Meaningfully produced” by a culture reliant on water transport, lightships were employed to protect human lives, enable commerce, and uphold standards of civilization set in 1731, when Trinity House launched the *Nore*. Crewed, viewed, and used, by a variety of people, from land and sea, different ideas associated with lightships help define the maritime culture that existed during their employment.

To decipher American cultural cognitive behaviors from 1820 to present, it is crucial to understand the different capacities or context in which lightships were used. Historical research provides evidence of lightships employed as navigational aids, rescue ships, armed naval vessels, store ships, troop transports, portable accommodations, river obstructions, and U-boat targets. After 1983, or upon individual ship decommissioning, lightships were converted into floating museums, fishing vessels, restaurants, naval targets, private vessels, or scrap metal. Individual reactions to lightships change, depending on the vessel’s context, the year it was viewed, and the person who viewed it. It is the sum of these individual reactions to lightships between 1820 to present that defines them within the American maritime cultural landscape.

By applying Westerdahl’s maritime cultural landscape theory and Hodder’s material culture theory to view data collected for this investigation, it was possible to draw scientific conclusions regarding lightships and their place within the American maritime cultural landscape. For respectively 163 years, lightships illuminated traditional transport zones in America. Employed up to 50 miles offshore in coastal zones, inlets, estuaries, rivers, and the Great Lakes, lightships marked traditionally used routes in multiple geographic zones. Variation

in lightship construction provides evidence for use within different geographic zones, defining borders as well as ship types. Westerdahl acknowledges these differences and uses them to explain human understanding of the landscape and reasoning behind shipbuilding traditions. Used in combination with Hodder's ideas regarding objects of material culture, it is possible to recognize the social implications of lightships. Created for a "maritime culture forged by two related confrontations: the confrontation between humans and nature," lightships represent a cultural effort to uphold civilization (Flatman 2003:149).

CHAPTER 4 : WOODEN CONSTRUCTION

Built to government standards and employed during a period marked by revolutionary changes in shipbuilding technology, American lightship construction experimented with, and conformed to, alterations in naval architecture from 1820 through 1952. A concept borrowed from England and replicated in domestic waters, lightships began as small wooden schooners, eventually built as welded steel ships. Ranging from 40 to 1050 tons, 38 ft. to 148 ft. 10 in. in length, 16 ft. to 32 ft. in beam, and 2 ft. 6 in. to 16 ft. 3 in. in draft, lightships varied according to environment, contract specifications, and trends in technology. Motivated by progress in England and France and improved by reforming hull shape and bow, including bilge keels, placing of the hawse pipe, and changing structural materials and propulsion, lightship designs slowly improved. Utilizing contracts, printed specifications, and archival documents, it is possible to track changes in American lightship development. American lightship construction demonstrated adaptability and ingenuity, especially considering modifications and the factors influencing ship design. Serving as purpose-built navigational markers as well as converted beacons, lightship construction and alterations spanned 163 years of American shipbuilding techniques.

Beginning in 1789, beacon boats, small boats with day marks on a single mast, served as the first American ships used as navigational markers (United States Coast Guard 1953:184). Supposedly constructed in 1791 by Joseph Hill, the converted sloop *Discovery* measured 26.2 ft. in length, 9.8 ft. in beam, 3.9 ft. in draft, and 8 16/95 tons. This original beacon boat was a “small undecked craft apparently built for sheltered waters” (Delgado 1989:1). Without any source of illumination or sound equipment, beacon boats failed to adequately protect or assist ships in dangerous waters. Beacon boats were replaced by light and bell boats, “queer vessels made of iron, flush-decked, turtle-backed and with a light or bell clappers fastened to the mast”

(United States Coast Guard 1953:184). Approved by George Washington, the light and bell boats, “sturdy, stubby masted schooners with iron lanterns,” served mariners in three Chesapeake Bay locations in 1795 (Hornberger and Turbyville 1997:23). Stationed at Willoughby Spit, Horseshoe (later Tail of the Horseshoe), and Middle Ground, local citizens rowed out to these small schooners, lighting and extinguishing their lamps at sunset and sunrise (Hornberger and Turbyville 1997:23).

Unsuitable in rough weather and unmanned by design, sound and light boats proved inadequate. Utilized in England since 1731 and in other locations around Europe prior to arrival in the United States, foreign lightships served as a model for American development. A study conducted by Robert F. Cairo (1974a-d) focused on early lightship development and identified some of the first European lightships (Figure 9). Included in Cairo’s four part series on early development are numerous plans for ships as well as lanterns. The concept for the first American lightship took form by replicating European lantern and mast designs and incorporating these features into schooner construction,

Utilized during the Revolutionary War, War of 1812, and further popularized in Chesapeake Bay because of their renowned “speed and practicality,” American schooners seemed a natural choice as a hull type for wooden lightships (Tilp 1982:32). Altered for use as work boats, some American schooners became “smaller, slower, full bodied, and while designed specifically for cargo carrying, they remained active in the passenger trade” (Tilp 1982:32). A seemingly perfect combination for a ship expected to be moored on station with a crew for extended periods, the generalized schooner style was manipulated and outfitted to serve as a lightship. Well known and commonly built from the plentiful supply of domestic wood harvested in coastal regions between Virginia and Texas, the schooner was widely established along the

Atlantic seaboard. Utilizing primarily oak, a wood type with known resistance to dry rot, for framing the hull, wooden ships in the United States generally lasted some 15 years (Fassett 1948:16).

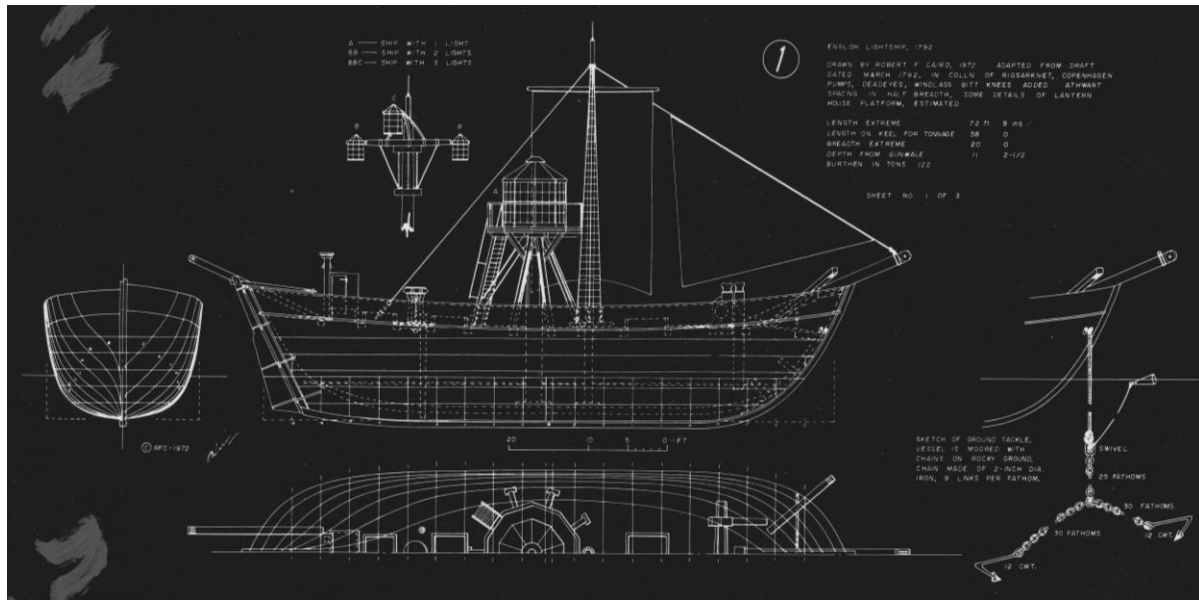


FIGURE 9. Robert F. Cairo's drawing of a 1792 Danish lightship, *Rigsarkivet*. (Photo courtesy of the USCG Historian's Office Archives, Washington, DC.)

The longevity of the first wooden lightships remains unknown for lack of available documentation; however, with few exceptions limited to accidents and collisions, the majority survived several decades of employment. Wooden lightship construction began in 1820 and ended in 1902. Utilizing archival documents and Willard Flint's (1989) *Lightships and Lightship Stations of the United States*, it is possible to trace the use life of 50 of the estimated 92 wooden lightships built. Totaling some 2030 years all together, the average use life for a wooden lightship spanned 40.6 years. Constructed using a combination of locust, red cedar, white oak, live oak, yellow pine, southern pine, Georgia pine, pine, hard pine, chestnut, and mahogany (lightship *BB* also known as the *Florida*, is the only lightship with mahogany listed as a construction element), shipwrights utilized frame-first construction techniques for building domestic lightships.

James Poole of Hampton, Virginia, and Christian Bergh of New York, constructed the first two American lightships. Bergh built a 50 ton wooden lightship for \$7,925.58 to temporarily mark the Northeast Pass of the Mississippi River Delta during reconstruction of the Frank's Island Lighthouse. The *Aurora Borealis*, later distinguished as ZZ by Willard Flint, had frames of locust and red cedar, and measured under 60 ft. Bergh used white oak for hull planking and fastened the body with iron bolts. A trunk cabin aft with berths for six crew and a caboose raised forward of the mast as a galley served as superstructure. For audible signaling, a 200 lb. fog bell hung from a gallows located forward of the caboose (Cipra 1997:206).

Christian Bergh utilized employees familiar with English lightship construction to build the *Aurora Borealis*. Remarks indicate that Bergh deviated from the original designs, altering at least the lantern plans during production (Cipra 1997:206-207). After being stationed off Wallace's Island, from 23 March 1821 to June 1823, the *Aurora Borealis* and crew relocated to Pensacola, serving as a relief vessel until 31 March 1837. This date comes from a letter sent by the Fifth Auditor to Congress, requesting \$8,000 to repair the *Aurora Borealis*' rotten hull (Light-House Board 1837). Additional research conducted did not uncover any additional information pertaining to the *Aurora Borealis* or any plans indicating further details of construction or repair.

A similar situation exists concerning the lightship fabricated by James Poole. Constructed the same year as the *Aurora Borealis*, lightship C was "70 tons burthen, copper fastened and coppered....a cabin with at least four berths....apartment for cooking, spars, a capstan belfry, yawl and davits." Initially stationed on Willoughby Spit, Virginia, lightship C could not withstand conditions in the lower Chesapeake Bay. The lightship was moved to the Craney Island Station, marking the Elizabeth River near Norfolk. C served through 1859. Of wooden

construction, small and constructed with a hull unable to contend with sea conditions immediately inside Chesapeake Bay, lightship *C* proved adequate for sheltered waters (Flint 1989).

Rudimentary lightship design persisted through 1855, the year marking construction of the first lightship built to standardized specifications. Early construction experimented, adding valuable insight into future models. Cedric Ridgely-Nevitt (1945) studied two early examples. Utilizing plans located at the Webb Institute, Ridgely-Nevitt described lightships serving at Cape Hatteras, North Carolina, and Upper Middle Shoals, Delaware. Henry Eckford (1775-1832), a Scotsman and apprentice of John Black (Eckford's uncle), obtained training in the Quebec shipyards from 1791 to 1796. He built America's earliest lightships in 1823. As manager of the shipyard owned by Christian Bergh, Eckford is famous for training apprentice Isaac Webb and building the 74-gun ship-of-the-line, USS *Ohio*. Henry Eckford played a large role in manufacturing early wooden American lightships and is linked to construction of at least seven lightships (Walker 2010:65-66).

The *Cape Hatteras*, Eckford's largest example, lasted only three years (Flint 1989). It was stationed approximately 15 miles off the Outer Banks on infamous Diamond Shoals. The *Cape Hatteras* blew ashore and wrecked near Ocracoke Inlet during a hurricane in 1827 (Flint 1989). The specifications for this vessel are located in Appendix A. Although Ridgely-Nevitt offered a description of the *Cape Hatteras*, without surveying the ship or examining detailed photos of the construction process, actual dimensions remain unknown.

No examples of 19th century wooden lightships remain afloat or readily accessible for survey. Although the Underwater Archaeology Branch (UAB) of North Carolina conducted a reconnaissance in 1990 and 1991 of the supposed Long Shoals lightship, a complete examination

never occurred. Another archaeological undertaking, by Graham McKay and Victor Mastone, in the Merrimac River, Massachusetts, intended to link ship remains with an early wooden lightship. Identification was unsuccessful due to the wreck's deterioration. Most data describing the evolution of American lightship construction comes directly from hand-written and printed documents, similar in format to Ridegely-Nevitt's article. The information gathered for this study referenced 92 wooden lightships, locating partial specifications for 79 examples and contracts for 9. Divided and compared for analysis, the following descriptions offer insight into dimensions, materials, and configuration of wooden lightships.

Elements of select wooden lightships appear in the following paragraphs and tables. They are separated and contrasted by the following components: frames (Table 2), hull planking (Table 3), masts (Table 4), rigging/awnings, sheathing, bilge keels, decking (Table 5), deck fasteners, scuppers, oil rooms, superstructure, ceiling, beams, knees, and stanchions (Table 6), wales and clamps (Table 7), general fastenings, ballast (Table 8), and general building information or arrangement. Incomplete, scattered, and not representative of the entirety of American wooden lightships, the enclosed information offers a glimpse into construction characteristics.

The majority of lightships had two masts, with at least eight exceptions. Rigged and equipped in a variety of configurations for maintaining position as opposed to propulsion, the common wooden-hulled lightship carried a schooner rig on spencer masts. Slight variations occurred regarding try-sail masts and *LV14*, constructed in 1852, was sloop rigged (Flint 1989). Shrouds differed, numbering two to four per mast. Eckford's lightships ??, *N*, and *X*, showed four shrouds per mast. *N* and *X* utilized five inch cordage on the shrouds and the larger Eckford design employed seven inch cordage. Remaining necessary rigging and storm sails of No. 1

TABLE 2
FRAME COMPOSITION FOR SELECT WOODEN LIGHTSHIPS

Year Constructed	Lightship	Frame Material	Frame Fastenings
1820	<i>Aurora Borealis</i>	Locust and Red Cedar	N/A
1823	??	White Oak	Iron bolts following a $\frac{7}{8}$ inch auger
1823	<i>N, X</i>	Seasoned White Oak	Iron bolts following a $\frac{3}{4}$ inch auger
1828	Neuse River	Live Oak, Locust, Red Cedar	N/A
1834	Roanoke River	Live Oak, Locust, Red Cedar	Iron bolts
1837	Long Shoals	Live Oak, Locust, Red Cedar	N/A
1877	LV42	White Oak	N/A
1891	LV55, LV56, LV57	White Oak	8 $\frac{5}{8}$ inch square iron spikes

Sources: *Aurora Borealis* (Cipra 1997:206-207), (Ridgely-Nevitt 1945:115-117), *N* (Ridgely-Nevitt 1945:117-120), *X* (Ridgely-Nevitt 1945:117-120), *Neuse River* (Wallace 1828), *Roanoke River* (Williams 1834), *Long Shoals* (Brown 1837), *LV42* (New York Times 1877), *LV55* (Strobridge1973:16-26), *LV 56* (Strobridge1973:16-26), *LV57* (Strobridge1973:16-26).

canvas comprised the other rigging and sail provisions (Ridgely-Nevitt 1945:116-117). Stays or guys, rigged between the hounds and stem and stern posts measured five inches (*Neuse River* and *Roanoke River* lightships), seven inches (*Long Shoals* lightship), and nine inches (??) (Wallace 1828; Williams 1834; Brown 1837; Ridgely-Nevitt 1945:116). Often ordered and replaced with other rigging elements, awnings comprised of No. 1 canvas adorned numerous weather decks, covering the deck between the stern and main mast.

Scantling composition, dimensions, and fastenings allow visualization of individual structures on early wooden lightships. Other features require attention for understanding the architecture and abilities to withstand maritime conditions. Often sheathed to 1 foot above the water line with 18, 24, or 32-ounce copper, depending on tonnage, protective linings persisted through the 20th century on certain vessels. Water drained through a minimum of three scuppers

TABLE 3
HULL PANKING INFORMATION FOR SELECT WOODEN LIGHTSHIPS

Year Constructed	Lightship	Hull Material	Available Dimensions of Hull Planking	Fasteners
1820	<i>Aurora Borealis</i>	White Oak	N/A	Iron Bolts
1823	??	Pine	1.25 inches molded	Bottom planks fastened with 9 inch composition spikes
1823	<i>N, X</i>	White Oak	2.25 inches molded, < 9 inches sided	Bottom planks fastened with 6 inch composition spikes
1828	Neuse River	Pine	1.25 inches molded	Iron Bolts
1834	Roanoke River	Pine	1.25 inches molded	N/A
1837	Long Shoals	N/A	2.5 inches sided on bottom plank	N/A

Sources: *Aurora Borealis* (Cipra 1997:206-207), (Ridgely-Nevitt 1945:115-117), *N* (Ridgely-Nevitt 1945:117-120), *X* (Ridgely-Nevitt 1945:117-120), *Neuse River* (Wallace 1828), *Roanoke River* (Williams 1834), *Long Shoals* (Brown 1837).

per side, and outer hulls were stabilized from excessive rolling by inclusion of bilge keels (1856) (Figure 10). Proper ballasting contributed to stabilization but occupied valuable space in the hold. Comprised of hard beach stone or pig iron, ballast (kentledge) often rested on battens two inches above the ceiling. Covered with platforms and periodically cleaned, ballast varied depending on tonnage, stowage capacity, and available materials.

The superstructure onboard lightships contributed to their lack of stability in rough seas or elevated weather conditions, making proper ballasting essential for onboard comfort as well as remaining afloat. Aside from masts, luminary, and sound devices on the weather deck, trunk cabins aft and cabooses forward served as living spaces on the first wooden lightship. According to David Cipra (1997:206), Christian Bergh constructed accommodations for six as well as a galley on the weather deck of the *Aurora Borealis*. Specifications for Eckford's lightships and the *Roanoke River*, *Neuse River*, and *Long Shoals* lightships called for crew accommodations between decks, or on the weather deck, depending on space availability. The average crew

TABLE 4
MAST INFORMATION FOR SELECT LIGHTSHIPS

Year Constructed	Lightship	Number of Masts	Mast Dimensions	Spacing Between Masts
1823	<i>N, X</i>	2	60 feet long, 17 inches square	3 feet
1828	<i>Neuse River</i>	2	45 feet long, 12 inches square	3 feet
1834	<i>Roanoke River</i>	2	45 feet long, 12 inches square	3 feet
1837	<i>Long Shoals</i>	2	50 feet long, 12 inches square	4 feet

Sources: ?? (Ridgely-Nevitt 1945:115-117), *N* (Ridgely-Nevitt 1945:117-120), *X* (Ridgely-Nevitt 1945:117-120), *Neuse River* (Wallace 1828), *Roanoke River* (Williams 1834), *Long Shoals* (Brown 1837).

TABLE 5
DECKING INFORMATION FOR SELECT WOODEN LIGHTSHIPS

Year Constructed	Lightship	Composition	Dimensions	Fastenings
1823	<i>N and X</i>	Yellow Heart Pine	2½ inches molded	5 inch iron spikes, deck binding bolted with iron following a ¾ inch auger
1823	??	N/A	3½ inches molded, < 8 inches sided	8 inch composition spikes, ¾ inch copper butt bolts
1823	??	N/A	4 inches molded on the 3 strakes next to the waterway, jogged over the beams and bolted through the waterways	8 inch composition spikes, ¾ inch copper butt bolts
1828	<i>Neuse River</i>	White Oak	N/A	Copper bolts
1834	<i>Roanoke River</i>	Yellow Pine	2½ inches molded	Copper spiked and plugged
1837	<i>Long Shoals</i>	Heart of Pitch Pine	2½ inches molded	Copper spiked and plugged
1877	<i>LV42</i>	Georgia Pine	N/A	N/A

Sources: ?? (Ridgely-Nevitt 1945:115-117), *N* (Ridgely-Nevitt 1945:117-120), *X* (Ridgely-Nevitt 1945:117-120), *Neuse River* (Wallace 1828), *Roanoke River* (Williams 1834), *Long Shoals* (Brown 1837), *LV42* (New York Times 1877).

TABLE 6
STANCHION, CEILING, BEAM, AND KNEE, INFORMATION FOR SELECT WOODEN
LIGHTSHIPS

Year Constructed	Lightship	Stanchions	Ceiling	Beams	Knees
1823	<i>N and X</i>	N/A	2 inches, composed of heart pine, fastened with iron spikes	Yellow Heart pine	N/A
1823	??	Bolted to frames	3 ¼ inches molded, < 10 inches sided, composed of oak, fastened with 8 inch iron spikes	14 inches sided by 12 inches molded, spaced 5 feet apart and composed of heart pine	6 inches sided and fitted 1¼ inches below beam. Configuration allots for air movement to upper sides of knees. Fastened with inch iron bolts
1828	<i>Neuse River</i>	Locust	2 inches sided, composed of oak	Yellow pine	N/A
1834	<i>Roanoke River</i>	Locust	2 inches sided, composed of oak	Southern yellow pine	N/A
1837	<i>Long Shoals</i>	Pitch Pine	Oak	N/A	N/A
1863	<i>LV21 and LV24</i>	N/A	N/A	N/A	Oak

Sources: (Ridgely-Nevitt 1945:115-117), *N* (Ridgely-Nevitt 1945:117-120), *X* (Ridgely-Nevitt 1945:117-120), *Neuse River* (Wallace 1828), *Roanoke River* (Williams 1834), *Long Shoals* (Brown 1837), (Ames 1863:2).

working early wooden lightships numbered between six and eight men (Light-House Board 1839, 1849, 1851). Photos and plans of lightships constructed after 1855, the year standardized construction began, exhibit small fore and aft houses on the weather deck. These were lantern houses, not living quarters. Considering crew size, vessel size, tonnage, and depth of hold, it is reasonable to hypothesize that the majority of crew quarters on early wooden lightships were within the vessel. Dennis Noble suggests a similar notion, claiming,

TABLE 7
INFORMATION REGARDING CLAMPS AND WALES ON SELECT WOODEN
LIGHTSHIPS

Year Constructed	Lightship	Wale Dimensions and Composition	Clamp Dimensions and Composition
1823	<i>N and X</i>	4 wales, 4 inches molded, composed of oak planking	3 inches molded, >10 inches sided, composed of oak
1823	??	6 wales, 4½ inches molded, 9 inches sided, composed of young living oak, fastened with ¾ inch iron bolts	3, 4 inch molded, > 11 inch sided, composed of oak, 3 inch air strake left vacant below clamps
1828	<i>Neuse River</i>	3 inch sided, composed of white oak, tapering down to meet bottom plank	N/A
1837	<i>Long Shoals</i>	4½ sided, composed of pitch pine, tapering down to meet bottom plank	N/A

Sources: (Ridgely-Nevitt 1945:115-117), *N* (Ridgely-Nevitt 1945:117-120), *X* (Ridgely-Nevitt 1945:117-120), *Neuse River* (Wallace 1828), *Roanoke River* (Williams 1834), *Long Shoals* (Brown 1837).

TABLE 8
BALLAST INFORMATION FOR SELECT WOODEN LIGHTSHIPS

Year Constructed	Lightship	Ballast Tonnage
1823	<i>N and X</i>	30 tons in pieces 120 to 160 pounds each
1823	??	60 tons
1839	<i>QQ</i>	71-72 tons storm ballast, replaced with 10-12 tons pig iron ballast

Sources: ?? (Ridgely-Nevitt 1945:115-117), *N and X* (Ridgely-Nevitt 1945:117-120), (Light-House Establishment 1839).

Lightships were originally single decked with the crew living below decks. The first changes for the crew involved building up the forecastle and decking it over so the crew could reside forward. Eventually, crew berthed above the water line with enough room for officers to have a room to themselves and the crew, two rooms (Noble 1997:137).

Noble (1997:136) suggests that including bilge keels, flattening the hulls, and reducing metacentric height evened out the effects of wave action, resulting in higher levels of crew comfort at sea.



FIGURE 10. This image depicts the bilge keel of a steel lightship constructed in 1904. (Photo courtesy of the USCG Historian's Office Archives, Box 24, Washington, DC.)

An inquiry, conducted 30 January 1952 by the Lighthouse Establishment regarding the aids to navigation, exposed widespread inadequacies. Rotten vessels, poor illumination, sparseness of aids, and better designs for light vessels stationed at exposed stations constituted a fraction of the complaints. Part of the inquiry included an investigation into foreign aids (Figure 11), especially lightships that were considered superior to American examples in every respect. The Lighthouse Board settled for slow change but initiated standards for new lightship construction. Created as part of the inquiry and dedicated to all subjects related to lightships, a

committee in charge of plans, construction, improvements, moorings, fog signals, and new aids began changes (Cairo 1974c:18-19). The design for the new first class lightships remained fairly standard for the next 10 to 15 years (Cairo 1974c:19). Sharp bows with round bilges were replaced by rounded bows with flat bottoms, increasing wooden lightship stability (Thompson 1983:29). *LV1* (Figures 12 and 13), the first domestic lightship built to new specifications, exhibited a double hull of oak cut from southern Virginia and seasoned in “the blue mud” of New England (Thompson 1983:36). An outside frame with an inner shell used salt poured between the hulls to harden the wood.

In 1860, five years after the first American lightship specifications, naval architect John Murphy gave a public lecture in New York titled “American Ships and Shipbuilders.” During the lecture, Murphy stated, “the characteristics of every well-built American ship are safety, capacity, and speed” (1860:1). Murphy (1860:3,5,7) claimed sharp bows reduced angles of resistance and flat bottoms equated with reduced stability. Written five years after the first lightship specifications, Murphy’s claims contradicted recent lightship improvements. Initially perplexing, the clashing of Murphy’s statement with lightship design offers explanation regarding earlier issues in construction. Problems associated with early wooden lightship designs stemmed from the inability to compensate for stationary vessels. Building lightships similar to merchant vessels poised for safety, capacity, and speed did not work for ships moored to the sea floor for months on end. Referring to Henry Eckford as “the father of naval architecture in this country” and claiming that Eckford “increased the length, and constructed his vessels with long flat floors and short turned bilges,” Murphy explained the inadequacies of Eckford’s early designs (Murphy 1860:7). *??*, *X*, *N*, and other lightships were designed for speed and cargo, not for stationary beaconage. The Lighthouse Board and contractors hired for lightship construction

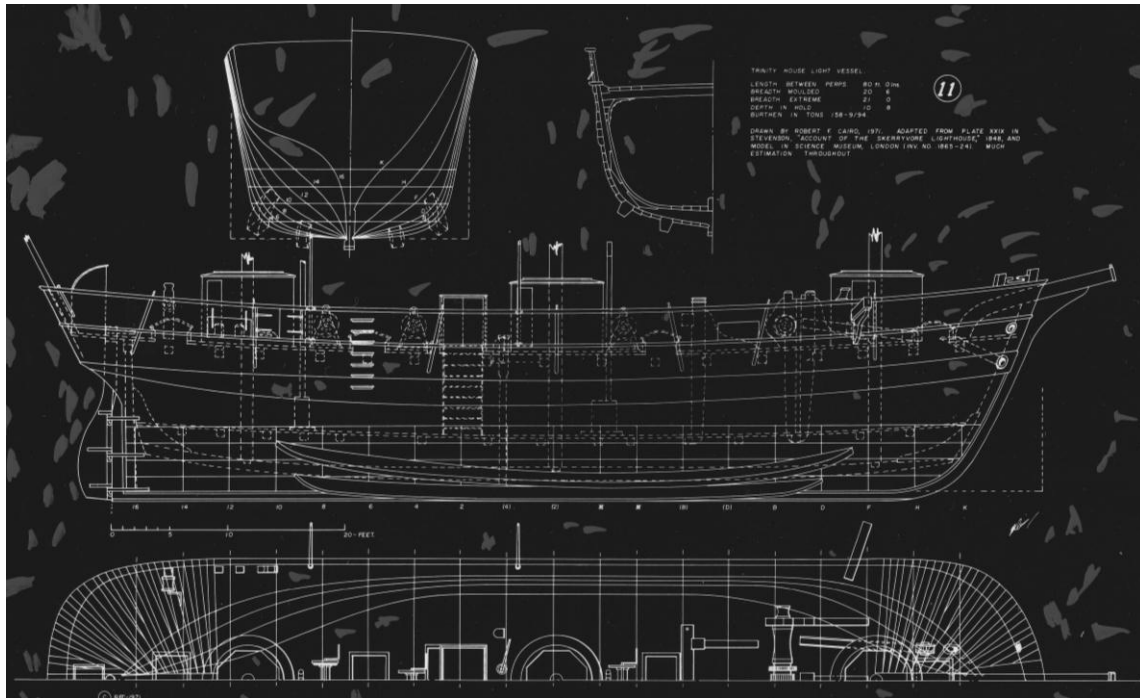


FIGURE 11. An 1848 English lightship. (Photo courtesy of the USCG Historian's Office Archives, Washington, DC).

began incorporating overall improvements to unconventional hull forms.

In 1857, 1862, and 1871, the Lighthouse Board published classification statistics for first (Figure 14), second (Figure 15), third (only in 1857), and fourth class lightships. Assigning taxonomy based on dimensions, tonnage, and masts, the class descriptions do not correspond to specific lightships, but to general dimensions (Table 9). First published in 1835 by Lloyd's Register, a similar 1870 set of specifications established mandates for wooden ship construction, defining class, and assigning fitness for cargo carrying as well as venue of cargo carrying (American Bureau of Shipping 1900). Never mentioned in Lighthouse correspondence, wooden classification ratings serve as a reckoning of American vessel classification requirements. They are important for comparing shipbuilding techniques, even though the rules for constructing wooden vessels remained general and did not address non-cargo carrying vessels.

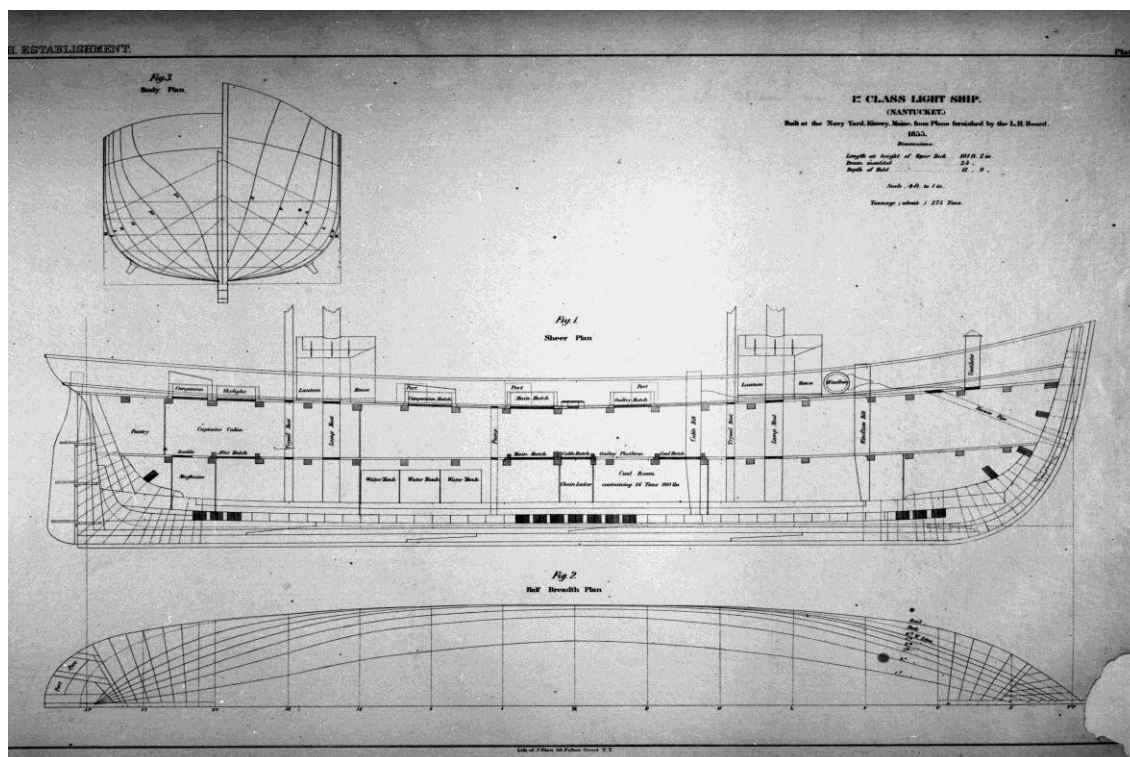


FIGURE 12. LV1 Nantucket New South Shoals lightship half-breadth, sheer, and body lines. (Photo courtesy of the National Archives, College Park, MD.)



FIGURE 13. LV1, the first domestic lightship built to national specifications. (Photo courtesy of the National Archives, College Park, MD.)

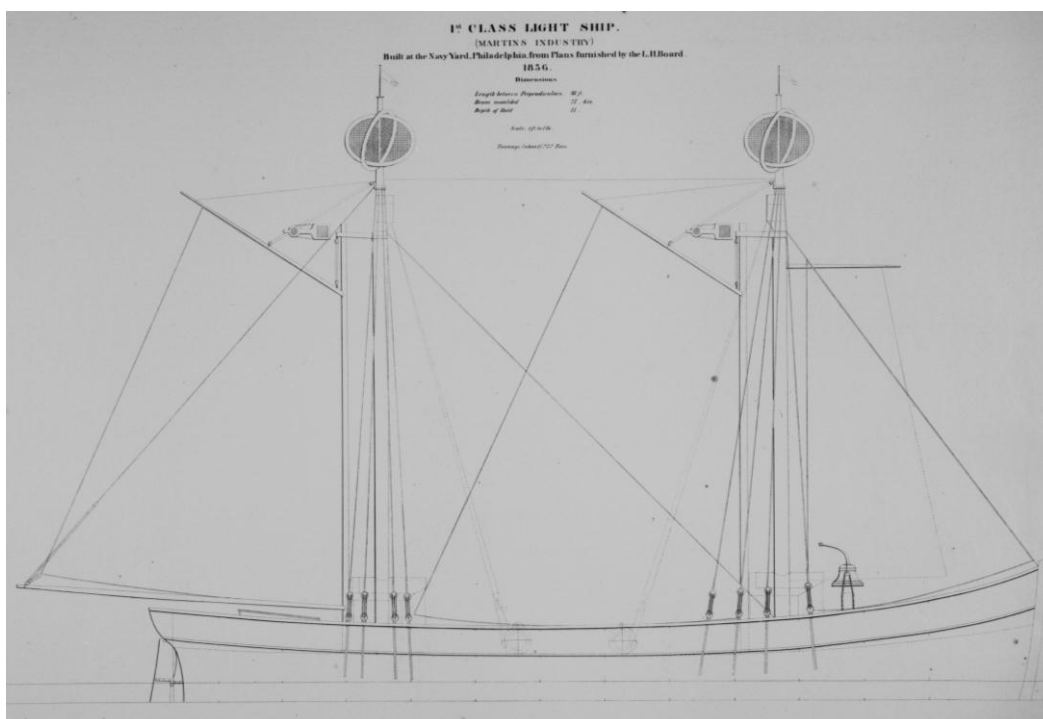


FIGURE 14. The first class lightship, Martins Industry, constructed in 1856. (Photo courtesy of the USCG Historian's Office Archives, Lightship File, Early Lightships, Washington, DC.)

The 1876 specifications for *LV41* depict wooden lightships prior to composite manufacturing. Constructed in Portland, Connecticut, by shipwrights S. Gildersleeve and Sons, *LV41* marks the beginning of the end for wooden lightship construction (Flint 1989). Divided into sections describing the scantlings, dimensions, joinery, and lay out, the specifications describe construction of *LV41* (Appendix B).

Wooden lightships required frequent maintenance (Table 10), often proving costly and leaving the vessel in a temporary state of restoration. The Annual Reports published by the Light-House Establishment document yearly repairs as well as specific problems requiring attention. Published from 1852 through 1910 as consolidated documents, the annual reports trace Federal dollars spent on lightship renovation. Prior to 1852, letters sent from lighthouse districts indicated required repairs and requested funds. Return letters from the Secretary of the Treasury

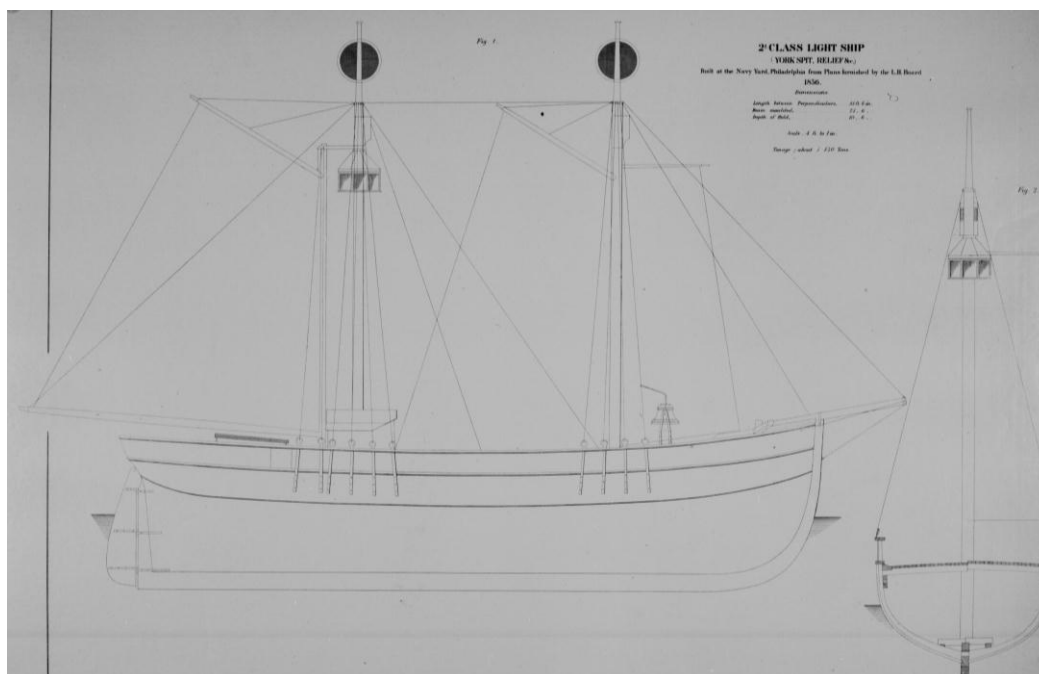


FIGURE 15. Second class lightship, York Spit Relief, 1856. (Photo courtesy of the USCG Historian's Office Archives, Lightship File, Early Lightships, Washington, DC.)

TABLE 9
LIMITED LIGHTSHIP CLASS DESCRIPTIONS

Class	Year	Rig	# of Lights	Tonnage	Length In feet & inches	Beam In feet & inches	Depth In feet & inches	Masts In feet & inches
First	1857	N/A	N/A	230-270	N/A	N/A	N/A	N/A
First	1862	Schooner	1 or 2	275	101' 2"	24	12' 9"	2, forged from white pine, extending 55' above deck, measuring 20" diameter
First	1871	Schooner	1 or 2	275	101' 2"	24	12' 9"	2, forged from white pine, extending 55' above deck, measuring 20" diameter
Second	1857	N/A	N/A	150-180	N/A	N/A	N/A	N/A

Class	Year	Rig	# of Lights	Tonnage	Length In feet & inches	Beam In feet & inches	Depth In feet & inches	Masts In feet & inches
Second	1862	Schooner	1 or 2	232	98'	23' 6"	11'	2, forged from white pine, extending 55' above deck, measuring 20" diameter
Second	1871	Schooner	1 or 2	232	98'	23' 6"	11'	2, forged from white pine, extending 55' above deck, measuring 20" diameter
Third	1857	N/A	N/A	100-130	N/A	N/A	N/A	N/A
Third	1862	Schooner	1 or 2	150	81' 6"	21' 6"	10' 6"	2, forged from white pine, extending 48' above deck, measuring 16" diameter
Third	1871	Schooner	1 or 2	150	81' 6"	21' 6"	10' 6"	2, forged from white pine, extending 48' above deck, measuring 16" diameter
Fourth	1857	N/A	N/A	60-80	N/A	N/A	N/A	N/A

Sources: (Light-House Board 1862:136-137), (Light-House Board 1871:184-185).

either granted monetary requests or delayed repairs until the following year, sometimes longer.

Table 10 offers a glimpse into repairs to wooden lightships (Figure 16). Organized by ship, in a separate document assembled during research, repairs to wooden lightships span over 600 lines of text. For purposes of conserving space and sparing repetitive information, Table 10 serves as a general indication of expenses and details related to wooden lightship repairs. Selected for completeness in cost, year, and repair details, the information in Table 10 is not representative of

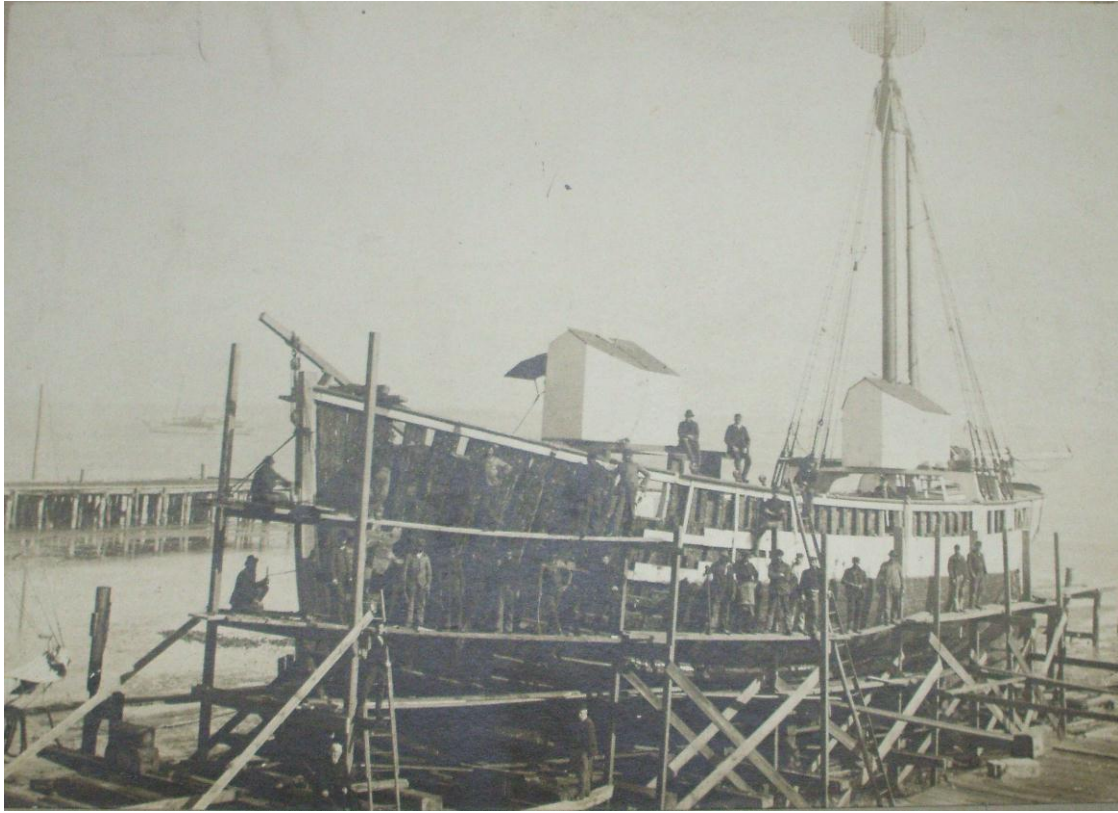


FIGURE 16. *LV29* undergoing repairs at Pregnall's Railway, Charleston, SC. (Photo courtesy of the National Archives, College Park, MD.)

all wooden lightship repairs.

LV74 was the last wooden-hulled lightship built by the Lighthouse Board when built in 1902 (Flint 1989). Slowly phased out after experiments with composite, iron, and eventually, steel construction, wood no longer met technological standards in naval architecture. Incapable of competing with reduced costs and longevity offered by metal hulls, wooden lightships dwindled in number. During the transition from wood to metal, the Lighthouse Board experimented with wooden scow construction on inland waters. *LV63*, *LV64*, and *LV65*, square ended scows, served on the Detroit River as the only purpose-built, non-schooner style wooden lightships (Flint 1989). The 1894 *Annual Report of the Light-House Board to the Secretary of the Treasury* claimed the oldest and smallest wooden lightships were stationed in sheltered waters

TABLE 10
A SAMPLING OF MAINTENANCE COSTS ASSOCIATED WITH
WOODEN LIGHTSHIPS

Lightship	Maintenance Costs	Year	Details
Key West LV	\$25	1849	Repairs to small boat
Key West LV	\$70	1849	Caulking and painting
Key West LV	\$95	1849	New rigging
Sand Key LV	\$15	1849	Repairs to lantern
Sand Key LV	\$200	1849	New quarter and deck awning
Sand Key LV	\$70	1849	Caulking and painting
Minots Ledge LV	\$2,500	1851	Anchors, chains, new windlass, strengthening of the decks, and other Small repairs
Relief LVs In Service As Of 1881	\$1,500	Per Year	Maintenance
LVs In Service As Of 1881	\$7,000	Per Year	Maintenance
Vessels Carrying Fog Signals	\$8,000	Per Year	Maintenance
Vessels Approved For Construction In 1889	\$7,000	Per Year	Maintenance
5 News LVs Under Construction	\$6,000	Per Year	Maintenance
First Class LVs	\$6,000	Per Year	Maintenance
Modern Large Light vessels	\$15,000	Per Year	Maintenance
LV6	\$1,388.67	28 Nov - 4 Jan 1897- 1898	New suit of yellow metal, new steel rigging, new main boom and gaff
LV7	\$4,432.87	1887	General repairs

Lightship	Maintenance Costs	Year	Details
LV7	\$3,500.00	1889	Decks, bulwarks, waterways, strong back of riding bitts, masts, gaffs, all rotten in spots and in need of repairs. Starboard boats need to be calked.
LV12	\$16,488.13	1874	Rebuilt
LV13	\$14,119.06	1878	Rebuilt
	\$2,500.00	1898	Leak repaired, hull recaulked & resheathed w/ metal
LV19	\$1,141.13	1887	Thoroughly repaired and equipped for service
LV20	\$703.07	1904	Yearly maintenance fee
LV23	\$12,000.00	1881	Overhauled & repaired from her keelson, up.
	\$12,281.04	Prior to Sept. 1882	Partially rebuilt and thoroughly fitted out
	\$100.00		New starboard hawse pipe
LV28	\$15,691.27	June 1880 - March 1881	Thoroughly rebuilt
LV34	\$5,500.00	End Of August 1893	Hauled off beach and sent to Charleston after being blown ashore from cyclone
LV37	\$10,292.95	Fiscal Year 1888-1889	Repairs, crew wages, supplies, total maintenance
LV38	\$3,084.66	1886	Repairs
LV39	\$6,000.00		New boilers
LV40	\$4,556.22	1884	Repairs, new boilers
	\$500.00	September 1889	Repaired from hurricane damages in Wilmington
	\$3,867.02	1893-1894	

Sources: (Light-House Board 1849, 1851, 1878, 1881, 1883, 1884, 1886, 1887, 1889, 1891, 1894, 1897, 1898, 1899, 1904).

and larger examples were lake boats intended for temporary service until replaced by lighthouses (Light-House Board 1897:243).

Wooden lightships lasted into the 1930s with the oldest examples being *LV13* (retired in 1933), *LV16*, (retired in 1932), *LV39* (retired in 1935), and *LV74* (retired in 1933). *LV13* served the longest, with 66 years on station. Toward the end of the 19th century through the beginning of the 20th century, remaining wooden vessels neared retirement. Recommendations by the Light-House Board advocated utilizing steel as hull material over wood. Preferred for increased strength, insurance, financing reductions, and the ability to add auxiliary and propulsion equipment, metal hulled ships were favored over wooden hulls. Such recommendations are evident in the 1896-1903 *Annual Reports*, with the largest proponent being the addition of propulsion machinery. Propulsion strengthened lightship capabilities by aiding lightship crews to maintain station during inclement weather as well as relieving tenders of towing lightships to and from station. Revamped and replaced by technological advancements, wooden lightships declined in number. As decking, deck houses, crew and officer quarters, doorways, rigging blocks, and launches, wood remained an important material but no longer served for hulls.

CHAPTER 5 : COMPOSITE, IRON, AND STEEL CONSTRUCTION

Metal shipbuilding became the predominant choice for domestic ship production by offering superior strength, rust resistance, and stiffer, sharper lines for less money. American yards, unequipped for such a transition, continued working in wood. Composite and iron hulled vessels lasted between 12 and 22 years, respectively, and existed in 5 non-purpose built lightships acquired by the Lighthouse Board in 1848 (former ships, *Spencer* and *Legare*), 1858 (former ship, *James Grey* also known as the *Lady Davis*), and 1876 (*LV97*). In 1881, the government appropriated funds for metal lightship construction. Metal shipbuilding increased in reputation and was eventually proven in the field. Iron and steel replaced wood as the primary structural material of lightships.

Iron shipbuilding developed during the Industrial Revolution and was applied in the United States in the 1830's. The first domestic iron vessels utilized materials purchased from England and were built in Savannah from 1834 to 1838 (Fasset 1948:43). Iron factories in Delaware and Pennsylvania became the new backdrop for modern ship construction. The new shipbuilding facilities lacked workers with engineering and architectural training required for successful ship design. American shipyards intending to construct iron vessels either imported English shipwrights or sent men overseas for training. Even then, domestic facilities specializing in metal ship design did not exist until 1894, the year the Webb Institute for Naval Architecture opened. Despite Americans ability to construct ships, until the Webb Institute opened, they had no means of designing them. The inclusion of metal as an American shipbuilding material was hampered by readily available wood, lack of metal shipbuilding facilities and tools, inability to compete in foreign markets, bloated tariffs, and the protected domestic market with higher wages than those overseas (Snow 1987:33-34).

Composite Construction

The general practice of integrating metal and wooden structural components together defines composite ship construction. Although incorporated on 14 American lightships, composite construction represents a small fraction of the fleet. Between 1881 through 1898, the Lighthouse Board funded construction of 13 composite ships and acquired one as a transfer from the Coast and Geodetic Survey, 20 May 1893 (Flint 1989). The first contract for composite construction was awarded to famous shipwrights and iron workers, Pusey & Jones. Pusey & Jones built five American lightships but only one of composite construction, *LV43* (Figure 17). Other contractors included Houston & Woodbridge of Linwood, Pennsylvania (*LV45* *LV46*), Harrison & Loring of South Boston, Massachusetts (*LV47*, *LV48*, *LV49*), Union Iron Works of San Francisco, California (*LV50*), Bath Iron Works of Bath, Maine (*LV66*, *LV68*, *LV69*, *LV71*), and Wolf & Zwicker of Portland, Oregon (*LV67*, *LV70*) (Flint 1989).

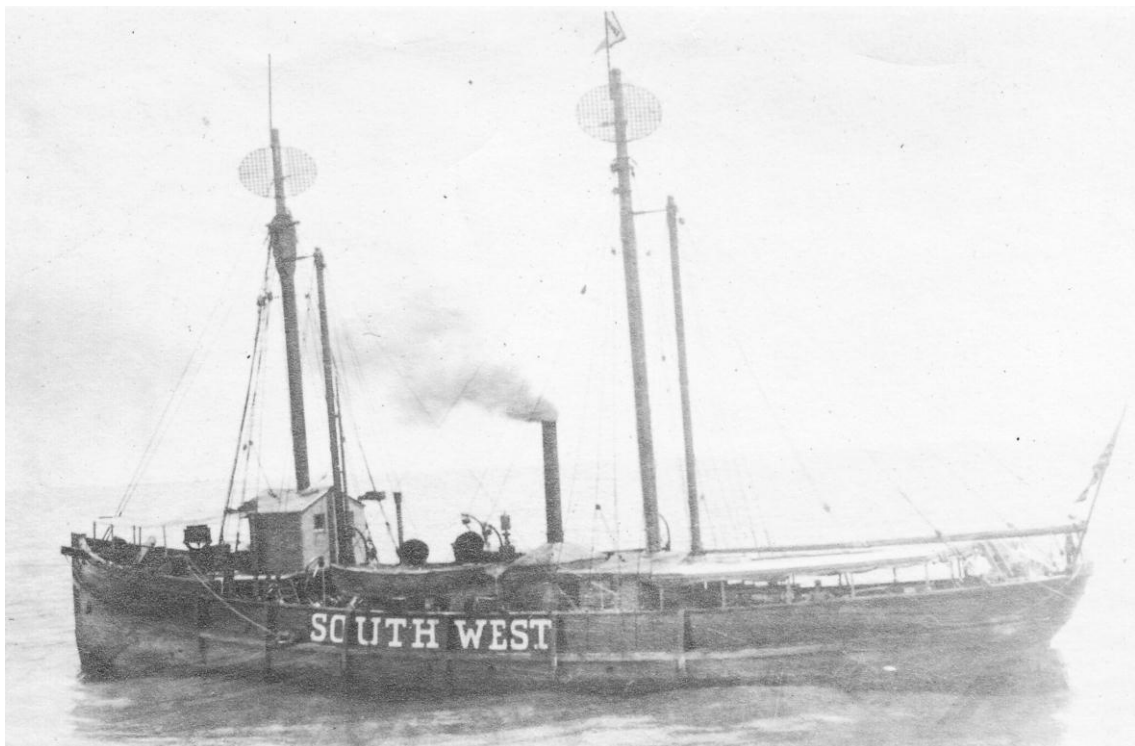


FIGURE 17. The first composite lightship, *LV43*, on station at Southwest Pass, Louisiana. (Photo courtesy of the USCG Historian's Office Archives, Box 26, Washington, DC.)

Houston & Woodbridge built the next two composite lightships. *LV45* and *LV46* were steel framed with iron hulls. Sheathed with yellow pine, workers fastened *LV45* and *LV46* together with iron rivets and screw bolts. Each ship displaced 401 tons and measured 124 feet 6 inches in length with varying beam and depth figures (Table 11). The new lightships carried schooner rigs, with fore and main sails on spencer masts. *LV45* cost \$58,500, \$1,500 less than initial appropriations. *LV46* cost \$60,000 (Figure 18). South Boston shipwrights built the next

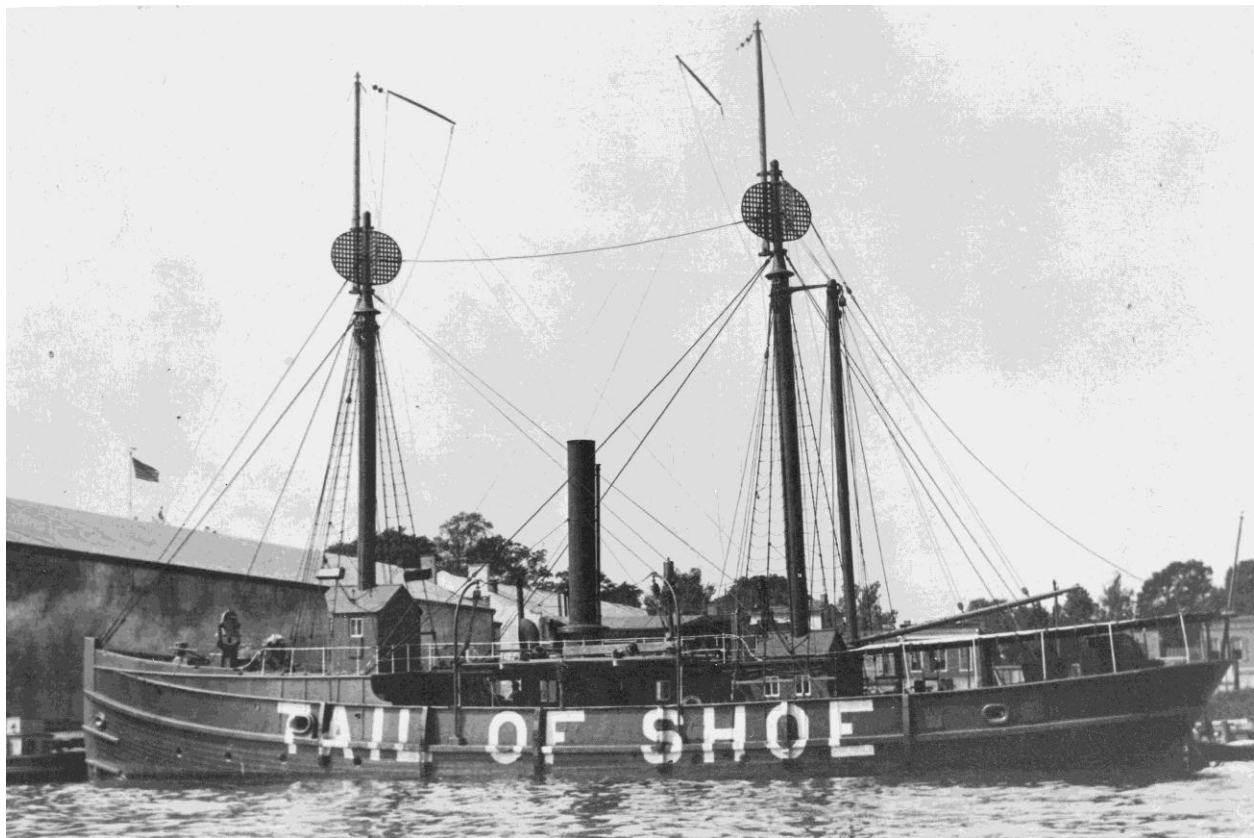


FIGURE 18. Composite lightship, *LV46*. (Photo courtesy of the USCG Historian's Office Archives, Box 26, Washington, DC.)

group of composite lightships, delivering the first models equipped with steam windlasses. *LV47*, *LV48*, and *LV49* were delivered by Harrison & Loring in 1891. The new ships had steel angle frames, Georgia pine planks, and white oak sheathing. *LV47*, *LV48*, and *LV49* were fastened with steel rivets and galvanized iron bolts. Each ship displaced 470 tons and measured 120 feet 10

inches in length, varying slightly in beam and draft (Table 11). The new lightships had two masts with daymarks. All three ships had schooner type rigs with sails hung on spencer masts (Flint 1989).

LV50, sister ship to *LV47*, *LV48*, *LV49*, was built in 1892. The lightship cost \$61,150 and was constructed at the yard of Union Iron Works in San Francisco. *LV50* had steel frames, Puget Sound pine planking, and white oak sheathing. The ship had two masts displaying lattice daymarks. Southwest lightship *LV50* was fastened with galvanized iron bolts and equipped with steam pumps and windlasses running off auxiliary boilers. The vessel utilized a schooner rig with sails carried on spencer masts for propulsion. After *LV50*, with the exception of four lightships (*LV75*, *LV77*, *LV96*, and *LV97*), all lightships were equipped for propulsion (Flint 1989).

In 1896, Bath Iron Works constructed *LV66* for \$69,282 and equipped the vessel with a steam, one-cylinder, surface condensing engine. *LV66* is described over a 20 page document titled, *U.S. Light-House Establishment Specifications for Composite Light-Vessel No.66* (Appendix C)(U.S. Light-House Establishment:1895). A similar set of specifications exists, for *LV67*. Wolf & Zwicker Iron Works of Portland, Oregon, constructed *LV67* in 1897. Spread over a 43 page document, details regarding the building of *LV67* read very closely, if not identical, to those for *LV66* (United States Light-House Establishment 1895b).

Bath Iron Works built their final vessels for the Lighthouse Board in 1897. Three steam screw lightships with steel frames, wooden bottoms, and steel plated top sides, put to sea that September. *LV68*, *LV69* (Figure19), and *LV71*, measured 122 feet, 10 inches in length, and varied in beam and depth (Table 11). The lightships' two masts displayed lantern galleries and ran off single cylinder, surface condensing engines. *LV68*, *LV69*, and *LV71* (Figure 20), were

equipped with steel frames, keel, and bilge strakes. Reinforced with diagonal steel bracing from keel to sheer, *LV68*, *LV69*, and *LV71* had wooden planking from the keel to main deck. Steel plating was installed from the main deck to the weather deck. *LV70* was constructed in 1898 by Wolf & Zwicker for \$73,000. The ship had the same components as previous lightships and displayed 2 masts with lantern galleries and daymarks (Flint 1989).

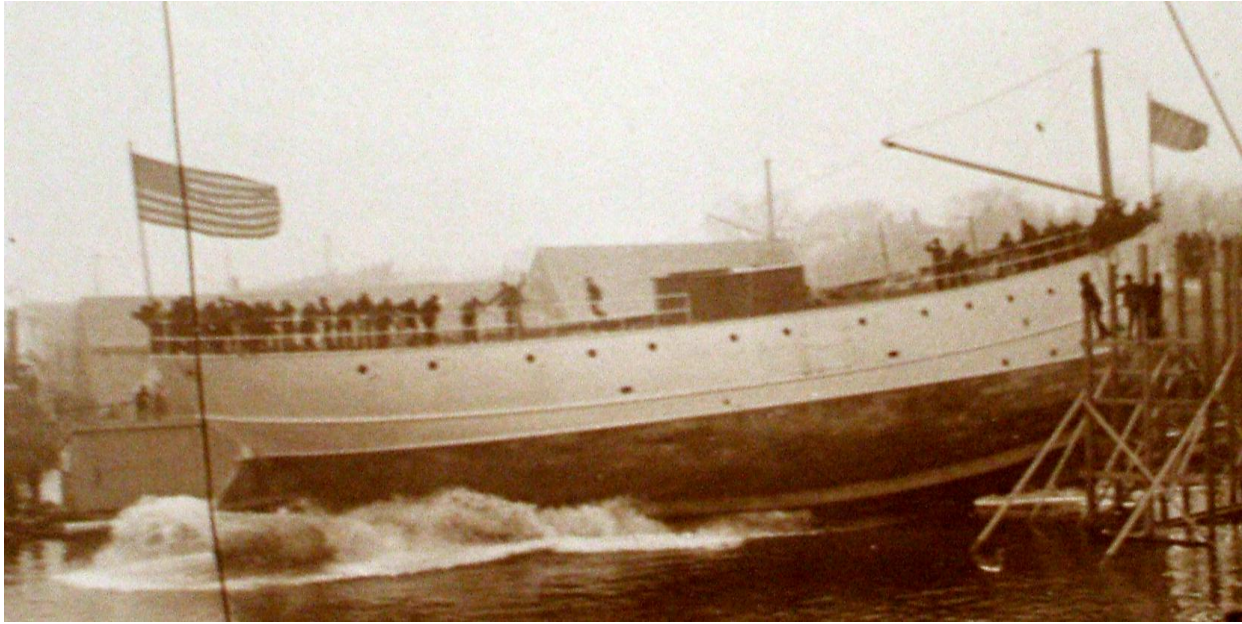


FIGURE 19. The launching of composite lightship, *LV69*. The bilge keel is visible, directly above the water line. (Photo courtesy of the National Archives, College Park, MD.)

Composite lightships held up well to environment and use, averaging 35 years of employment. *LV49* held up the longest, serving 50 years, respectively, in waters off Virginia and Massachusetts. Lightships required numerous and frequent renovations and received repairs, refitments, and overhauling. Re-caulking, mast replacement, rebuilding deckhouses, bottom maintenance, and replacements of hatch coamings, were common. Rigging upkeep, painting, and auxiliary machinery maintenance and upgrades describe additional care. Vessel collisions caused damages and these events served to initiate further repairs. A heavy gale collapsed a steam chimney onboard *LV46*, resulting in an explosion in the port boiler. *LV50* blew ashore

after 74 mph winds and sustained over \$30,000 worth of damages. Perhaps the worst incident involving a composite lightship involves *LV71*. When sunk by a Nazi submarine on 6 August 1918, no salvage operation or any amount of repairs could restore the demolished lightship (Flint 1989; Lighthouse Board 1881, 1883, 1884, 1886, 1887, 1889, 1891, 1894, 1897, 1898).



FIGURE 20. Composite lightship, *LV71*, port side, built by Bath Iron Works, 1897. (Photo courtesy of the National Archives, College Park, MD.)

Iron Construction

Liverpool Dock Trustees built the first iron lightships in 1842 and 1850. The English firm set new standards in lightship construction, including water-tight bulkheads to compartmentalize ship space, increase buoyancy, and strengthen hulls (Cairo 1974b:42). Shipwrights lowered hawse pipes, increased riding capabilities, and relieved strains on mooring lines. Lanterns were individually attached to each of the three masts. Ball-shaped or flat lattice-work day marks served as distinguishing characteristics. In 1848, after the Mexican-American War, the Lighthouse Board acquired two former Revenue Marine cutters for the American lightship fleet.

The *Spencer* and *Legare* (Figure 21) became America's first metal hulled lightships. The Lighthouse Board purchased an additional iron vessel in 1858. This was the former steam tug *James Gray*. The *James Gray* was converted into Confederate gunboat *Lady Davis*. After the war ended, the Light-House Board "acquired" the *Lady Davis*, converting the ship into a lightship. Renamed *LV31*, the Lighthouse Board utilized the converted gunboat to mark the wreck of the *Weehawken*, off Charleston, South Carolina (Flint 1989).

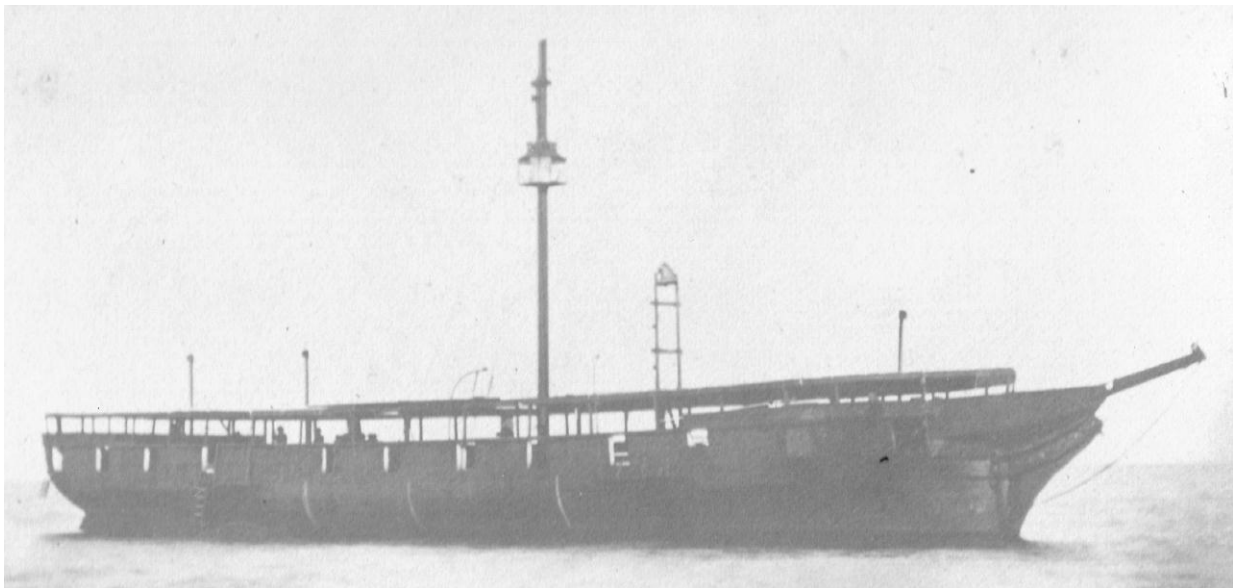


FIGURE 21. The 400 ton iron Revenue Cutter, formerly known as *Legare*. Renamed *W*, this former Revenue cutter served 13 years as a lightship on Merrills Shell Bank Station, Mississippi (Flint 1989). (Photo courtesy of the USCG Historian's Office Archives, Washington, DC.)

In 1882, the Lighthouse Board allocated funds for building the first iron lightship. *LV44* was built by Pusey & Jones with an unsheathed iron hull and two masts, each having a lattice day mark surmounted with a ball. *LV44* was propelled by sail using a schooner rig on spencer masts. The ship measured 115 feet 6 inches, measured 25 feet in beam, and drew 10 feet 6 inches of water. *LV44* cost \$49,999.59 and served on the Northeast End Station, New Jersey, through 1926. Transferred to Cornfield Point, Connecticut, *LV44* served another 12 years in Long Island

Sound. The last lightship without propulsion machinery, *LV44* was decommissioned after 56 years of service (Flint 1989).

Three iron lightships were built after *LV44* by F.W. Wheeler & Company of West Bay City, Michigan. *LV52* (Figure 22), *LV53*, and *LV54* cost \$53,325 each and were stationed on (*LV52*) Fenwick Island Shoal, Delaware, (*LV53*) Frying Pan Shoals, North Carolina, and (*LV54*) Nantucket New South Shoal, Massachusetts. The lightships were constructed with hawse pipes running through the stem. All three vessels had two masts with spencers for sails. *LV52* measured 118 feet, 10 inches in length, 26 feet 6 inches in breadth, 12 feet in draft, and had one day mark on the foremast. *LV53* measured 119 feet in length, 26 feet 6 inches in breadth, 11 feet 6 inches in draft, and displayed 2 day marks. *LV54* also displayed 2 day marks and measured 119 feet in length, 26 feet 6 inches in beam, and drew 12 feet of water. The iron hulled lightships measured 310 gross tons or 375 tons displaced (Flint 1989).



FIGURE 22. Iron lightship, *LV52*. (Photo courtesy of the USCG Historian's Office Archives, Washington, DC.)

The 1890 *Annual Report* states the following regarding the iron used in domestic lightship construction:

All iron to be of the best American make and brand for its specified purpose; to be branded with the maker's name. All surfaces must be free from flaws, blisters, or cracks. Brittle or coarse crystalline iron must not be used in any part of the vessel and the absolute main breaking strain shall not be less than 48,000 pounds per square inch (Lighthouse Board 1890).

The following year, *The Annual Report of the Lighthouse Board to the Secretary of the Treasury, for the Year Ended June 30, 1891* offered specifications and instructions for building lightships LV51, LV52, LV53, and LV54. These specifications describe construction of the last iron lightships built domestically (Appendix D). Purpose-built iron lightships lasted, on average, 52 years. Corrosion resulting from salt water contact with iron hulls proved problematic. The 1884 *Annual Report of the Lighthouse Board* imposed an annual requirement of hauling, scraping, and repainting iron-hulled lightships to manage oxidization (Lighthouse Board 1884:43). General repairs consisted of overhauling auxiliary machinery, power plant and propulsion upgrades, signal management and improvements, and mooring replacements. Iron reappears for the last time as a major component in American lightship construction in 1893, comprising outside and floor plates on LV58 (Flint 1989).

Steel Construction

Steel replaced iron as the predominant material in domestic lightship construction circa 1900. Shipbuilders were initially reluctant to upgrade facilities and obtain new tools, processing

machinery, and materials to build steel ships. This was a slow process and without immediate or prospective returns of considerable startup costs, shipyard financiers risked financial ruin.

Federal contracts for the production of 34 new steel navy vessels from 1884 to 1889 encouraged domestic growth (Snow 1987:35). Steel shipyards grew in number and domestic capabilities for manufacturing flourished.

Steel was used in 12 composite lightships from 1887 to 1898. The *Annual Report* of 1890 speaks to inspecting and testing steel, stating, “As a consequence of the adoption of the rules and of the systematic testing and inspection to which material is now subjected, it is safe to say that the steel used in construction of the new vessels is of excellent quality, and that the service at large will be greatly benefited” (Lighthouse Board 1890:79). Appropriating funds for the construction of 53 steel lightships, the Lighthouse Board spent over \$6,000,000 on domestic ships (Flint 1989). The Lighthouse Board built scows (*LV75* and *LV77*), whalebacks (*LV82*, *LV95*, *LV96*, *LV98*, *LV101*, *LV102*), all-welded frames and shells (*WLV189*, *WLV196*, *WLV604*, *WLV605*, *WLV612*, *WLV613*), and basic steel hulled examples, depending on venue of employment.

LV51 was built in 1892. The first American steel lightship, *LV51* was fitted with electric illuminating apparatus and steam screw propulsion. The lightship was constructed with the hawse pipe positioned through the stem. Hawse pipes originally ran through decks, however, placement along the centerline of the vessel relieved hull straining and provided a steadier platform in stormy seas. F.W. Wheeler & Company equipped *LV51* with a single compound, non-condensing engine (Flint 1989).

LV58 was the second steel lightship contracted by the Lighthouse Board and the “fore-runner of the modern lightship” (Flint 1989). *LV58* had a complete upper deck above the main

deck, including crew accommodations and luminary equipment. The arrangement of crew's quarters above the water line improved living conditions and increased freeboard. Higher freeboard provided stability "for a safer and drier ship" (Flint 1989). Despite the steel hull, *LV58* was built with iron components because of the stiffness of the metal and its resistance to corrosion. *LV58* had an iron keel, stem, sternpost, rudderpost, rudder frame, floor plates, and hull plating (United States Light-House Establishment 1893:1-9-15).

In 1902 and 1906, the Lighthouse Board changed steel lightship design. Contracting with Johnson Boiler Company of Ferrysburg, Michigan to construct lightships for the Great Lakes, the Lighthouse Board spent \$28,948 on 2 non-propelled scows. The flat bottomed scows were designed for towing and low exposure environments, and worked well as light platforms in lake waters. *LV75* and *LV77* (Figure 23) varied in length, beam, and draft (Table 11) and were used in Lake St. Clair and Lake Michigan for 36 and 37 years. Forced to decommission due to station closings, the Lighthouse Board sold *LV75* in 1939 for use as a lighter in New York Harbor (Flint 1989).

The Lighthouse Board continued commissioning shipwrights to build larger, sharper, steel lightships for coastal stations. *LV76*, *LV78*, *LV79*, *LV80*, *LV81* (Figure 24), and *LV83* represented new designs and were manufactured under similar specifications. Built by Burlee Dry Dock, *LV76* measured 117 feet 7 inches in length, drafted 14 feet, 11¼ inches, and stretched 28 feet 8 inches in beam. The Lighthouse Board specified that *LV76* (Figure 25) have a bar keel of rolled or hammered iron, measuring 7 inches sided and 1⅝ inches molded. The stem measured 6½ inches by 1⅞ inches, and the sternpost 6 inches by 3¼ inches of forged iron. The frames were spaced 18 inches apart and reduced in size near the bow and stern. Floor plates ran from

bilge to bilge; cant, belt, and reverse frames were included for support (United States Light-House Establishment 1901:11-13).



FIGURE 23. LV77 moored on station. (Photo courtesy of the USCG Historian's Office Archives, Box 21, Washington, DC.)

Deck beams on LV76 measured 8 inches by $3\frac{1}{2}$ inches by $\frac{13}{32}$ inches and were fitted on every second frame. Beams varied in size near the bow, stern, hatches, and under the windlass. Spar deck and lower deck beams were smaller than main deck beams and secured with welded beam knees. The center keelson was installed as a horizontal plate 36 inches wide, weighed 20 pounds per square foot, and was tapered at both ends. Bilge keelsons measured 7 inches by 3 inches by $\frac{11}{32}$ inches and contained inside angles measuring $3\frac{1}{2}$ inches by 3 inches by $\frac{3}{8}$



FIGURE 24. *LV81*, moored on Heald Bank, Texas. (Photo courtesy of the USCG Historian's Office Archives, Washington, DC.)

inches. Outer bilge keels extended 21 inches deep and for lengths of 60 feet down the sides. Bulkheads located on frame Nos. 8, 20, 50, and 70 formed watertight compartments and added transverse strength. The inside hull received cement to cover rivet heads and assist water drainage, while the exterior hull was painted with three coats of red lead (Flint 1989; United States Light-House Establishment 1901:14-21).

Steel whalebacks represent the next phase in American lightship construction. *LV82*, *LV95*, *LV96*, *LV98*, *LV101* (Figure 26), and *LV102* constitute the only lightships with whaleback weather decks. Designed by the Division of Marine Engineering, United States Bureau of Lighthouses, whaleback lightships ranged from 95 to 108 feet in length, 21 to 25 feet in beam, and drafted 7 feet to 11 feet of water (Table 11). Constructed by Racine Truscott Shell Lake Boat

vessel that is constantly awash in heavy weather. Further details of the form characteristics are the curves of displacement, center of buoyancy, metacenter, center of gravity with varying conditions of load, etc. (Cook 1915:188).

Cook (1915:188) notes a continuous upper deck when describing *LV101* and *LV102*, subdivided below the main deck by watertight compartments. Cook discusses contents of each compartment in one paragraph, noting placement of trimming tanks, fresh water tanks, and various rooms for storing and fixing onboard necessities. In describing construction, Cook states,

The scantling throughout is much heavier than that required by any classification society for a vessel of the size, in order that the greatest practical strength may be obtained, as well as sufficient material to bear the heavy corrosion brought upon a vessel liable to extended periods of continuous duty in exposed waters (Cook 1915:188).

Cook (1915:189) claims that unusual sheer, freeboard, rounded gunwale, and tubular foremast define whaleback style lightships. The whalebacks were stationed in the Great Lakes, Atlantic, and Gulf of Mexico, and five utilized propulsion.

LV101 became the Portsmouth Lightship Museum upon decommissioning. *LV102* was sold after 46 years of service. After decommissioned, *LV102* became a crab processing ship, *Cross Rip*, and then a fishing vessel. The Boston VFW acquired *LV82* in July 1936 and converted it into the floating headquarters for the USS *Constitution*, located in the Fort Point Channel, South Boston. *LV 96* and *LV98* remained active lightships for respectively 41 and 40



FIGURE 26. Steel whaleback lightship, *LV101*. (Photo courtesy of the USCG Historian's Office Archives, Box 21, Washington, DC.)

years. Both were decommissioned and sold in 1955; their next uses remain unknown (Flint 1989).

After whalebacks, the Lighthouse Board appropriated funds for 23 more lightships. The final lightships were constructed from 1920 through 1952 and exhibited marked changes. *LV105* was built by Consolidated Shipping in 1922, and became the largest and most equipped lightship of the time. The new vessel measured 146 feet 3 inches in length, 30 feet in beam, with a draft of 12 feet 7 inches. *LV105* displaced 825 tons and cost \$437,404, roughly the same amount as all 6 whalebacks (\$494,357). *LV105* was a replacement vessel for *LV71* and served on station for 20 years, then as an examination vessel during WWII for 2 years (Flint 1989).

In 1936, *LV112* replaced *LV105* as the largest lightship. *LV112* was assembled by Pusey & Jones for \$300,956. It was paid for by the British Parliament in repayment for sinking the

previous Nantucket lightship, *LV117*. *LV112* arrived on Nantucket Station in 1936 and remained in service through 1975. *LV112* was 148 feet 10 inches, overall and displaced 1,050 tons. Pusey & Jones equipped *LV112* with a compound reciprocating engine, steel deckhouses, state-of-the-art radio system, and the largest electric lens lanterns used on domestic lightships (Flint 1989).

The 1930s marked the end of another transition in steel lightship construction. *LV112*, *LV114*, *LV115*, *LV116* (Figure 27), *LV117*, and *LV118* were the last domestic models manufactured from non-welded steel. From 1930 to 1938, Pusey & Jones, Albina Iron Works, Charleston Drydock & Machine, and Rice Brothers, built the new lightships. The United States Coast Guard Historian's Office Archives contains photographs depicting the construction process of *LV116*. Figures 28, 29, and 30, document the construction of *LV116*, March through December 1929. *LV114*, *LV115*, *LV116*, and *LV117* were equivalent in size (Table 11),

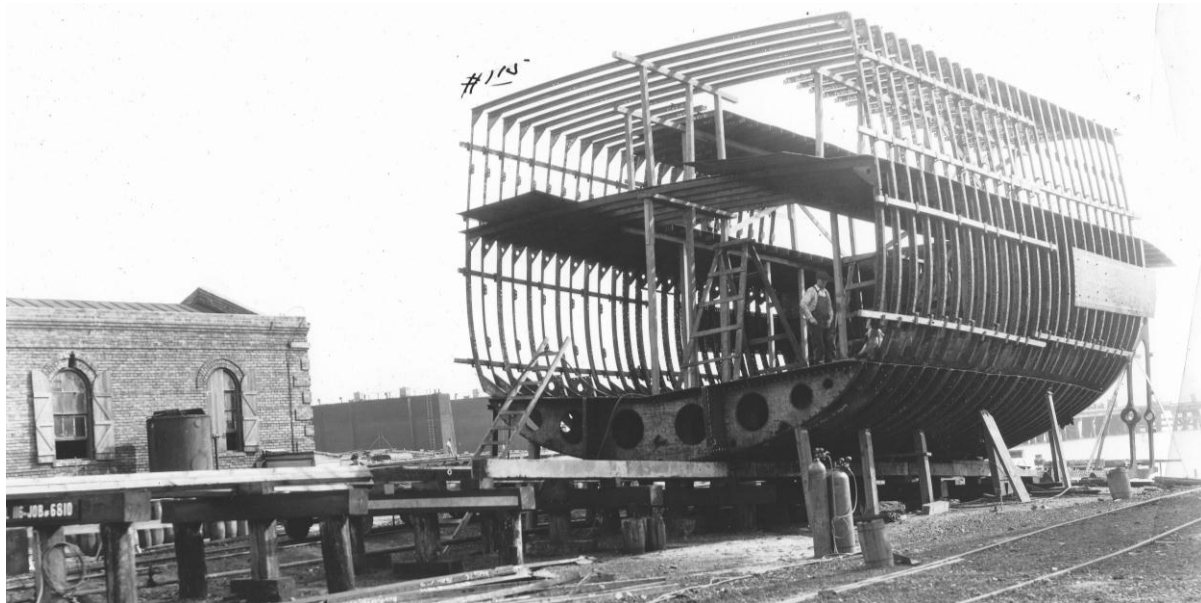


FIGURE 27. Taken 29 March 1929 at Charleston Drydock and Machine Company, construction of *LV116* was underway. (Photo courtesy of USCG Historian's Office Archives, Box 13, Washington, DC.)

displacing 630 tons each. *LV118* was the smallest of all 6 and measured 114 feet 9 inches in length, 26 feet in beam, 13 feet 4 inches in draft, and displaced 412 tons (Flint 1989).

The United States Coast Guard acquired responsibility for lightships in 1939 and changed lightship designations from LV to WAL in February 1942, and WAL to WLV in 1965 (Flint 1989). The last six lightships built were all-welded steel lightships with diesel propulsion. *WLV189* (Figure 31), *WLV196*, *WLV604*, *WLV605*, *WLV612*, and *WLV613* represented an amalgamation of 119 years of domestic production experience. All six lightships were built with the same length, beam, draft, and tonnage (Table 11). They were all equipped with AC electrical systems, breakwaters on the foredeck, two masts, and a stack amidships. Willard Flint claims the last six lightships had the highest degree of watertight integrity because bulkheads were carried to the weather deck (Flint 1989).

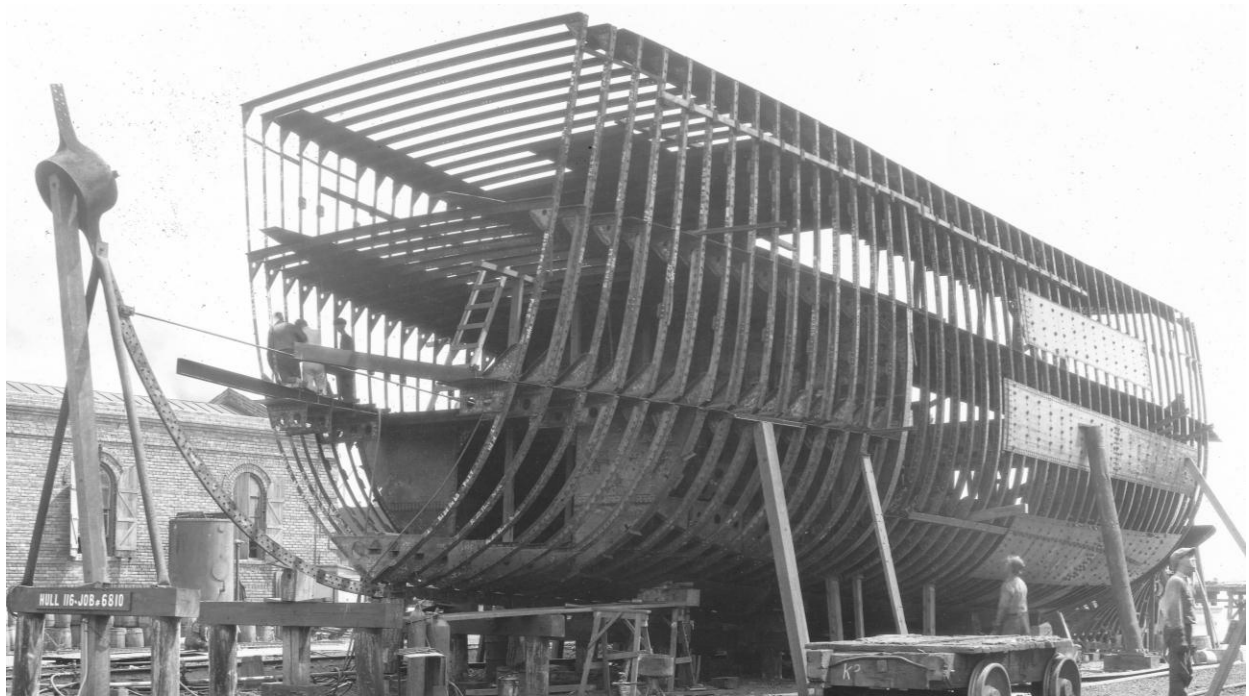


FIGURE 28. *LV116*, taken 25 May 1929. Bulkheads, frames, plating, stem, and hawse pipe in place. (Photo courtesy of USCG Historian's Office Archives, Box 13, Washington, DC.)

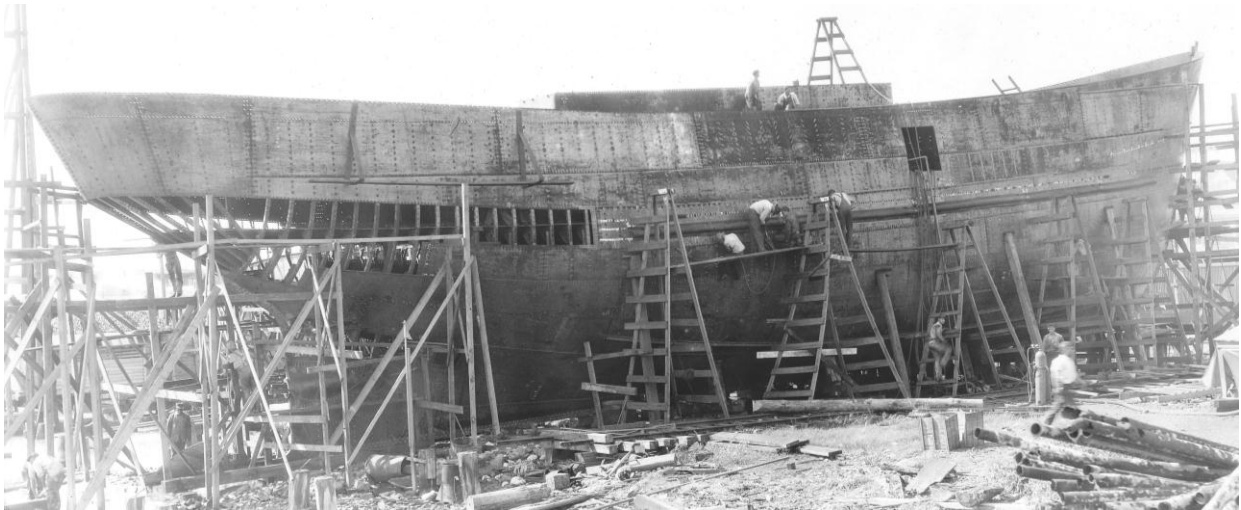


FIGURE 29. *LV116*, taken 25 September 1929. (Photo courtesy of USCG Historian's Office Archives, Box 13, Washington, DC.)

Fifty-three steel lightships were constructed over sixty-two years. The average use life for steel vessels was respectively 40 years. Overhauling, hull maintenance, repainting, equipment upgrades, and general repairs constituted common maintenance. Steel lightships were the largest, strongest, and most technologically equipped examples in the fleet and exhibited various hull designs. Despite interchangeability, smaller lightships with less freeboard and fuller hulls typically signified a lightship constructed for the Great Lakes (Flint 1989). Larger, sharper hulled examples with pronounced bows indicated a model better suited to coastal conditions or exposed stations.

The Lighthouse Board defined modern lightship construction as vessels designed with better trim, less draft, improved balance, increased buoyancy, and easier handling on station (Lighthouse Service 1914:134). Construction notes from 1946 assert the ability of lightships to maintain station during hurricane force winds as well as remain afloat with flooded compartments (United States Coast Guard Public Information Division 1946:288-289). Further characteristics offered by the Coast Guard claim fuller lines above the waterline, forward and aft,

increasing displacement in high waves and heavy seas (Flint 1989; United States Coast Guard 1946:906).



FIGURE 30. *LV116*, taken 26 December 1929. (Photo courtesy of USCG Historian's Office Archives, Box 13, Washington, DC.)

Converted lightships deserve a brief explanation as non-purpose built craft. The Lighthouse Board purchased at least 14 vessels for use as lightships and altered them by adding luminary apparatus, signaling devices, and auxiliary machinery. Propulsion was added or

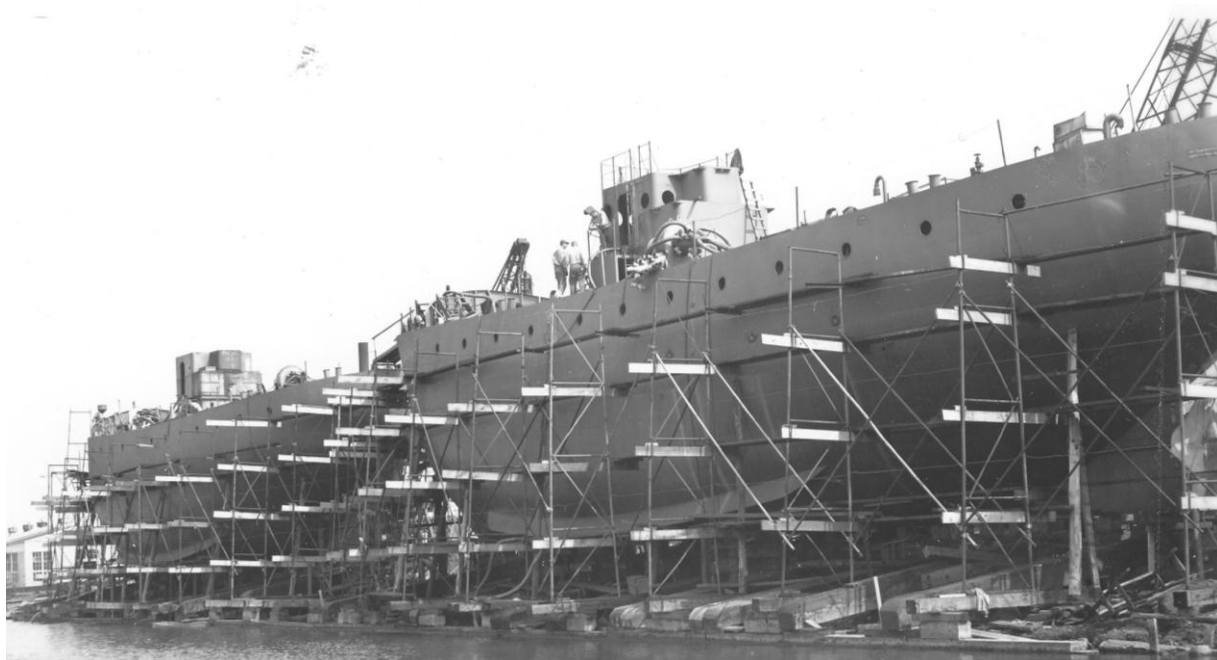


FIGURE 31. An all-welded steel lightship under construction in Defoe Shipbuilding yard, Bay City, Michigan, 1946. (Photo courtesy of the United States Coast Guard Historian's Office Archives, General Subject Files Box, Washington, DC.)

removed, hulls were repainted, and vessels were equipped with standard supplies, food, and fuel.

Converted lightships represented the first iron-hulled and composite ships and functioned in various roles. In certain situations, the Lighthouse Board found it cheaper to buy and convert non-purpose craft into lightships, rather than to build new. Converted lightships were used as temporary replacements in times of war or as substitutions for wrecked ships or lightships in repair. The majority of converted lightships were acquired during the 19th century and came from inter-governmental agencies. *Spencer* and *Legare* were transferred from the Revenue Marine to the Lighthouse Board (Flint 1989). *McLane* also came from the Revenue Marine and was stationed, in 1849, in Louisiana (Lighthouse Board 1849). The schooners *Ascension* and *Arctic* were purchased from the Navy (Lighthouse Board 1860). The Lighthouse Board purchased the *Drift* from the Coast and Geodetic Survey; *Granite* and *Florida* were previously Federal sloops (Lighthouse Establishment 1861). Converted lightships were important as navigational aids and were considered part of the American fleet.

TABLE 11.
LIGHTSHIP DIMENSIONS IN FEET, INCHES, AND TONS.

Year	Lightship	Length	Beam	Draft	Displaced Tons FW=Fresh Water	Gross Tons
1819	<i>C</i>					70
1820	<i>ZZ, Aurora Borealis</i>	< 60'				50
1821	<i>Q</i>				120	
1821	<i>DD</i>					72
1823	<i>VV</i>	90'	23'			154
1823	<i>N</i>	72'	20'	8' 7"	110	120
1823	<i>X</i>	72'	20'	8' 7"		120
1823	??					300
1824	<i>AA, Caesar</i>					220
1827	<i>LV25</i>	61'	16'	6' 6"		41/72.5
1828	<i>H</i>	76'	21' 6"			139 & 55/95
1828	<i>HH</i>	76'	21' 6"	8' 9"		140 & 55/95
1830	<i>BB, Florida</i>					141 & 55/95
1832	<i>YY, Louis McLane</i>	47'	17' 9"			142 & 55/95
1834	<i>Roanoke River LV</i>	76'	21' 6"	8' 9"		143 & 55/95
1835	<i>LV 12 (1)</i>	64'	20'	8' 6"		144 & 55/95
1835	<i>O</i>	51'	16' 8"	7'		145 & 55/95
1835	<i>L</i>	40'	17'	6' 10"		146 & 55/95
1835	<i>MM</i>	77' 6"	22' 6"	8' 8"		147 & 55/95
1837	<i>Long Shoals LV</i>	78'	24'	9' 4"		151 & 55/95
1838	<i>NN, Key West LV</i>					152 & 55/95
1847	<i>Z</i>	78'	20'			156 & 55/95
1849	<i>LV2</i>	98'	25'	9' 6"		210
1852	<i>LV14</i>	91'	22'	9'		159
1853	<i>LV8</i>	98'	23' 6"	11' 6"		232
1853	<i>LV11</i>	104'	24' 8"	9' 10"		320
1854	<i>LV7</i>	98' 5"	22' 5"	10'		142

Year	Lightship	Length	Beam	Draft	Displaced Tons FW=Fresh Water	Gross Tons
1855	LV4	77'	20'	9' 6"		104
1855	LV6	80'	24	10' 6"		140
1855	LV35					
1856	T	81' 6"	21' 6"	10' 6"		150
1857	LV9	81' 2"	28' 2"	9' 6"		181
1857	LV23	94' 6"	24' 11"	9' 6"		186
1857	LV33	81' 6"	22'	8' 8"		260
1858	Lady Davis, James Gray, LV31	111'	25' 6"	7'		250
1863	LV32	100'	24'	10' 6"		
1863	LV21	78'	21' 6"	10'		150
1864	LV28	82'	22'	9'		83
1864	LV29	101'	23' 6"	10' 6"		232
1865	LV34	101' 10"	23'	11'	218	150
1867	LV20	81' 6"	21' 6"	10' 6"		165
1869	LV37	98'	23' 6"	10' 6"		242
1870	LV38	92'	22' 5"	11'		232
1875	LV39	119' 6"	26' 9"	12' 6"		387
1875	LV40	114' 5"	27'	14'		349
1876	LV41	120' 6"	26' 9"	11'		387
1876	LV97	80' 6"	19' 6"	10' 8"	87	
1891	LV47	120' 10"	26' 6"	11' 5"	470	
1891	LV48	120' 10"	27' 8"	12'	470	295
1891	LV49	120' 10"	26' 9"	14'	470	
1891	LV55	102' 8"	20'	14'		
1891	LV56	102' 8"	20'	14'		
1891	LV57	102' 8"	20'	14'		
1892	LV 50	120' 10"	26' 9"	11' 3"	470	
1892	LV51	118' 10"	26' 9"	12'	375	
1892	LV52	118' 10"	26' 6"	12'	375	310
1893	LV64	38'	12' 2"	2' 6"	16.7	
1893	LV65	38'	12' 2"	2' 6"	16.7	
1894	LV58	121' 10"	28' 6"	13'		449
1896	LV66	123'	28' 6"	13'	590	
1897	LV71	122' 10"	28' 6"	13' 6"	590	
1901	LV73/WAL503	123' 9"	28' 6"	14' 9"	693	
1902	LV74	129' 9"	28' 6"	13'	495	
1902	LV75	83' 9"	23'	9' 6"		160
1904	LV76/WAL504	129' 6"	28' 8"	12' 6"	578	
1904	LV78/WAL505	129'	28' 6"	12' 6"	668	
1904	LV79/WAL506	129'	28' 6"	12' 6"	668	

Year	Lightship	Length	Beam	Draft	Displaced Tons FW=Fresh Water	Gross Tons
1906	<i>LV77</i>	75'	21' 6"	9' 3"	155 FW	
1907	<i>LV84/WAL509</i>	135' 5"	29'	12' 9"	683	
1907	<i>LV85/WAL510</i>	135' 5"	29'	12' 9"	683	
1907	<i>LV86/WAL511</i>	135' 5"	29'	12' 6"	683	
1907	<i>LV87/WAL512</i>	135' 5"	29'	12' 9"	683	
1908	<i>LV91/WAL515</i>	135' 5"	29'	12' 7"	685	478
1908	<i>LV92/WAL516</i>	135' 5"	29'	12' 7"	685	478
1912	<i>LV95/WAL519</i>	108' 5"	23'	11' 6"	368 FW	
1914	<i>LV96/WAL520</i>	101' 6 "	23' 6"	11' 3"	170 FW	
1915	<i>LV98/WAL521</i>	101'	23' 6"	11'	195 FW	
1916	<i>LV101/WAL524</i>	101' 10"	25'	12' 2"	360	
1916	<i>LV102/WAL525</i>	101' 10"	25'	11' 9"	393.9	
1920	<i>LV99/WAL522</i>	91' 8"	22'	10' 7"	215 FW	
1920	<i>LV103/WAL526</i>	96' 5"	24'	11' 9"	310 FW	
1922	<i>LV105/WAL527</i>	146' 3"	30'	12' 7"	825	
1923	<i>LV106/WAL528</i>	132' 4"	30'	14' 7"	775	
1923	<i>LV107/WAL529</i>	132' 4"	30'	14' 7"	775	
1923	<i>LV108/WAL530</i>	132' 4"	30'	14' 7"	775	
1923	<i>LV109/WAL531</i>	132' 4"	30'	14' 7"	775	
1923	<i>LV110/WAL532</i>	132' 4"	30'	14' 7"	775	
1926	<i>LV111/WAL533</i>	132' 4"	30'	14' 4"	775	
1929	<i>LV100/WAL523</i>	133' 3"	30'	13' 3"	630	
1930	<i>LV116/WAL538</i>	133' 3"	30'	13'	630	
1946	<i>WLV189</i>	128'	30'	11'	630	
1950	<i>WLV612</i>	128'	30'	11'	617	
1952	<i>WLV613</i>	128'	30'	11'	617	540

Sources: Brown (1837); Cipra (1997); Cook (1915); Flint (1989); Lighthouse Board (1862, 1871, 1876, 1881, 1883, 1884, 1886, 1887, 1889, 1890, 1891, 1893, 1894, 1897, 1898); Poirier and Bellatoni (2000); Ridgely-Nevitt (1945); U.S. Light-House Establishment (1895a, 1895b, 1901); Wallace (1828); Williams (1834).

CHAPTER 6 : CHARACTERISTIC FEATURES

The basic characteristics of lightships remained constant throughout their employment. Boldly colored hulls, lights, and audible signaling capabilities were installed on every lightship. Paralleling civilian changes in construction materials, fuel, technology, and communication capabilities, equipment and machinery onboard lightships improved. This chapter focuses on the exterior characteristics that differentiated lightships from other watercraft. Luminary devices, fog signals, and definitive markings will be discussed separately, in chronological order.

Luminary Devices

Luminary devices were lit one half hour before sunset and extinguished one half hour after sunrise. Lights are arguably the most characteristic feature on lightships (United States Light-House Service 1835). Contained inside various lantern designs and displayed from 22 to 68 feet above the weather deck, luminary devices onboard lightships underwent several modifications. Early lighting examples were shallow, covered pans utilizing 10 wicks to burn whale oil. Hung in gimbals and hoisted into position using hand winches, early lamps failed to produce adequate lighting. The coarse wicking, inferior oil, and lack of glass chimneys produced a dull, intermittent light visible for only short distances (United States Coast Guard 1945:906).

The wooden and copper lantern on the 1820 lightship *Aurora Borealis* measured 4½ feet in diameter by 4 feet tall and was raised and lowered between two masts for lighting, trimming, and cleaning (Cipra 1997:206). Three years later, Henry Eckford built lightships *N*, *X*, and ??, with similar lighting arrangements. On Eckford's ships, lanterns mounted on cradles were hoisted up and down a frame using winches at the foot of the mast (Cairo1974a:11) (Figure 32). Contracts detailing lighting specifications in 1828, 1834, and 1837 indicate the continuance of similar lighting designs. The Neuse River lightship displayed a fixed, white light, 40 feet

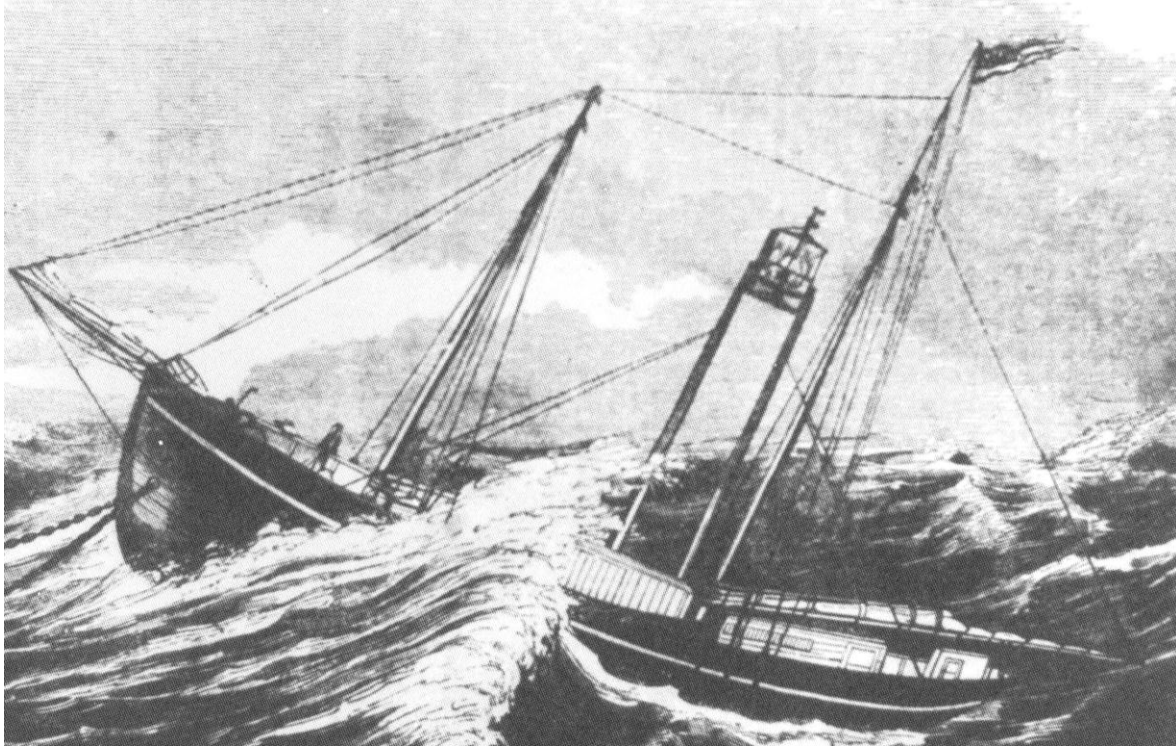


FIGURE 32. Lightship *N*. Built by Henry Eckford, 1823. Photo courtesy of James W. Claflin (Kirklin 2007:25.)

above the deck. Lighting details of the Neuse River lightship appear in the 1828 contract written by Thomas B. Wallace,

To have a lantern made of copper, two feet square, and two and a half feet high, to contain a copper lamp of the compass kind, to hold six quarts of oil, and fitted to burn eight wicks, and hung with a compass motion; the former to be glazed with white glass of double thickness, eight inches by ten; the lantern to travel up and down between the masts upon a frame. It will be raised by means of two leaded weights to be suspended by a single rope, attached to their upper ends, and running over a sheave, placed in the head of each mast and passing through a groove in the side of the traveling frames, and fixed to its lower ends, that they can be drawn down by a single rope, as a whip attached to the frame (Wallace 1828).

The 1834 Roanoke River Lightship and 1837 Long Shoals Lightship had similar designs, except the number of wicks increased from 8 to 12 (Brown 1837; Williams 1834).

Complaints from mariners regarding visibility, height, brightness, and inferiority of American navigational aids led to Congressional inquests in 1838 and 1851. Fresnel lenses, used in France since 1822, were far superior to lenses used in America and simplified light maintenance (Tilp 1978:94). Demands for similar lights in domestic waters resulted in slow implementation. In 1852, the Lighthouse Service purchased Fresnel lenses for all lighthouses (Cairo 1974b:42). New Fresnel lenses meant that the parabolic reflectors and Argand lamps previously used only in lighthouses were installed in lightships (Hornberger and Turbyville 1997:39). New reflectors, lenses, lamps, and lantern designs were added between 1853 and 1856 (Light-House Board 1856) (Figure 33).

Within ten years of acquiring Fresnel lenses for lighthouses, the Light-House Board extended the same upgrade to lightships. Contract specifications called for three small Fresnel lenses and listed them in the 1862 *Instructions and Directions to Light-House and Light-vessel Keepers of the United States*, as standard issue for light-vessels of the first fitting (The Light-House Board 1862:138). Further details regarding the lanterns and illuminating apparatus included,

One or two lanterns, as the case may be, made according to the printed specifications, plans, and drawings. One hoisting machine, complete, for each lantern, as prescribed.



FIGURE 33. The lighting apparatus on *LV3*, stationed off Shovelful Shoals, Massachusetts. The 1892 *Annual Report of the Light-House Board* claims that a set of 3 lanterns with brackets, gimbals, lamps, etc., weighs about 700 pounds and costs \$620 (The Light-House Board 1892:30). (Photo courtesy of the USCG Historian's Office Archives, Box 25, Washington, DC.)

One lantern house for each lantern. Eight parabolic reflectors, 12 inches diameter, and lamps fitted to the lantern frame with gimbals, cups, balls and sockets for each lantern; three small Fresnel lenses or Costan bowl lamps, with Argand burners, according to circumstances, to be determined at the time of building the vessel or establishing the light (The Light-House Board 1862:138).

Standardization in 1855 equipped most lightships with single or double lanterns, containing 8 oil lamps and, by 1862, reflectors. Lamp variations include Funck type, fountain-burner, and constant level oil lamps (Figure 34) (Flint 1989).

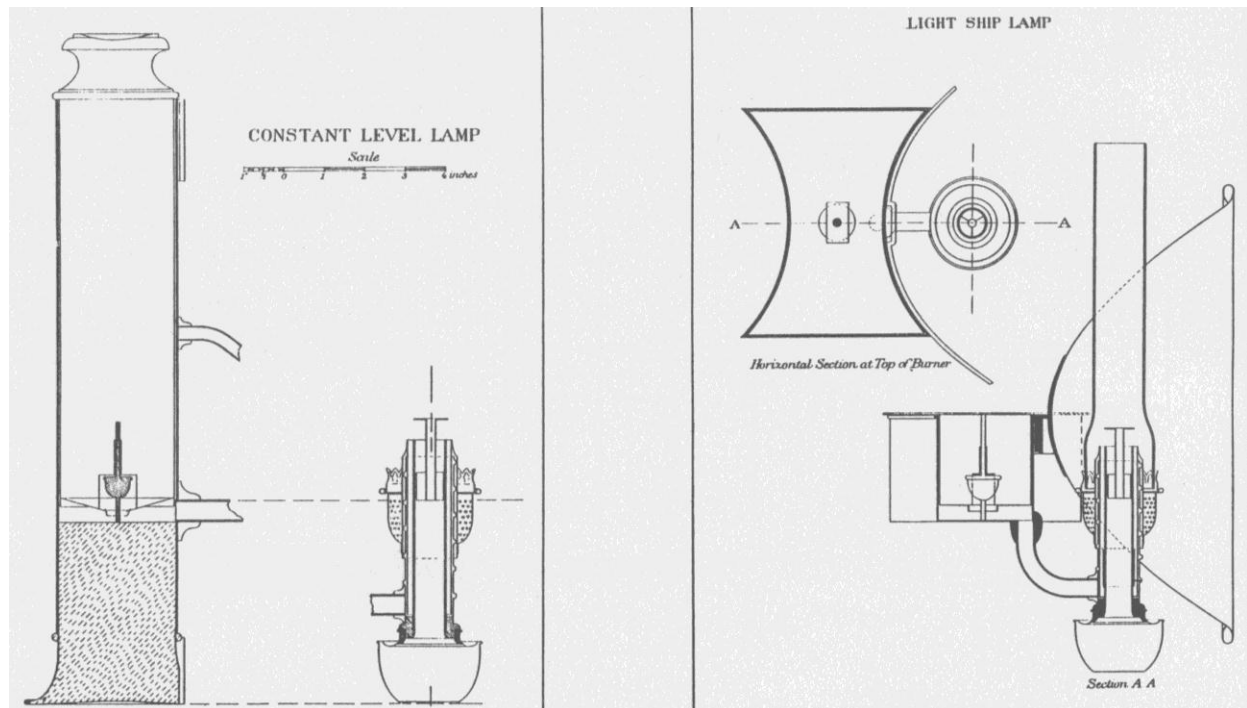


FIGURE 34. Constant level oil lamp. (Photo courtesy of United States Light-House Establishment 1902:Plate 9).

As lighting apparatus and Light-House Board practices improved, an increase in luminary devices required more fuel. Fuel costs became an important financial topic for the Light-House Board. Sperm whale oil, or spermaceti, a traditional and favored choice in England, was diminishing in availability and inflated in cost. William Shubrick encouraged domestic production of colza or rape seed oil during the 1840's and 1850's. Colza oil became the preferred choice because it was cheaper than alternate oils by half (The Light-House Board 1862:144-145). Farmers in Texas failed to grow enough rape to satisfy domestic needs (Shubrick 1854). Initiatives in Virginia and Maryland using French methods of producing similar oil from wild

cabbage also failed; farmers could not produce enough oil to meet Light-House Service demands (Tilp 1978:94).

Fuel preferences changed in 1864 as lard oil became standardized. By 1876-1877, mineral oil surpassed lard oil (Flint 1990:14; Hornberger and Turbyville 1997:117). In 1879, *The Annual Report of the Light-House Board* discussed mineral oil as a successful illuminant, suggesting substitution in all fourth, fifth, and sixth order lights (The Light-House Board 1879:7). Kerosene replaced mineral oil by 1885. Lanterns using compressed petroleum gas or acetylene gas gained momentum between 1910 and 1922 (Flint 1990:14; Hornberger and Turbyville 1997:117; Hyde 1995:27). Oil was expensive to use and was eventually replaced by electric lighting. Effective when lantern burn times commenced at sunset and ended at sunrise, replacing previous practices of lighting and extinguishing lanterns a half hour before and after daylight hours ended (The Light-House Board 1879:7).

The end of the 19th century proved an interesting and experimental time for lightship illumination. The Naval Secretary, Commander G. W. Coffin, suggested incorporating flashing and revolving characteristics on lightships in October 1890 (The Light-House Board 1892:28). Less than a year later, an English revolving apparatus using a red flashing light was installed on the foremast of *LV48* (Flint 1989; New York Times 1891). The lights were connected by worm gear to engines housed underneath the deck. The worm gear rotated the lamps, producing a flashing light. The new lights helped distinguish lightships from all other traffic in New York Bay. The engines, worm gear, revolving clockwork run by weights, and the spring clock manufactured by England's Chance Brothers cost \$1,755. The Light-House Board spent \$3,510 to furnish *LV48* and *LV16* with the first revolving lightship lamps (The Light-House Board 1892:31).

Another big change regarding lightship luminary characteristics was implementing electric lighting. The first electric plant was installed on *LV51* in 1892. The electric plant consisted of a dynamo or generator, producing direct current for powering the interior and exterior lights. According to the 1891 *Annual Report of the Light-House Board*,

The two dynamos are to be compound wound, and to be at least of 60 amperes capacity, with an electro-motive force of about 110 volts at terminals of machine; they are to be automatically regulated, so that three-fourths of the lamps may be extinguished with safety without material change of speed. They must not spark and must not require the brushes to be shifted to accommodate change of load. Their commercial efficiency must be at least 80 percent. The engines and dynamos are to be located that, with the Evans friction cones, either engine can run either or both dynamos. The dynamos will be furnished with sliding bed plates so that they can be quickly thrown in or out of action (The Light-house Board 1891:187).

Thomson-Houston contractors installed “Ideal” type electric engines, “Thomson-Houston” type dynamos, and a light system, onboard *LV51* in July 1892 (The Light-House Board 1893:202). Four lens lanterns, containing eight lamps, were hung on gimbals using brackets permanently fastened to each masthead. Each lamp yielded 100 candle power incandescent light and provided total candle power of approximately 4,000 units (The Light-House Board 1891:187; The Light-House Board 1892:29). The flashing device used an electric circuit connected to the dynamos. The device was capable of being set at intervals between 5 and 20 seconds (The Light-House Board 1891:187; The Light-House Board 1893:202). The first electric

power plant on a lightship proved successful and cost \$4,217.69 (The Light-House Board 1893:202).

Three years later, a similar electric-plant with flashing capabilities was detailed in the Light-House Board's (1895a) *Specifications for Composite Light-Vessel No.66*. Powered by two General Electric Marine Sturtevant engines (known as m.p. 4-8-550, with 5 inch by 4 inch double cylinders), *LV66* contained the same flashing device as *LV51*. Lead covered Okonite wiring, rated to 96 percent conductivity and measuring no smaller than the No. 14 Brown & Sharpe gauge, connected the engines with the luminary devices. Arranged in lanterns (Figure 35), the lamps consisted of 100 and 110-volt lights capable of producing 16 and 100 units of candle power. Controlled by circuits installed on a black slate switchboard, Weston volt meters and ammeters made monitoring and switching electric currents between dynamos possible. (The Light-House Board 1895a:33-34).

Despite demonstrated success of electric lighting onboard lightships, the Light-House Board continued to install oil fueled lamps through 1912. Three oil burning lenses on the foremast served as first-fitting for lightships built from 1892 through 1893 and 1904 through 1908. In 1893, twelve foot long lanterns with three oil lamps were fixed to the foredeck of *LV63*, *LV64*, and *LV65*, replacing cluster lighting on lightships destined for the Great Lakes. Technology improved and, by 1911, an incandescent oil vapor lamp was installed on *LV94*. Measuring six feet six inches in diameter, the lantern housed a fourth order lens carried on a compound pendulum mounted in gimbals. The incandescent oil vapor lamp on *LV94* produced 2,900 candle power and was displayed 68 feet above water level (Flint 1989).

Incandescent oil vapor lamps generated light by vaporizing kerosene and directing the gas through a chamber and into a mantle. These lights were popular in lighthouses prior to use in

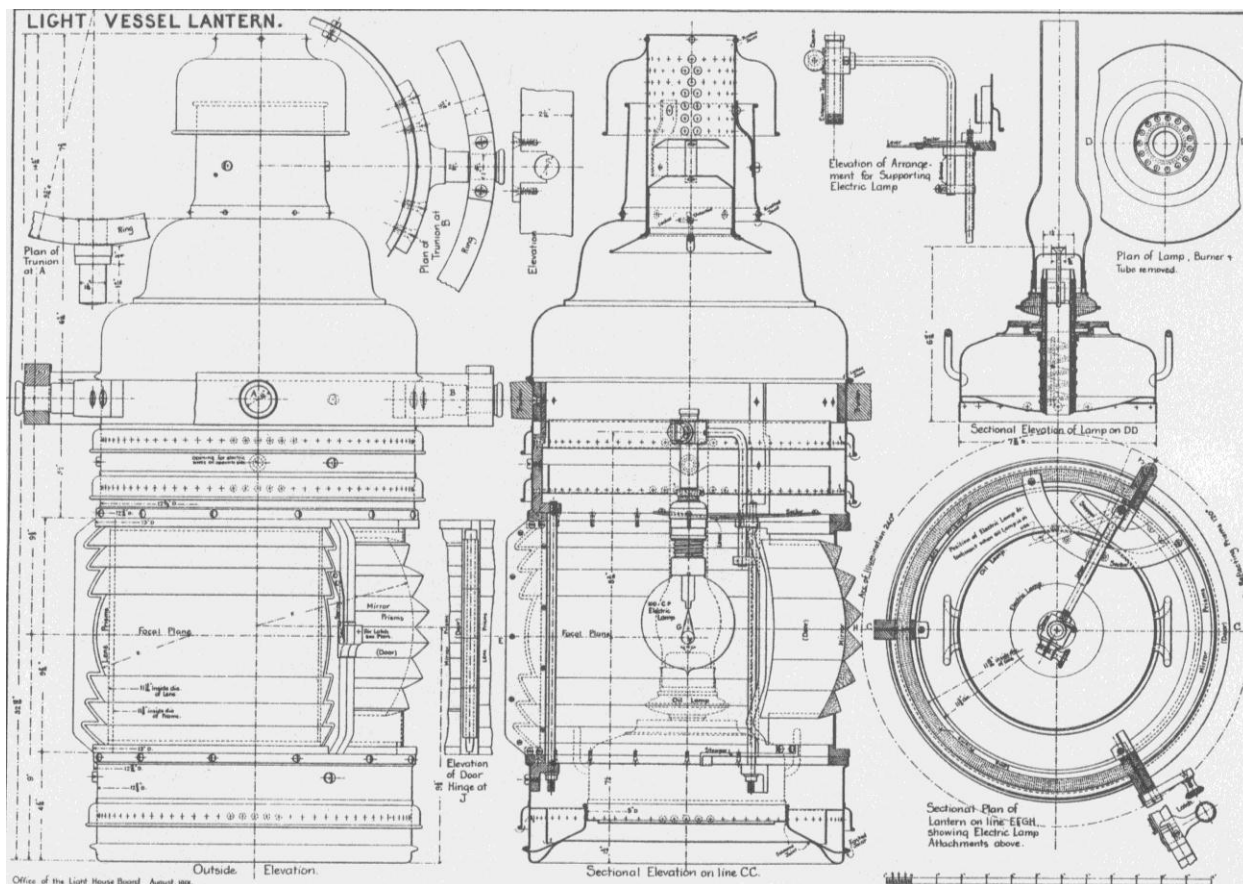


FIGURE 35. Sectional plan of an electric lantern employed on lightships. (Photo courtesy of the United States Light-House Establishment 1902:Plate12.)

lightships and did much for popularizing the demand for kerosene (American Lighthouse Coordinating Committee 1998; Hyde 1995:27-28). By 1916, kerosene replaced oil as the predominant luminary fuel onboard lightships, but interest and demand waned within six years. The Light-House Board began to understand the inherent dangers in using and storing kerosene. The combustible nature of kerosene led to dwindling use on lightships; it was replaced with safer fuels (Flint 1989).

Acetylene burning lamps became a popular choice for lightship illumination during the first decade of the 20th century. Acetylene lamps magnified and distributed light through lenses measuring 300 mm to 375 mm thick. The lamps had a continuously burning pilot flame and

solenoid gas valves for supplying fuel to the main burner. Flashing, or oscillation, of the lights was produced by a clockwork apparatus below the weather deck. Controlled by “electrical impulses which turned the masthead gas off and on to provide the desired duration and frequency of the flashes or occultations” (Flint 1990:14), acetylene lamps functioned differently from earlier models. First-fittings were limited to three lightships: *LV99*, *LV103*, and *LV105* (Flint 1989).

The Light-House Board continued experimenting with installation of electric luminary devices. In 1913, *LV97* displayed a 500 mm buoy lantern on a single mast. The lantern, comprised of a single 12 inch parabolic, silvered reflector, flashed every 10 seconds. Gears driven by an electric motor, located below the lantern, facilitated flashing. The lantern was “carried upon hardened steel knife-edged gimbals” (Bureau of Lighthouses, Department of Commerce 1913:66). Described as a concentrated, tungsten filament 30 candlepower incandescent lamp, the characteristic flash on *LV45* yielded approximately 80,000 candlepower. The first light of its kind when installed, the luminary device and flashing apparatus ran off seven sets of Ironclad Exide Vehicle Type batteries. Seven batteries supplied light for 21 days and were periodically sent ashore for charging. The luminary device was controlled by a switchboard on the berth deck. It was monitored by instruments that managed proper functioning of the light. If interrupted or failing, an alarm was triggered to alert the crew of malfunction (Bureau of Lighthouses, Department of Commerce 1913:66-67).

Ten years later, in 1923, further improvements to electric lighting arrived. Special, 150-watt electric lamps providing increased candle power measuring 5,500 units, were installed on lightships, *LV52*, *LV72*, *LV91*, and *LV105*,

The filament of the lamp is of the saw-tooth type, having measurements of approximately 15 millimeters in height and width, and is mounted in a G 25 bulb. The light is rated at 2,500 lumens, and when placed in the lantern with a 500 millimeter Fresnel lens develops 5,500 candlepower (Bureau of Lighthouses, Department of Commerce 1923:300).

Spheroid mirrors, placed above and below the lamps, collected and redistributed the beam, enabling the light to be seen in heavy seas (Bureau of Lighthouses, Department of Commerce 1923:300).

Between 1923 and 1930, the predominant electric luminary device onboard lightships was a 375 mm, electric lens lantern, producing some 13,000 to 16,000 candlepower. It was replaced by 375 mm and 500 mm duplex, electric lens lanterns. The last 6 lightships built between 1938 and 1952 produced 15,000 candlepower from a single masthead apparatus (Flint 1989). In 1953, a 5,500,000 candlepower lighting apparatus was installed on *WLV613*. Upon installation, this was the brightest beacon light in the world. The British designed device was visible 67 more nights out of the year than previous electric lights. It rested on a tripod foremast, aft of amidships. Comprised of 2 sets of 4, 18-inch parabolic reflectors revolving around 2, 1,000 watt lamps, the duplex high intensity light had adjustable candlepower and a back-up 500 mm lens lantern, displayed 56 feet above the ocean's surface (United States Coast Guard 1953:24-25).

From 1960 to 1971, *WLV112*, *WLV189*, *WLV196*, *WLV604*, and *WLV612* received new, high-intensity lights, including 24 locomotive headlights arranged in groups of 6, inside a 4 sided revolving lamp housing. The new apparatus produced between 500,000 and 600,000 candlepower (Figure 36) (Flint 1989). Electric train lights had intensity 500 to 600 times



FIGURE 36. Locomotive train lights on the Columbia lightship. (Photo by author, 2010.)

stronger than original lightship luminary devices and were the last significant improvement in lightship luminary devices. Additional changes in lightship illumination included installation of running lights, deck lighting, interior illumination, and manual signaling lights. In 1929, 29 of the 37 lightships in service received riding lights. Augmenting data available to approaching mariners, riding lights indicated the vessel's position as well as current direction (Bureau of Lighthouses, Department of Commerce 1929:303).

Lightships utilized fourth, fifth, and sixth order lights encased in lanterns as visual navigational markers (Figure 37, 38). Lights varied in composition, size, and characteristics, and

changed over time from fixed white lights to red flashing or oscillating beacons. New lighting features helped differentiate lightships from nearby or adjacent craft. Improvements to gimbals helped maintain vertical light positioning while allowing pendulous motion caused by waves. Experiments with different fuels and, eventually, electricity created brighter and more efficient lights, gradually reducing the amount of fuel stored onboard lightships as well as associated costs. Most importantly, lights became visible at greater distances, averaging between 8 and 12 miles of reach (Flint 1989). The range of view per foot per height depends on refraction but, generally, for every four to five inches increased in height another nautical mile becomes visible (Ball 1913).

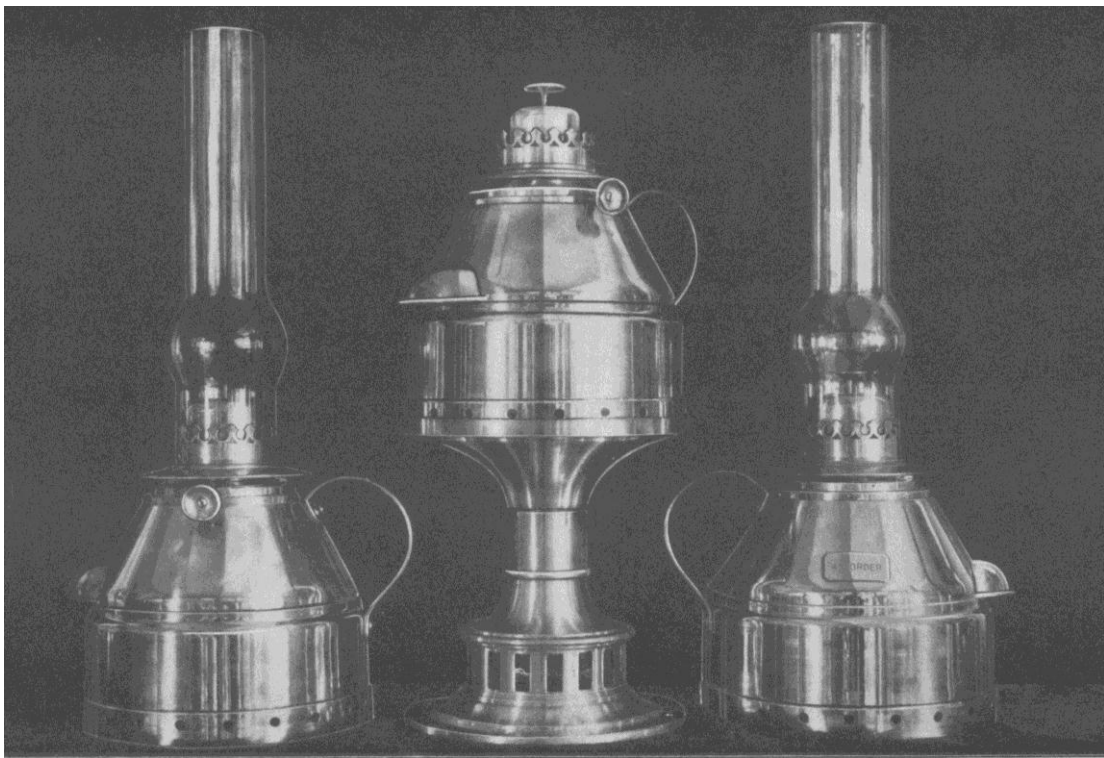


FIGURE 37. Fourth order lamps. (Photo courtesy of United States Light-House Establishment 1902:Plate 8.)

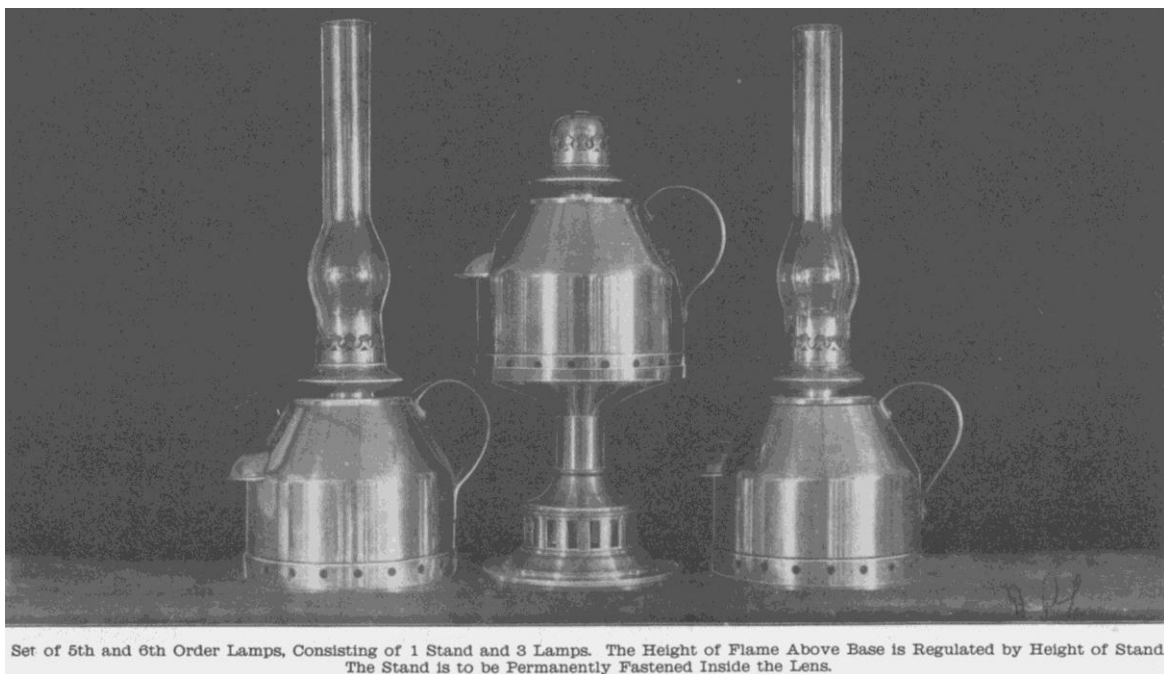


FIGURE 38. Fifth and sixth order lamps. (Photo courtesy of United States Light-House Establishment 1902: Plate 8.)

Audible Fog Signaling Devices

Despite advancements in light signal technology, inclement weather, heavy seas, and smoke continued to inhibit abilities to view navigation lights. Included to “provide an accurate means of determining position in relation to sound,” fog signals offered a way to warn ships of impending dangers (United States Coast Guard 1945:1003). To ensure proper functioning, fog signals were characterized by sounds that were easily recognized and lasted long enough for direction of the noise to be deciphered by ear. Developments in fog signaling apparatus paralleled an increase in shipping. The changes are exhibited by the range of devices used between 1820 and 1983. Basic, hand-operated fog signals were replaced by and used in conjunction with newer mechanisms operated by various engines. Major developments included locomotive steam whistles and power from internal combustion engines. Power plants eventually switched to electric power, saving space and fuel costs. Radiobeacon technology was the

pinnacle in fog signal development, providing the first means of emitting signals that could be accurately read in low to zero visibility. Epitomized by the metal bell, fog signal development changed the mariner's reliance upon light signals. Strengthening the identity of individual lightships as well as increasing signaling capabilities, fog signals vastly improved the ability of lightship crews to warn of their location as well as submerged obstructions (United States Coast Guard 1945:1003-1014).

Hand operated metal bells were installed on or above the weather deck of every United States lightship during first-fitting. Often inscribed with USLHS (United States Lighthouse Service) or USLHE (United States Light-House Establishment) across the middle of the body, bells ranged in weight from 200 to 1,050 pounds (Figure 39) (Flint 1989). Early bells hung in a belfry or gallows. They were sequentially struck by hand a predetermined number of strokes during times of heavy fog. In the 1850's, bell strokes were interchanged with horn blasts every five minutes to alert passing mariners to the lightship's location (Flint 1989). Bells used as navigational aids were made by various foundries, such as Daniel Jones, F.A. Williams, the Blake Bell Company, and Cincinnati Bell Company (Lewis 1851; Light-House Board 1894:286).

Hand operated fog horns, gongs, and cannon served as alternate sound devices onboard lightships from 1820 through the 1850's. Gongs were not installed as frequently as bells or horns and were limited in use, appearing at least on *LV11* (Flint 1989). Cannon were also limited in number and were discontinued because of risks associated with using and storing black powder (Flint 1989; Holland 1968:34). In 1850, Celadon L. Daboll invented the compressed air fog trumpet. He tested his device on the Bartlett Reef lightship, off New London, Connecticut. The first power operated fog signal Daboll used was a hand-powered machine that produced sounds made by air passing through "a whistle and trumpet with a vibrating reed similar to a clarinet"



FIGURE 39. This is the 1,000 pound, metal signaling bell installed onboard LV83. Scale is in inches. (Photo by author, 2010.)

(Figure 40) (United States Coast Guard 1845:1004). The Daboll Fog Trumpet was described in an article published in *Scientific American*,

The Daboll Fog Trumpet is made like a monster clarinet and is sounded by air condensed in a reservoir by machinery driven by a hot-air engine. The largest trumpet is 17 feet long, with a mouth 38 inches across, and a throat $3\frac{1}{2}$ inches in diameter. Its reed of steel is ten inches long, $2\frac{1}{2}$ inches wide, an inch thick at its fixed end and half that at the other. The Ericsson engine that drives it has a 32-inch cylinder, which, at 20 pounds pressure, can give a five-second blast every minute. The Daboll trumpet is, however, going out of favor because of its liability to accident and the difficulty of getting it repaired (*Scientific*

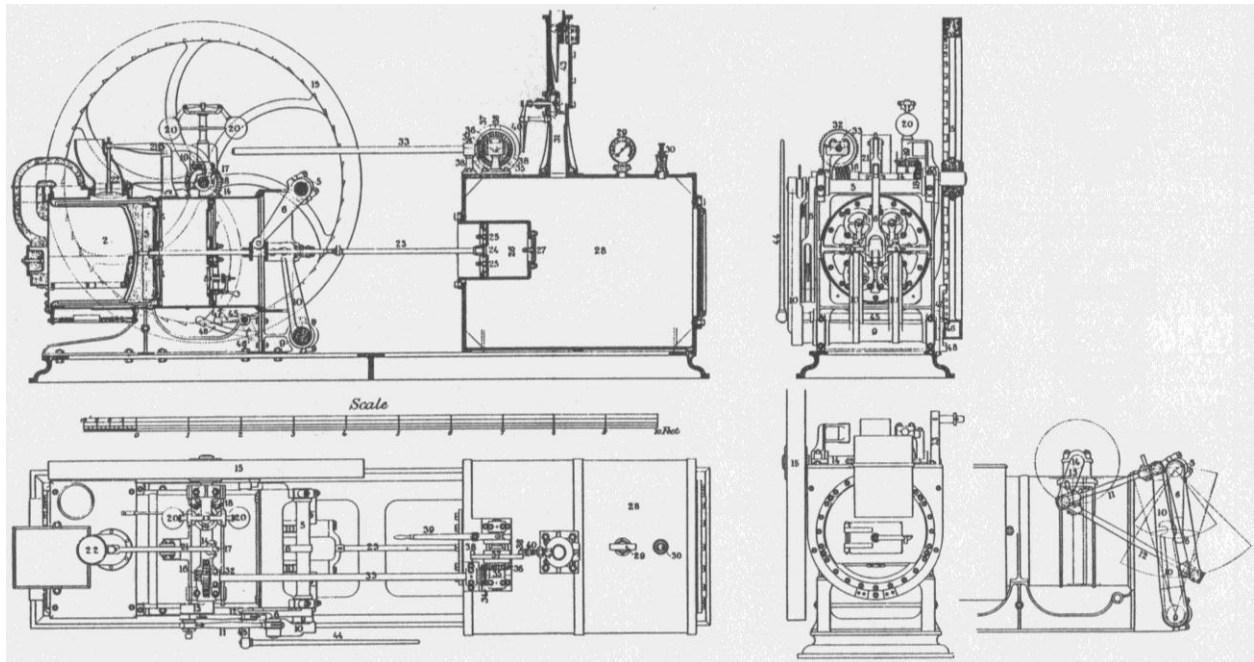


FIGURE 40. Daboll's fog signal with Ericsson's caloric engine. (Photo courtesy of United States Light-House Establishment 1902:Plate 25.)

American 1883:161). A similar device, the Anderson hand-operated fog bell, was invented and implemented in 1869, but never acquired popularity (Flint 1989).

Locomotive steam whistles, invented in 1855, were another advance in audible lightship signaling. Ranging from 6 to 8, 10, or 12 inches, lightship steam whistles ran off boilers requiring large amounts of fresh water and fuel (Figure 41). The first steam whistle was installed on *LV39*. Steam whistles, also known as chime whistles, served as the predominant fog signaling device onboard lightships for 48 years (1875-1923) until replaced by four-way diaphone horns (Flint 1989; United States Coast Guard 1945:1003-1005).

Air sirens also functioned as alternate fog signaling devices onboard lightships (United States Coast Guard 1945:1005). Used in conjunction with caloric or steam engines, then internal combustion engines, and, eventually, electricity, air sirens persisted from 1876 through 1926. Brown's First-Class Fog Siren was the first model mounted on a lightship. Compressed air was supplied to the signaling device using a caloric engine. In a 24 November 1875 article referring

to Brown's First-Class Fog Siren (Figure 42), the author claimed air sirens onboard *LV41* and *LV42* were audible for up to 10 miles (The New York Times 1875). A *Scientific American* article published in the September 1883 issue, claimed air sirens may be heard up to 20 miles and offered details pertaining to function,

The siren is sounded by driving steam through a flat, circular disc, containing a number of slits, the disc being fixed in the throat of an immense trumpet. Behind this, is a revolving plate, having in it a similar number of openings. The plate is revolved by steam 2,400 times each minute. Whenever the slits in the plate coincide with those in the disc, a jet of steam escapes through each opening, under great pressure, into the trumpet. If there are ten openings, there will be 24,000 screams each minute. These combined in the trumpet give a single, long shriek in deafening volume and great range. The sound can generally be heard at a distance of 20 miles, and readily be distinguished from all noises at sea. The siren is the furthest reaching fog signal yet produced, but it is the most expensive to build, the most difficult to run, and the most costly to keep going (*Scientific American* 1883:161).

Six inch air sirens using two three cylinder engines burning kerosene fuel were installed on *LV96* in 1914 and *LV98* in 1915. In 1916, air siren engines changed again; the types used on *LV101* and *LV102* ran off compressors supplied with steam from 2 40 horsepower, kerosene engines. *LV111* was the last lightship fitted with an air siren. Installed in 1926, *LV111* had a four-way, electric multi-horn device (Flint 1989).



FIGURE 41. Lightship steam whistle. (Photo Courtesy of the USCG Historian's Office Archives, Lightship Subject Files General, Box 2, Washington, DC.)

The 1890 Annual Report of the Light-House Board indicated steam-powered fog signals, albeit improved, required too much time to change cold water into steam. Requiring an hour or more to produce steam, fog would come and go before signals were ready. The Light-House Board investigated alternatives (The Light-House Board 1890:31). An 1896 article in *Scientific American* further described problems related to steam powered, fog signal plants. Coal storage consumed space onboard ships and posed transfer problems between tenders and lightships. In an effort to reduce amounts of coal required, as well as improving speed and readiness of fog signals, the Light-House Board installed Hornsby-Ackroyd oil engines (Figure 43) onboard *LV42* and *LV45* (*Scientific American* 1896:1).

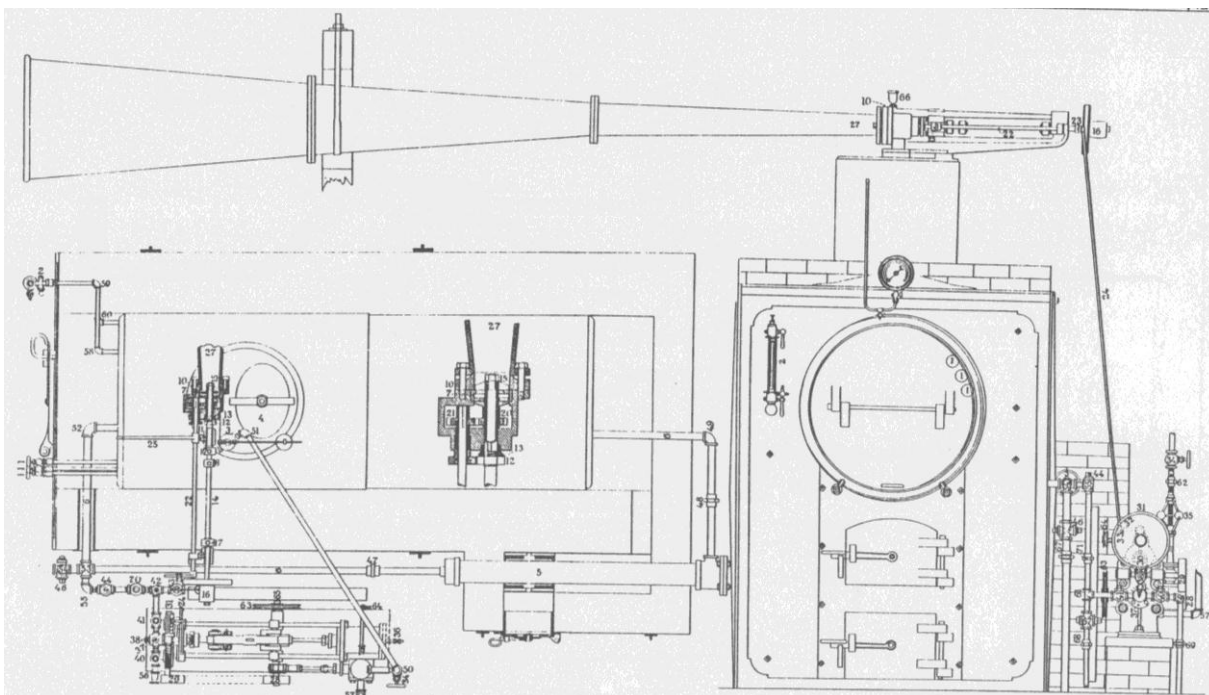


FIGURE 42. Brown's First-Class Fog Siren. (Photo courtesy of United States Light-House Establishment 1902:Plate 19.)

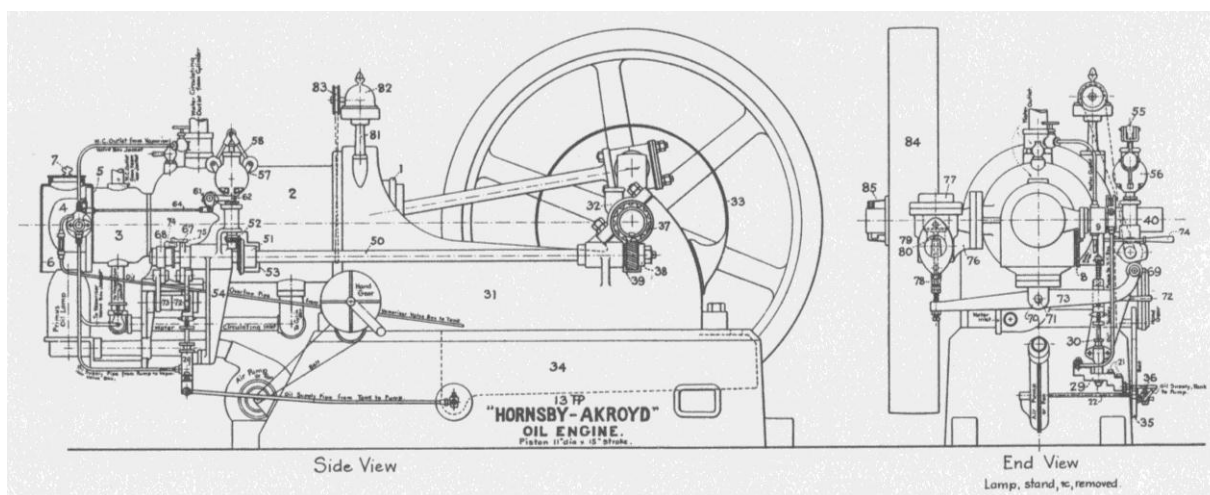


FIGURE 43. Hornsby-Akroyd oil engine. (Photo courtesy of United States Light-House Establishment 1902:Plate 29.)

The Hornsby-Akroyd oil engines allowed steam whistles onboard *LV42* and *LV45* to be ready in 10 to 15 minutes. Built by the De La Vergne Refrigerating Machine Company, plants on *LV42* and *LV45* differed in horsepower (*Scientific American* 1896:1). By the turn of the 20th

century, internal combustion engines compensated for short-comings of earlier fog signals. Faster steam generation coupled with alterations in air compressors improved sound signals and diminished the demand for fresh water and fuel stores required (United States Coast Guard 1945:1005).

On 3 March 1905, the Light-House Board approved trials of a new fog signal. Between 1 June and 1 August 1906, submarine bells installed on lightships *LV3*, *LV51*, *LV54*, *LV63*, and *LV66* sent signals to passing ships, testing audibility and distance. Prepaid postage cards were given to mariners whose ships were equipped for hearing the new signals. Information pertaining to weather and any additional influences affecting the signal were requested by the Light-House Board and aided in determining their usefulness (Light-House Board 1906:22-23).

The submarine bell was invented by Professor Elisha Gray and Arthur J. Mundy. It was attached to the lightship's keel or hung over the side. Passing ships detected the bell signal through a submerged telephone receiver. Microphones installed on port, starboard, bow, and stern picked up the submarine signals, allowing the captain to ascertain the lightship's position. When a signal was detected, crew members listened to each phone, one at a time, and decided where the signal was strongest. Initial trials proved successful and additional devices were installed on lightships (Flint 1990:15; *New York Times* 1906). Submarine bells were replaced by submarine oscillators. Submarine oscillators were mounted on *LV85*, *LV106*, and *LV112*. They extended ± 25 feet below the vessel and were attached to the hull with a davit (Flint 1989; United States Coast Guard 1945:908). Doubling the audible range of the bell, the oscillator proved beneficial but expensive.

In 1921, radiobeacons or radio fog signals became the first navigational aids in the world “on which accurate bearings could be taken in fog” (United States Coast Guard 1945:1006).

Transmitting repetitive dot and dash signals, radio operators broadcast signals that were,

picked up by the ship's radio direction finder – a separate receiving set on the bridge, having a loop antennae with an indicator mounted over a magnetic compass or gyro-compass reader. Here again, the receiver, this time the navigator, obtains a null on both sides of the signal, and takes as his bearing the azimuth between the two determined fading points (Gordon 1938:44).

Individually differentiated by specific dot and dash combinations, radiobeacon signals were broadcast at specific times or in inclement weather. Vacuum tube transmitters installed in 1924 enabled 24 hour position fixing and radiobeacons functioned non-stop (Flint 1990:15).

Radiobeacons were broadcast and distributed on frequencies measuring 300 or 500 kilocycles per second and were eventually linked with air horn signals incorporated throughout the lightship fleet (Lighthouse Service 1923,1924).

Air diaphragm horns were first used in 1929 and included as first-fittings on the last 14 lightships. The horns provided sound-in-air signaling to passing ships. The Lighthouse Service purchased air horn patents and began manufacturing their own models for use throughout the service (United States Coast guard 1945:1005). The most common model was the 17 inch Leslie Typhon Horn installed on numerous lightships from 1931 to 1963 (Flint 1989). It produced single, low pitched tones or two notes of different pitch. Air diaphragm horns utilized compressed air derived from various power plants (Flint 1990:15). Compressors utilized steam, electric, or internal combustion engines to build air pressure capable of producing at least 8 second blasts every 60 seconds (Adamson 1955:365; United States Coast Guard 1945:916).

Four-way horns were replaced by twin, two-tone diaphone horns. Chime producing duplex and triplex horns were also featured on a limited number of lightships (Flint 1989,1990:15).

Influenced by permanent obstacles, atmospheric conditions, refraction of sound, and the observer's surroundings, lightship fog signals proved crucial in providing locational information to passing ships (Light-House Board 1894:289-306). They were fitted on the weather deck, stack, main mast, or on top of the pilot house. Fog signals existed in a variety of forms, including hand-rung and automatic devices. Signals improved with technological advancements in power plant production, offering stronger signals, detectable at longer ranges. Fog signals added distinguishable characteristics to individual ships, assisting mariners in differentiating lightships from each other. Fog signals served as defining features and were irreplaceable to mariners as directional aids during times of limited visibility.

Day Marks, Hull Markings, and Exterior Paint

Day marks, hull markings, and exterior colors were applied for identification purposes and helped mariners distinguish lightships from ships and other navigational aids. Lightships were labeled with their number and station name in bold white lettering across the port and starboard profiles. While traditionally red, early lightships were painted with white, lead colored, tallow, cream, green, and black paint. Six and a half foot white letters and red painted hulls became standard in 1940. Metal, lattice-work day marks served as an additional characteristic feature on lightships. Often circular in form, day marks were cast in iron and, eventually, steel. Black or red day marks varied in number, depending on the lightship, and were displayed on one or both masts or sometimes strung between them to indicate specific vessels (Flint 1989).

CHAPTER 7 : LIGHTSHIP RECORDING: THE 2010 LV83 DOCUMENTATION PROJECT

Archaeological surveys of lightships are few in number. Previous projects include examination of 19th century wooden lightships in North Carolina and Massachusetts and a remote sensing survey of LV51 in Long Island Sound, Connecticut (Bellatoni and Poirier 2000; Lawrence 2002; McKay 2007). A fourth endeavor, conducted during June and July 2010, will be described in this chapter. For six weeks, Northwest Seaport, located in Seattle, Washington, hired the author and two maritime archaeology graduate students from East Carolina to record predetermined features aboard LV83, *Swiftsure* lightship. Northwest Seaport prioritized recording ship elements before commencing renovation. The documentation crew surveyed cabin configurations, interior stenciling and graffiti, electrification, and the current rigging plan scheduled to be altered or refurbished during repairs. The team collected and accessioned historically significant artifacts, identified crew modifications, and technological upgrades. Crew members used drawings, diagrams, and photography, low impact survey methods, to document LV83.

Commencing with cabin configurations, the crew recorded captain's quarters, pilothouse, and main deck crew spaces, including doors, sinks, bunks, lights, outlets, coat hooks, and ghosts. Ghosts refer to marks on walls indicating previous furniture, fixtures, etc. In certain quarters, most notably Port 2 Officer's Quarters and the Starboard Officer's Office, the walls no longer exhibit ghosts due to sanding associated with renovation. Multiple coats throughout the main deck quarters indicate repeated painting throughout service. The numerous paint layers make it impossible to determine all ghosting or cabin configurations during employment. Eighty-eight separate sketch maps document cabin spaces. Sketch maps contain measurements that will allow restorations to return features, such as lights, light switches, outlets, closets, shelving, sinks, and

furniture, to earlier locations (Figure 44). Scaled photographs, individually logged in the main photo log, provide digital renditions of existing conditions in recorded cabins (Mackenzie and Marcotte 2010:12).

Recording *LV83*'s stenciling and graffiti required visual inspection of the spar, main, and machinery decks, chain lockers, and fresh water tank space. Most stenciling appeared on piping, distinguishing contents and, sometimes, direction of flow (Figure 45). Other stenciling, appearing as single letters and numbers on walls and deck beams throughout the main and machinery decks, delineated frame numbers, fire equipment, or USCG/Navy Codes. Navy codes refer to individual markings on accesses and portholes. On lightships, letters "X", "Y", and "Z", alert crew to parts of the ship that should be open or closed under weather conditions, for example, a porthole. All observable stenciling was recorded with scaled photography and logged. Each stencil was marked with painter's tape subsequent to photography, as directed by the 2010 documentation parameters. It is the intention of Northwest Seaport to preserve or recreate these stencils during restoration (MacKenzie and Marcotte 2010:12-13).

Artifacts were recorded next. The recording team created a brief description, composition, and location for each artifact on separate artifact accession forms. Logged and photographed *in situ* with a scale, 80 artifacts comprise the *LV83* collection. Examples of logged artifacts include rigging blocks, lamps, a Hills Bros. coffee can, toolboxes, dishes, navigational devices, light fixtures (Figure 46), and charts. The majority of the artifacts were individually tagged with accession numbers and then moved to the wardroom, presently one of the driest locations onboard. If the artifacts were large or contained hazardous materials, such as gas or oil, they were left *in situ*; their location noted in the accession form's "remarks" section. As

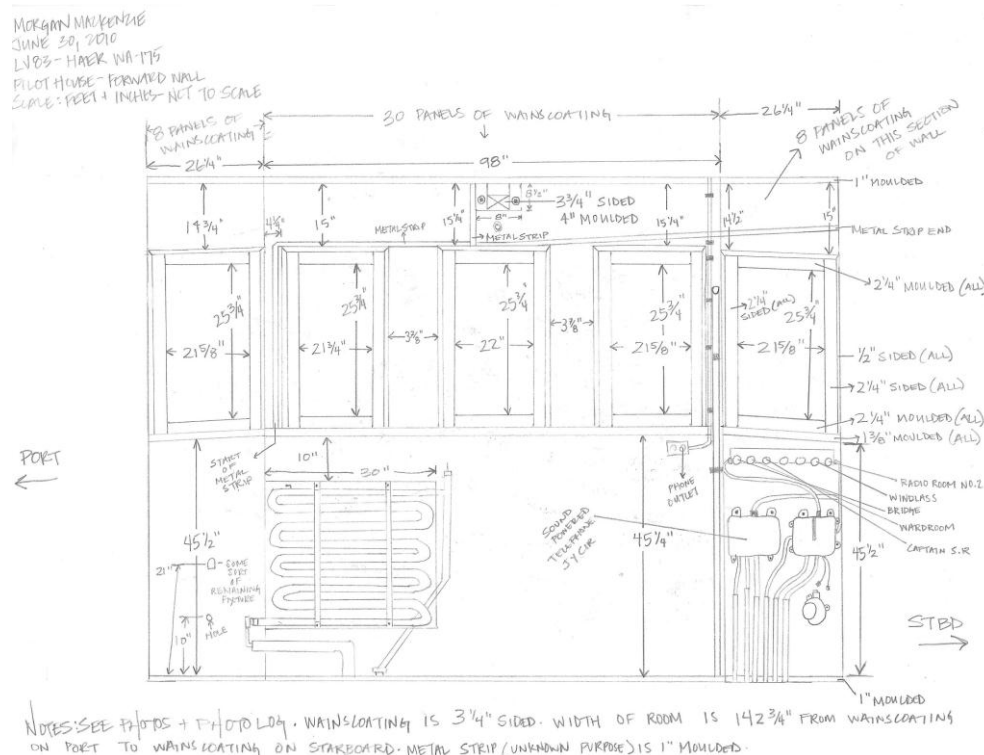


FIGURE 44. Sketch map drawing of the forward wall of the pilot house. This is an example of the mud maps created during the recording process. Four sketch maps, one for each wall surface, were produced for each room. (Drawing by author, 2010.)

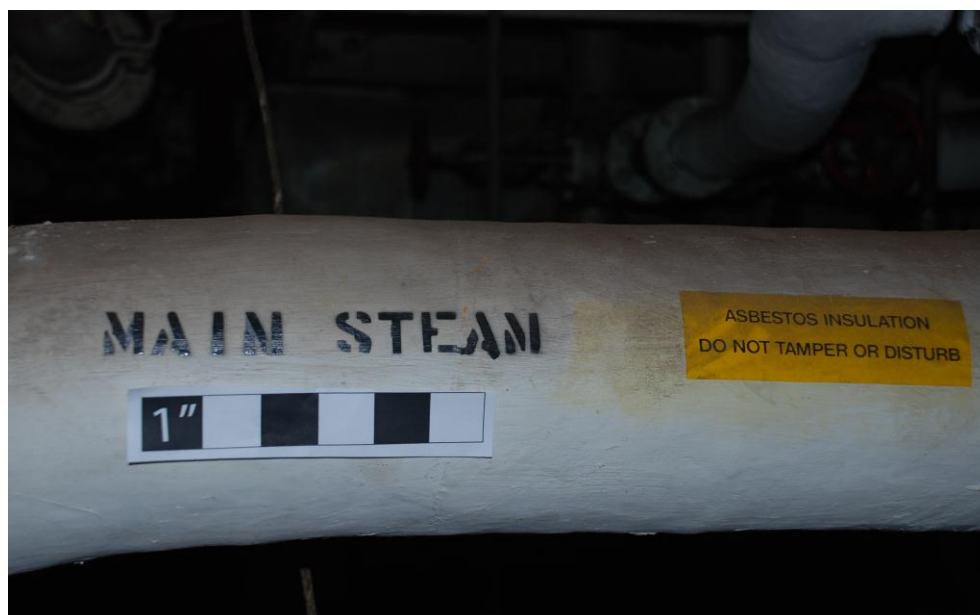


FIGURE 45. Stenciling on main steam pipe, photographed with a scale bar. This pipe is wrapped with asbestos insulation. The asbestos will be removed during renovations, necessitating markings such as these to be recorded. (Photo by author, 2010.)

Northwest Seaport intends to save the tools, furniture, machinery, spare rigging, and original artifacts, such as the ships' wheel, bell, and steam engine; these items were not tagged or accessioned. Artifacts collected by the archaeologists do not represent the entirety of items related to *LV83*. Previous sales, indicated by price tags left on items onboard, indicate that the *LV83* artifact collection is incomplete. The propeller and mushroom anchor are no longer present



FIGURE 46. A signal light on the weather deck of *LV83*. This artifact was photographed with a scale bar and tagged with an accession form indicating found location, present condition, and accession number. (Photo by author, 2010.)

and binders in the Northwest Seaport archives contain pictures of the steam whistle at a private, undisclosed residence (MacKenzie and Marcotte 2010:15).

The remaining tasks associated with the Lightship No. 83 2010 documentation project were recording the rigging plan and electrical system. The recording team was commissioned to

create a diagram of the masts, rigging, and radio antennae, including hardware and connection points. The team sketched, photographed, and measured accessible areas of existing rigging. Shown in profile, plan, bow, and stern views, it will be possible for restoration crews to re-establish rigging to earlier configurations, should Northwest Seaport chose to refurbish decaying sections (Appendix E). Close-up photographs and notes describing shrouds, turnbuckles, wrapped and unwrapped metal rigging, document their condition and locations. The wire rigging onboard, measuring 1 in., without flat wrap, 1.25 in., with flat wrap, and 2.25 in., with double flat wrap, before and after the turnbuckles, remains in various states of corrosion (Figure 47). The flat wrap, a protective sheath over metal braided cord, is comprised of rope, fabric, or a yellow material, apparent above and below where ratlines intersected (Mackenzie and Marcotte 2010:15-16).

The current rigging configuration is no longer intact. Sections are missing, detached, and re-routed. There are unused attachment points and markings on the masts and funnel where fastenings previously existed. The documentation plan suggested using a range finder to measure the existent rigging configuration. The ± 1 yard accuracy inherent with using a basic range finder is unacceptable. The rigging is not safe for climbing so these measurements were not obtained. Photographs from the United States Coast Guard Archives offer additional evidence of previous rigging plans. These photographs are available at the Northwest Seaport archives as well as in the Historian's Office, United States Coast Guard Headquarters, Washington, DC (Mackenzie and Marcotte 2010:17).

Following the rigging study, the electrical system was the last phase of fieldwork. Tasked with recording electrical, navigational, and shipboard communications, the recording crew created templates for diagraming systems. Utilizing finger phasing, the act of following

something by running your fingers along it, and painter's tape, the recording team tracked the lighting and communications systems by locating and following wires, lights, communication



FIGURE 47. Different wrapping techniques on shrouds. Note the change in wrapping width from 1.25 in., to 2.25 in. (Photo author, 2010.)

outlets (Figure 48), and switches, to and from junction boxes (Figure 49)(Figure 50). Wiring layouts for the communications and lighting systems are shown in separate plan and profile views in appendices F-G). Appendix H depicts the location of junction boxes on the interior and exterior of the ship (MacKenzie and Marcotte 2010:17-19).

Diagrams, combined with sketch maps, photography, and notes collected during the 2010 documentation project, augment the archaeological and historical record concerning lightships,



FIGURE 48. Pilot house communication switches, wiring, and devices. Note that wires traveling between decks are protected by metal tubing. The phone and phone cord plugged into the communications outlet indicates how devices were connected to the onboard system. Similar outlets installed throughout the ship enabled communication with the bridge at all times (Photo by author, 2010).



FIGURE 49. Scaled image shows two junction boxes and wires. The blue painter's tape was used to follow communications systems throughout *LV83*. (Photo by author, 2010.)

specifically *LV83*. They were effective in capturing details scheduled to be lost during lead paint and asbestos removal. Recording cabin configurations, stenciling, and graffiti enables Northwest Seaport to refurbish *LV83* to conditions indicative of the post-WWII period without losing historical and archaeological context noted at the time of survey. Visual analysis of crew and officer's quarters noted several paint layers applied to the walls during the vessel's use life. The recording crew observed paint applied to crew spaces as changing to buff, white, green, and ultimately, white. Much ghosting remains on the outermost paint application, indicating missing furniture or artifacts that once facilitated onboard life. Numerous coats of paint negated an opportunity to record even earlier ghosting. This made it hard to determine previous crew space arrangements differing from those present (MacKenzie and Marcotte 2010:21).



FIGURE 50. Electrical wiring cables onboard *LV83*. Grouped together and painted white, tape was required to prevent confusion while tracing wires. (Photo by author, 2010.)

Stenciling and graffiti provided evidence of crew modifications to working and living spaces. Bunks, lights, and fixtures, if remaining, appear to be in original locations; however, because of the various coats of paint, this is not certain (Figure 51). Ghosts from clothing hooks and mirrors vary between rooms. A makeshift blind attached to the porthole was discovered in the Port Aft Officer's Cabin. Although it was possible to identify some crew modifications during the 2010 survey, it was not feasible to determine all. Maintenance during use life,

combined with various coats of paint, deterioration, repairs, and unknown factors, mask evidence related to previous occupation (MacKenzie and Marcotte 2010:21).

Present conditions onboard *LV83* made determining crew modifications over time difficult. The same can be said for interpreting the electrical system. *LV83* was launched at the dawn of shipboard electrification and equipped with a dynamo and engines to generate electricity. Originally wired for direct current (DC), the ship was converted to alternating current (AC) sometime after 1950, most likely when it was decommissioned in 1960 (Northwest Seaport, 2010, pers. comm.). Mil-Spec (Military Specification) wiring, speculated to be a DSD 4 armored cable, is sheathed with braided metal and soldered at connections; DSD 4 refers to the size, material, and characteristics of the wire (Northwest Seaport's electrician, 2010, pers. comm.). No bypasses, storage batteries, or generators from the AC system remain onboard. Electrical circuitry derived energy from missing generators once housed in the aft starboard engine room. Lack of familiarity and knowledge pertaining to electrical systems, combined with missing equipment, made determining electrical installations and system changes difficult to understand.

It is the intention of Northwest Seaport to replace corroded sections of rigging. The rigging objective of the documentation project was conducted using photography and sketch mapping. Port, starboard, bow, and stern templates were created by the recording crew. Recorders were able to obtain full perspectives for creating rigging diagrams (Appendix E) from adjacent vessels as well as the roof of the naval armory. *LV83* was never intended to be a sailing ship and was equipped with a steam engine during first-fitting. Rigging provided access to signaling devices, displaying flags, and providing support to elements aloft (MacKenzie and Marcotte 2010:17-19).



FIGURE 51. Port Side Crew Quarters. Three bunks were removed from the inboard partition. Ghosting and light fixtures allow for a visual recreation of how the cabin would have looked while inhabited by crew. Note the various shades of paint as well as deterioration. Scale is 1 inch. (Photo by author, 2010.)

Collecting and accessioning *LV83* artifacts proved far easier and less time consuming than expected. Individually described on accession forms, 80 artifacts were selected by the

recording team (Appendix I). The artifacts were chosen for historical significance and for recreating a working lightship environment. They represent necessities and creature comforts of life. Photo logs (Appendix J) describing the artifacts provide an inventory of artifacts that will be put back *in situ* prior to converting the ship into a museum. Conservation is required on numerous pieces and it is unclear if funds exist that will allow Northwest Seaport to do so. Should some accessioned artifacts be lost, stolen, or sold, similar to events in the past, the information collected will preserve them in the archaeological record (MacKenzie and Marcotte 2010:11,15).

The 2010 documentation project was an archaeological investigation documenting elements onboard *LV83* scheduled to be lost or altered during restoration. The complete report is on file in the Northwest Seaport Archives, Seattle, Washington. The project enabled Northwest Seaport to return documented features onboard *LV83* to a post-World War Two condition subsequent to repairs. The electrical system warrants further documentation and review by a professional familiar with early shipboard electrification. The rigging should be more accurately recorded with a total station to obtain measurements and locations for reattaching fixtures after the deck and superstructure are replaced. Further research has the potential of clarifying changes to the ship during employment. Sampling paint layers and point sequencing analysis may help form a timeline for modifications to crew spaces. These recommendations were relayed to the Northwest Seaport managing board, 28 July 2010.



FIGURE 52. LV83, port quarter. (Photo courtesy of the USCG Historian's Office Archives, Box 24, Washington, DC.)

CHAPTER 8: ANALYSIS AND CONCLUSIONS

The main goals of this investigation were to trace the history, construction changes, and role of lightships within the American maritime cultural landscape. Using these three objectives, six questions were developed to guide research and yield data that has not yet been represented in the historical or archaeological record. In addition to research questions, four hypotheses were drawn. Hypotheses were based on information the author expected to find while researching use and importance of lightships. These research questions and hypotheses are discussed in this section.

The first research question was multi-part and focused on converted lightships. What was the process of converting non-purpose craft into lightships? What were these early vessels, why were they chosen, and what was the process of converting a ship into a lightship? How did converted lightships compare to purpose-built lightships? The first research question dealt with converted lightships because early research suggested that the government initially converted more lightships than they built; this was not the case. Limited information is available on at least 13 converted lightships. Most converted lightships came from inter-governmental agency transfers and were either donated or purchased for less than the cost of building a new vessel.

The process of converting non-purpose built ships into lightships was basic. Propulsion was added or removed, hulls were repainted, and vessels were equipped with standard supplies, food, and fuel. Signaling equipment was also added, turning these ships into navigational aids. Converted lightships were used as temporary replacements in times of war or as substitutions for wrecked or lightships in repair. Most converted lightships were acquired during the 19th century and had use lives comparable to purpose-built craft from the same period. There does not appear

to be much evidence regarding converted lightship use during the 20th century. Lack of converted lightship use during the 20th century indicates that purpose-built lightships were preferred.

The second research question was, what is the evolution of lightship construction and what prompted change? Discussed in chapters three and four, changes in lightship construction spanned 132 (1829-1952) years. Early lightships were heavily built wooden schooners that were unsuited for their intended purpose. Lack of propulsion made it difficult to maintain station during inclement weather. Crews were often inattentive and fog signals were weak. Lightships rolled uncontrollably during heavy wave action and lights were often extinguished.

Several improvements were added to lightship design. In 1856, bilge keels were included to reduce rolling. The biggest change was arguably the transition from wood to steel construction. Metal hulled ships were favored over wooden hulls because of the increased strength, insurance, financing reductions, and the ability to add auxiliary and propulsion equipment. In 1891, the Light-House Board began equipping lightships with propulsion and electricity. Adding propulsion allowed lightships to move independently as well as to maintain station during inclement weather. Onboard electricity reduced the amount of fuel required onboard. In 1892, hawse pipes were relocated to the stem. Originally running through decks, hawsepipes were placed along the centerline of the vessel, relieving hull straining and providing a steadier platform in stormy seas. In 1894, crew spaces were moved above the waterline. Ships were eventually built larger with higher freeboard. Transverse bulkheads were included during the late 19th century and aided buoyancy and structural support.

These improvements, amongst others, were instituted for a number of reasons. Historically, English lightships were superior when compared with domestic examples. When England implemented new devices or changed lightship design, the Light-House Board often

followed suit. Lightship crews also offered input, relaying perceived inadequacies to the Board. The main reason for improving lightship design was advancements in naval engineering. In 1894, upon opening the Webb Institute for Naval Architecture, America finally had the capacity to design better ships without going overseas for men or training. The Board experimented with different hull types and began building models suited to the environment of employment.

A discussion of hull types compared with use environment is the focus of the third research question. The original question was what does the venue of use tell us about the construction process of a lightship? Research concluded that multiple hull types exist for domestic lightships. Scow style lightships were only used in the Great Lakes. Lower wave energy and lake conditions permitted employment of smaller, rounded vessels. These vessels were not employed on coastal stations where conditions would have been too adverse to sustain crews for extended periods, perhaps even at all. Coastal lightships differed from scow style lightships. They were larger, drew more water, and had sharper bows.

Christer Westerdahl explains differences in hull forms as resulting from changes in geographical border zones. Lightships were stationed along both coasts of the United States, in the Great Lakes, and in estuarine environments. These areas were part of America's traditional zones of transport geography. The majority of lightships stationed throughout the traditional zones of transport geography, or transport corridors, were similar in construction. As naval engineering, shipbuilding technologies, and readily available materials became more abundant in America, lightship construction styles began to vary, depending on the use environment. Westerdahl's maritime landscape theory attempts to explain these differences by the presence and identification of border zones. Westerdahl's ideas regarding border zones, in part, contribute to answering the fourth research question. At the beginning of this investigation, an

archaeological theory was chosen to help explain the data that was gathered. The research question, how do lightships contribute to the maritime cultural landscape of the United States from 1820-1983, was formed to understand why lightships were built and employed within America's maritime landscape. A maritime cultural landscape is "the whole network of sailing routes, old as well as new, with ports and harbors along the coast, and its related constructions and remains of human activity, underwater as well as terrestrial" (Westerdahl 1992:6). In America, this "network of sailing routes," or transportation corridors, were marked by navigational aids, specifically including, lightships.

Lightships marked the American maritime cultural landscape but they also contributed to it. According to Westerdahl, lightships can be studied as shipwrecks, land remains, tradition of usage, study of natural topography, place names, blockages, transit points, and sea routes (Westerdahl 1992:7-10). In addition, lightships can be considered objects of material culture. Ian Hodder claims material culture is, "actively and meaningfully produced" in an environment where, "the individual actor, culture, and history are central" (1985:1). In America, lightships were "actively and meaningfully produced" to enable commerce and protect goods and people traveling within maritime transportation corridors. Hodder claims that "objects of material culture" evoke different responses from different individuals, depending on the context of the relationship between the person and the "object of material culture."

The true role of lightships within America's maritime cultural landscape can not be understood without considering and incorporating different variations in personal evocation. To do this, it is important to understand the different capacities in which lightships were used. In answering the fifth research question, what were alternative uses for lightships, the roles of lightships were discussed. In America, lightships were employed as navigational aids, rescue

ships, armed naval vessels, store ships, troop transports, portable accommodations, river obstructions, floating museums, fishing vessels, restaurants, naval targets, private vessels, and or scrap metal. Individuals perceive lightships differently, depending on the vessel's context, the year it was viewed, and the person who viewed it. These individual reactions to lightships in alternate roles, as sources of the landscape, and as defining features within maritime transportation corridors explain the capacity of lightships within America's maritime cultural landscape.

The final research question dealt with lightships and their place within navigational technology. As this investigation focused on American lightships, only technology employed within domestic waters was considered. Used from 1820 to 1983, lightships were employed for 163 years. The United States was established in 1776 and remains today, spanning 235 years, collectively. In 235 years, only 72 passed without lightships serving as navigational beacons. Lightships were essential aids to navigation. They served in venues where the Light-House Board was unable to build permanent lighthouses. Until replaced by screw-pile lighthouses, buoys, LORAN, and, eventually, GPS, lightships were the only means of effectively marking predetermined hazardous locations within America's maritime transportation corridors.

The answers to the aforementioned research questions serve to explain the history, construction and use of lightships. Archaeological theories devised by Christer Westerdahl and Ian Hodder were used to offer cultural perspectives and cognitive behaviors associated with lightships during employment in the American maritime cultural landscape. To further augment explanation regarding lightships and their impact on American society, 1820 to present, four hypotheses were formed. Based on expected results, this investigation intended to demonstrate that, if lightships existed in the United States between 1820 and 1983, their employment will

show reliance on maritime exploitation. If lightship construction continued to improve, then Americans embraced the use of inland and open waters for a variety of means and sought better means of managing these resources. If lightships safeguarded mariners and goods and were continually employed, repaired, and modified, then lightships were, at the time, irreplaceable aids to navigation in American waters. Last, if lightships did not exist, then humans found some other means of providing navigational markers.

Lightship employment does show reliance on maritime exploitation. Explained theoretically and historically as indicators of coastal trade, lightships were designed to enable commerce. An indicator of a civilized society and culture dependent on material goods, commerce facilitated the continuation of American society. As commerce expanded and technology changed, navigational aids also changed. Lightships were phased out because people found a better means of marking maritime transportation corridors; with satellites. Prior to modern developments, lightships were irreplaceable. A perfect example of the dependence mariners placed on lightships is exhibited by the high number of casualties during and after the Civil War. The destruction of navigational aids lead to an increased number of maritime accidents, destruction of property, and loss of life.

The lightships that remain today are symbolic of an earlier time in America. Employed before and during the Industrial Revolution, numerous wars, and as navigational aids, lightships were essential features in the American maritime cultural landscape. The versatility of these ships speaks to the ingenuity of the men that built them and the society that employed them. The constant improvements in construction as well as characteristic features exhibit a timeline of modifications that eventually, lead to overall replacement. A product of the “confrontation

between humans and nature,” lightships “bridged land with maritime” and enabled social interactions in American society (Flatman 2003:149,151).

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APPENDIX A

APPENDIX A : SPECIFICATIONS FOR THE CAPE HATTERAS LIGHTSHIP

To be three hundred tons burthen, built in frames of white oak, and bolted together with iron to follow a $\frac{7}{8}$ in., auger, the bottom and ceiling plank to be $3\frac{1}{4}$ inches thick of oak and not more than 10 inches wide particularly the former; the wales to be $4\frac{1}{2}$ inches thick and six strakes in number, of young living oak, the width to be nine inches each, three strakes under the wales to diminish from the thickness of the wales to the thickness of the bottom plank, the beams are to be five feet asunder the heights between the decks six feet six inches, the building of the lower deck to be secured in the same manner as the upper; the butt bolts to be of $\frac{3}{4}$ inch copper. The beams and deck plank of heart pine, the former to be fourteen inches sided and twelve inches molded; the knees to be six inches sided and fitted one inch and a quarter below the top of the beam in order to give air to the upper side of the knees and to be bolted with inch iron. The deck to be $3\frac{1}{2}$ inches thick, and not more than 8 inches wide, three strakes next to the waterways to be four inches thick and to jet in or jog over the beams, and to be bolted through the waterways in and out. The clamps three in number and four inches thick and not less than eleven inches wide, of oak, an air strake of 3 inches wide to be left under the clamps. The fastening of the bottom plank to be of nine inch composition spikes, the deck of eight inch composition and the ceiling of eight inch iron spikes The fastening of the keelson and floor timbers to be of copper bolts $1\frac{1}{8}$ inch diameter, also the dead wood, stem lining, etc., etc. To have a companion to enter the cabin, and fitted up with berths for eight persons, with shelves, cupboards, lockers, storerooms, etc., to be executed and painted in a plain and neat manner – to have an oil room sufficiently large to stow twelve cisterns of forty gallons each, which are to be of double block tin. To have two masts, the foremast to be sixty feet long and sixteen inches square – with four shrouds each of seven inch rope and the stays of nine inch rope – also falls suitable for hoisting

the lanterns, of four inch rope to winches to east mast. Two chain cables of one hundred and twenty fathoms long and one inch and three quarters diameter, of the most approved plan – two cast iron anchors of 3,000 lbs. each, of the mushroom form with shanks of wrought iron – one pipe of cast iron about twenty fathoms long, and of one inch in thickness – an anchor of 2,000 lbs. of the common kind, one caboose sufficiently large enough for eight persons. To be coppered with thirty two ounce copper in the usual way of painting vessels. The stanchions are to be bolted to the frames generally, the waist to be planked up with 1 ¼ inch pine plank, with a box rail – the butt bolts to be ¾ of copper in the bottom, iron in the wales. To have sixty tons of kentledge and that to be secured with a platform to run fore and aft, of 1½ inch pine plank. To have two lanterns, three feet square and five feet high, independent of the roof of copper with conductors, and one lamp in each, of the compass kind, to contain twelve wicks. Two boats of twenty feet long, with six oars each – two harness casks, twelve water casks of ninety gallons each, six water casks of forty gallons each two storm stay sails of No. 1 canvas and awning of the same, one bell of 1,000 pounds, fitted in strong bits, the windlass to be fitted with an iron spindle of suitable size, with all the necessary fixtures, for the two chain cables. All of the material to be of the best kind and executed in a faithful and workmanlike manner, and conforming in all respects to the plan furnished the contractor” (Ridgely-Nevitt 1945:115-117).

APPENDIX B

APPENDIX B : LV41 CONSTRUCTION SPECIFICATIONS

Dimensions

Length from aft of sternpost to the fore side of rabbet of stem at main deck... 114 feet

Breadth of beam, (molded)... 26 feet 9 inches

Breadth of beam, (extreme)... 27 feet 5 inches

Depth of hold from top of timber... 12 feet 5 inches

Keel

Of sea-coast white oak, sided 12 inches in two pieces in depth; the upper piece 10 inches and the bottom pieces each 10 inches in depth. The whole depth of the keel below the molding-edge of the timbers will be 19 inches; scarfs of keel in length 7 feet 3 inches and hooked 2 inches; the nibs will be fastened with two copper bolts in each nib of $\frac{5}{8}$ inch diameter, riveted on composition rings; in addition to which, each scarf will have two bolts of copper of $\frac{3}{4}$ inch diameter, driven under the futtocks, and riveted on composition rings. The upper and lower pieces of the keel will be coaged to each other with white oak coags 12 inches long, 3 by $2\frac{1}{2}$ inches, and 22 inches asunder, and on the alternate side of the middle line. The upper and lower keels will be bolted together with the best quality of $\frac{3}{4}$ inch copper, about 7 feet 4 inches asunder, and riveted on composition rings; the pieces of the keel to correspond to lengths, as shown on plan; a composition dovetail plate let in at each nib, through which the nib-bolts will be driven.

False Keel

Of white oak, in thickness 4 inches, and in lengths about 15 feet, to be put on after the deadwood and keelson bolts are driven and riveted and the underside of the main keel is

coppered, to be fastened to the keel with copper bolts $\frac{5}{8}$ of an inch in diameter, 8 inches long, and 2 feet asunder; false keel to be sheathed with yellow metal.

Stem

Of white oak, side 12 inches, the front of the stem to be 10 inches at head, clear of the fore side of the rabbet, the after side to be at the bearding-line; scarf in length $4\frac{1}{2}$ feet, to be hooked $1\frac{1}{4}$ inches, and fastened with three copper bolts, in diameter $\frac{3}{4}$ inch, and riveted on composition rings; the nibs to be fastened with two bolts of $\frac{5}{8}$ -inch copper each, and riveted; composition dovetails on the lower scarf, fastened with $\frac{3}{4}$ -inch copper bolts, will also connect the stem with keel dovetails shown on plan; dovetail plates at nibs same as those in keel-scarfs.

Sternpost

Sternpost of white oak, sided 12 inches; molded at head clear of rabbet 10 inches; at heel clear of rabbet 15 inches; the forward side of the sternpost will, at the heel, be before the aft side of the rabbet, 9 inches, and continue the same to head of the post. The sternpost will keep its full siding one foot below the counter, and thence will taper to 7 inches at the keel; on the aft side, the main piece will have two tenons in the keel, and on the post and keel, composition dovetails, as marked on the plan, fastened with copper bolts of $\frac{3}{4}$ inch diameter. Inner post of live oak.

Copper Bolts

All the bolts on the outside; or going through to outside from the top of the seventh strake of wales, or about 12 feet 9 inches amidships, and 15 feet at ends, down to the bottom of the keel, to be of the best approved copper securing a soft or large headed clinch.

Apron

Apron of live oak or locust, sided 12 inches; molded at head 12 inches, and at heel sufficient to come fair with the inside of the timbers; bolted to stem with 7-inch bolts, not more than 18 or 20

inches asunder, of copper or galvanized iron; as they are below or above the line of copper fastenings; riveted on rings.

Deadwoods

Deadwoods of live oak and white oak, (as marked on the plan,) sided 12 inches. The sternpost knee of white oak or live oak will lay on keel and to fore side of main post. Bolts of copper 1 inch and $1\frac{1}{8}$ inches diameter, and from 18 to 20 inches asunder on the keel, and outside of stem and sternpost. The different pieces composing the deadwoods and their fastenings are shown on the plan; all bolts riveted on rings.

Gripe of Stem

There will be a gripe of 4 inches in thickness, of white oak, fastened to stem with copper bolts, in diameter $\frac{3}{4}$ inch, and in length 8 inches, 18 inches asunder and well punched in; the front of main stem will be sheathed in yellow metal and all bolts riveted. The stem will be bearded, commencing 1 inch from the rabbet, to 5 inches in thickness in front of gripe.

Stem-Metal

Of composition on front of gripe 1 inch, on the side $\frac{3}{8}$ inch thick, extending from 4 feet under the keel to 2 feet above the copper-line; nailed to main stem with proper stem-nails of composition; composition figures 6 inches in length forward and aft, marking the draught from 9 to 14 feet.

Counter-Timbers

Of white oak, sided 8 inches; and molded at underside of rail 5 inches, and to lap the sternpost and deadwood 5 feet; these timbers may be doubled, and $3\frac{1}{2}$ feet will be allowed for the lap of the joints; the center timber will project outside of counter-timbers to receive the bottom plank.

Knight-Heads

Of live oak or locust, sided at the head 12 inches, and at the heel 6 inches. Hawse-pieces of live oak or locust, sided 8 inches, bolted to the apron and to each other with galvanized iron bolts $\frac{3}{4}$ inch in diameter, about 20 inches asunder. The forward cant-timber will be bolted to the hawse pieces with bolts $\frac{3}{4}$ inch in diameter.

Frame

The timber and room of frame from center to center 22 inches; floor timbers, futtocks of sea-coast white oak, natural crook, sided 8 inches; top-timbers of white oak, hackmatack, or locust; stanchions of locust sided 8 inches; in the bulwarks forward and aft, where the timbers will be double to the rail, knotty red cedar may be used with the white oak. Molding sizes on top of keel 12 inches, at side of keel 13 inches, (floors will jog over the keel 1 inch), at floor heads 9 inches, at plank sheer $5\frac{1}{2}$ inches, at rail $4\frac{1}{2}$ inches; the timbers of the frame to be placed close together, and in each scarf to be two bolts, in diameter $\frac{3}{4}$ inch; the joints must lap 4 feet, and the butts close and hold their full size except that upon the floors, which hold their full length, a chock of 3 inches will be admitted on the inside. The cant-timbers will have $1\frac{1}{2}$ inches left on their heels for a length of 12 inches, to jog into the deadwoods; each timber to be secured with four galvanized-iron bolts through the heels and deadwoods, driven from alternate sides and riveted. The heels of cant-timbers to have a space of 1 inch between them at the heels to receive salt, or for ventilation.

Fillings

Of white pine to be solid in the bottom, to the height of 12 inches above the throat of the floors. Water-courses will be cut in the fillings under the keelson.

Breast-Hooks

Of white oak, side 9 inches; arms in length 6 to 7 feet; throat-bolts 1 inch in diameter, riveted on outside of stem, the remaining bolts $\frac{7}{8}$ inch diameter; about nine inches asunder; driven from the outside of the timbers, and riveted on the inside. There will be one hook under the rail, and three below the deck forward, and two below the deck aft; in all, six hooks.

Keelson

Of seasoned white oak, sided 13 inches, in depth 18 inches, and formed of two planks, each 9 inches in thickness. The logs from which these planks are made must be cut through the heart, but the center pith of the heart must not be in them; the forward and after pieces as represented on the plan forming part of the deadwood. The keelsons will be coaged together, as the keels; scarfs in length 4 feet; between the planks there will be a good coat of oil or white lead. When the keelson is in place the deadwood bolts, before mentioned, will be driven; and through the keelson and each floor timber and keel will be driven one copper bolt in diameter 1 inch, and riveted on composition rings on the underside of the main keel. Corners chamfered after the bolts are driven. The butts, fastenings, &c., are shown on the plan.

Garboard-Strakes

Garboard-strakes of sea-coast white oak, two in number on each side. The strake next to the keel on each side, in width 12 inches, and in thickness 7 inches amidships. The second strake on each side, 12 inches in width, 5 inches thick, wearing away into the thickness of the bottom plank at the stem and sternpost; these strakes must not have the center or heart pith in them. The strakes next to the keel will be bolted through the keel and each other with copper bolts, in diameter $\frac{3}{4}$ inch, under every other filling, or about 3 feet 8 inches asunder, and riveted on rings, and through the timbers with four copper bolts of $\frac{7}{8}$ inch diameter in each frame, and riveted on

top of timbers. When the form of the bottom will not permit the strakes next to the keel being fastened to each other, they will be driven to come out about 3 inches below the garboard, on the side of the keel, and riveted; farther forward and aft of this, they will be in length 22 inches. When the planks are less than four inches in thickness, they will be omitted. The second strake will be fastened edgeways, with one copper bolt, in diameter $\frac{3}{4}$ inch, in length 20 inches, and 3 feet 8 inches asunder, into the strakes next to the keel, and through the timbers, 2 copper bolts of $\frac{5}{8}$ inch diameter, and two locust treenails of $1\frac{1}{8}$ inches diameter in each frame. All the bolts to be driven through and riveted and treenails wedged on both ends.

Wales

Of seasoned sea-coast white oak, or fine-grained southern pine, as may be decided, in thickness 4 inches, and in width amidships 7 inches, at hood ends 5 inches; eight strakes on each side; the five upper strakes will be square fastened with four galvanized bolts of $\frac{5}{8}$ inch diameter, driven through and riveted on rings on the clamps inside; heads trimmed, plugged, and punched; wherever a knee bolt will take the place of the outside fastenings, it will be omitted; the three lower strakes will be fastened with two composition spikes, 8 inches long, and a $\frac{1}{2}$ inch wire, and 2 copper bolts, $\frac{5}{8}$ inch diameter, driven through and riveted on composition rings on the inside.

Bottom Plank

Of seasoned sea-coast white oak, in thickness, when finished, $3\frac{1}{4}$ inches, and increasing to 4 inches at the wales; in width gradually increasing from 7 inches at the wales, to $9\frac{1}{2}$ or 10 inches at the bilge; the rabbet of the stem and post will be 3 inches. The outside planking will have copper butt-bolts of $\frac{3}{4}$ inch diameter, driven in the frame next on each side of the one on which the plank butts, and a hood-bolt $\frac{3}{4}$ inch diameter in the upper corner of each fore and after

hood, to go through from each side alternately, and riveted when they can be got through, otherwise in length $10\frac{1}{2}$ inches. The bottom plank will be square fastened with one composition spike 8 inches long, $\frac{1}{2}$ inch wire, and three locust treenails of $1\frac{1}{8}$ inches diameter, in each frame, treenails to go through, and wedged on each end; when the width of the plank is reduced to four inches, one-half of the above square fastenings may be omitted, the remainder being placed on the alternate edges. In the wales and the upper strakes of the bottom plank, the garboard strakes, and the clamps, accepting the fore and after hoods, the planks must not be less than 40 feet in length amidships, nor must there be less than four strakes between two butts on the same frame. All planks to be carefully searched on the inside before they are put on, and lay solid to the timbers. The heads of all bolts driven from the outside, when nearly up, will be trimmed and driven home with a wedge or punch, so not to wound or bruise the plank.

Bilge Keel

There will be a bilge keel on either side of tough white oak, about 60 feet in length; to be made in two thicknesses; the first piece to lay on the timber, and to take the place of a strake of plank, to be in one length; sided in the middle, 10 inches at the timbers, and to mold 5 inches; the outside piece 13 inches thick in the middle, and 7 inches at the ends; when the whole keel is completed, it will side 9 inches at the face of outside plank, leaving a hollow rabbet of $\frac{1}{2}$ inch each side; and taper to 7 inches at the face; corners rounded off largely. The inside piece will have two copper bolts of $\frac{3}{4}$ inch diameter in each frame, driven through and riveted on thick strakes inside; the outside piece will have two copper bolts in each frame of 1 inch diameter; and on every frame these bolts will be through bolts; and riveted on the thick strakes inside, on composition rings. The sizes, bolting, &c., of these keels are shown on the plan.

Clamps

Clamps of upper deck, of seasoned fine-grained yellow pine, 5 strakes on each side, in width 9 inches, and in thickness 5 inches, for a length of 50 feet, in which they will jog over the timbers 1 inch; forward and aft, they will be in thickness $3\frac{1}{2}$ inches; when the clamps are 5 inches in thickness they will be bolted edgeways in every other room, with iron-bolts of $\frac{3}{4}$ inch diameter; in working these planks, sufficient spikes of $8\frac{1}{2}$ inches long will be used to get the plank well to their places; after the wale and knee bolts are driven through the clamps, they will be square-fastened, with $\frac{5}{8}$ inch bolts, driven from inside with rings under heads, and in length about 9 inches; observe that all inside fastenings will be driven in the middle of the timbers, so as to not interfere with the outside fastenings which will be driven nearer the edges. There will be an air-list, 4 inches wide, at the lower edge of these clamps, with chocks at the frames jogged into the clamps and ceiling. There will be salt-stops just above the air-list, and below lower deck, as shown on plan.

Thick Strakes

Thick strakes at the turn of the bilge, of seasoned fine-grain yellow pine, six strakes on each side, 5 inches thick, and 9 inches in width; these planks will run up, forward, and aft, and nib into the upper deck clamps; the fore and after hoods will wear into the thickness of the clamps; they will be bolted edgeways into each other with $\frac{3}{4}$ inch galvanized-iron bolts in every other room, and to the timbers with two $\frac{3}{4}$ inch bolts, 13 inches long in each frame, and when finished they will be square fastened, by the treenails, butt-bolts, bilge keel bolts, and any other outside through-fastenings which may come into them. Below these will 4 inch plank, as shown on plan.

Berth-Deck Beams

Of fine-grained yellow pine, side 9 inches, and molded 7 inches, with a spring, of three inches in 24 feet; the ends of every beam will be let into thick strakes, and fastened with an iron galvanized bolt of $\frac{7}{8}$ inch diameter; for the length of about 50 feet amidships to be lodge-kneed, sided 5 inches, arms 2 feet 6 inches, and bodies to fill space between the beams; in the arms and through the beams, three bolts of galvanized iron, in the bodies, four bolts of galvanized iron, driven from outside of timbers; all in diameter $\frac{3}{4}$ inch, and riveted on rings; there must be one bolt in every timber on which the knee lays. Carlings of fore and aft pieces, sided 6 inches by 5 inches deep; ledges of yellow pine sided 6 inches, molded $4\frac{1}{2}$ inches, except such as may require to be of larger dimensions, as shown on plan; fore and aft pieces of boiler hatch of yellow pine, sided 10 inches, and 7 inches deep and to be kneed as shown on plan; comings and head-ledges of oak, 6 inches wide and 5 inches deep, let down on the beams and showing 2 inches above the deck, fastened with $\frac{5}{8}$ inch galvanized bolts. Mast partners of yellow pine, 10 inches wide by 7 inches deep, kneed with lodge and lap-knees, sided 5 inches, fastened with $\frac{3}{4}$ inch galvanized bolts; man hole scuttles over the water tanks, all fitted properly with rings; close hatches fitted on all the hatches, of 2 inch pine plank.

Under Lower-Deck

There will be laid a floor of 2 inch white-pine or yellow-pine plank from side to side, and from stem to stern, level with the top of the keelson; this will be for platforms for tanks, floors of coal bunkers, chain lockers, &c. In the spaces marked for coal, the seams must be tight to prevent coal dust, &c., passing; bulkheads at after and forward ends of boiler hatch from this floor to upper deck made of two thicknesses of 1 inch white pine, tongued and grooved and planed smooth; also, fore and aft bulkheads, length of boiler-hatch, of 2 inch white pine, tight

seams; stanchions of yellow pine, 4 inches by 5 inches; these are shown on plan. The plank of the coal bunkers will run fore and aft and in the passage-way between decks will be lined up and down with 1 inch white pine, tongued and grooved.

Berth-Deck Plank

Of fine-grained yellow pine, 3 inches thick and 6 inches wide, fastened in each beam with two 6-inch galvanized spikes, and in each ledge, with one 5-inch spike, heads punched and plugged.

Berth-Deck Water-Ways

Water-ways of fine-grained yellow pine, sided 7 inches, and 12 inches wide; jogged over the beams 1 inch for a length of 50 feet, fastened with one bolt through each beam into the clamps, and one bolt between every two beams through the knees into the clamps, and bolts into each frame; the bolts of $\frac{5}{8}$ inch diameter galvanized iron.

Hold

Stanchions in the hold of yellow pine 5 inches square, with caps and shoes. Shackles or ring bolts in keelson for securing the chains of $1\frac{3}{4}$ inch iron. The tanks will be secured by stanchions reaching from berth-deck beams to the timbers or bilge-strakes, chocks, &c.

Upper-Deck Beams

Upper-deck beams of fine grained yellow pine, sided 10 inches, and molded $8\frac{1}{2}$ inches; the longest beam to spring 6 inches in 24 feet; these beams, as those of the deck below, will be stanchioned as marked on the plan.

Upper-Deck Knees

Knees of white oak or hackmatack; the lodge-knees to side 6 inches; the dagger-knees 6 inches. The bodies of the lodge-knees to fill the spaces between the beams and the bodies of the

dagger-knees, to be in length 6 feet, reaching to lower edge of the clamps. Arms in length 3 feet 6 inches for the ten beams amidships, the remainder will be three feet in length; bolts in the arms and through the beams, four in number and in the body, exclusive of the throat-bolt, seven or eight in number, each in diameter $\frac{7}{8}$ inch galvanized iron; the end bolt in body and arm may be $\frac{3}{4}$ inch, the ends fastened with two spikes of 8 inches; there must be at least one bolt in each timber upon which a knee rests or passes; all the bolts through the body will be driven from outside of the plank and riveted on rings, and those below the fifth strake of wales to be of copper. There is one hanging knee, (marked on plan), into which the two dagger-knees next to it miter.

Carlings, Ledges, Etc.

Carlings of fore and aft pieces of yellow pine, sided 8 inches, and 6 inches deep; ledges sided 6 inches, molded 5 inches; there will be one ledge between every two beams. Fore and aft pieces of deck framing for hatches, bitts, windlass, hawse and deck pipes, pumps, mast partners, &c., according to plan, and as mentioned under their different heads; trysail-mast steps of yellow pine, sided 14 inches, and projecting 2 inches above deck, molded 10 inches.

Boiler-Hatch

Along the boiler-hatch, and as shown on the deck plan, will be a string piece of yellow pine sided 10 inches, and in depth 14 inches, and in length 26 feet 8 inches; this stringer will be let up from below to the top of the beams, and the beams will be kneed to it with hackmatack knees, sided $5\frac{1}{2}$ inches, as shown on the plan. The knees to be well bolted with $\frac{3}{4}$ inch galvanized iron bolts and riveted.

Mast-Partners

Mast-partners of yellow pine 10 inches wide and 8 inches thick, kneed with lodge and lap-knees, sided $5\frac{1}{2}$ inches, and fastened with $\frac{3}{4}$ inch galvanized iron; arms in length 2 feet 6 inches; bodies to fill the space between the beams.

Mast-Steps

White oak, (or live oak,) 13 inches wide, 10 inches thick, and 7 feet long, fitted on top of keelson, scored out for heels of masts, and fastened with nine bolts of $\frac{7}{8}$ inch galvanized iron.

Water-Ways

Of the best quality of fine-grained and solid yellow pine, the heart of these pieces must be upon the back, sided 10 inches, and molded 12 inches, to jog over the beams 1 inch, and be chimed at the deck-edge 2 inches; side-edge in thickness 3 inches, deck edge in thickness $4\frac{1}{2}$ inches; there will be one bolt through each beam, and into the clamp 4 inches, and one bolt between every two beams, through the knee and into the clamp, all in diameter $\frac{3}{4}$ inch, of galvanized iron; also one $\frac{5}{8}$ inch bolt into each timber; between every two beams there will be a through bolt of galvanized iron of $\frac{3}{4}$ inch diameter, driven from the outside, and riveted on the deck-edge of the water-way.

Deck-Plank

Deck-plank, of clear, sound, and well-seasoned white pine, free of sap and large knots, $3\frac{1}{2}$ inches thick, and 5 inches wide; fastened with two galvanized iron spikes $6\frac{1}{2}$ inches long in each beam; and one $5\frac{1}{2}$ inches long in each ledge; spikes plugged; all spikes and bolt holes to be plugged immediately after being driven; holes to be clean and dry and thick white lead to be used.

Stanchions

Stanchions between decks under the beams, of locust, in diameter 6 inches at foot, $4\frac{1}{2}$ inches at head, to be turned and fitted with caps and shoes of iron; to be located as directed by the superintendent.

Plank-Sheer Molding

Plank-sheer molding inside, of white oak, $3\frac{1}{2}$ inches thick, fastened to water-ways, and timbers, with $\frac{1}{2}$ inch bolts; where the plank-sheer rises forward and aft, the spirketing will be of white oak, 3 inches thick, fastened with 7-inch spikes; outside fastenings will come through the spirketing.

Rail

Of white oak, 4 inches thick by 12 inches wide, tenoned to head of stanchions; hook-scarfs 4 feet long, fastened with $\frac{1}{2}$ inch bolts; on the outside and inside of the timbers, under the rail, will be a string-plank of oak, $2\frac{1}{2}$ inches thick and 7 inches wide, fastened with $\frac{1}{2}$ inch bolts driven through bolt strings and riveted; to these strings, the rail will be fastened with $\frac{5}{8}$ inch bolts, 22 inches asunder in both strings, and riveted; the plank-sheer and rail will have the cant outward of the spring of the beam; pin rails $3\frac{1}{2}$ inches thick; abaft the after port, and forward of the forward port, the frame will be doubled to the rail and some of the timbers may be of knotty red cedar; between the two ports a single timber or stanchion of locust.

Bulwarks

Bulwark-plank 2 inches thick and 4 inches wide; abaft the after port and forward of the forward port, the plank will be of seasoned white oak; and yellow pine between the two ports, fastened to every timber, with two spikes, 5 inches long, galvanized, and heads plugged; inside and outside bulwarks to be calked.

Ports

Three ports on each side, each about 2 feet 4 inches, with a rabbet of 1¼ inches on the port timbers; port-shutters formed of two thicknesses of 1½ inch white pine, and flush with the bulwarks; hung with heavy composition hinges, 2 feet 6 inches long; all the shutters to have one stout ring or eye-bolt at the lower edge outside, to trice the port-shutter up; and inside at the lower corners, similar ring or eye-bolts and two in same kind as bulwarks for lashing in the shutters; all of galvanized iron. The two middle ports will be fitted with ring and eye-bolts necessary for working a carriage-gun. The other ports will have warping chocks fitted in them to ship and unship.

Cat-Heads

As shown on the plan, of white oak, sided 10 inches and 13 inches deep; band on head, with two eyes-this band fitted on tight, and riveted; two galvanized sheaves in each, with steel pins, and to be fitted with patent stopper on side, iron cleats, shank-painters, belaying-pins, ring and eye-bolts, &c.; all complete, to properly work the anchors. Stanchions at inner ends, with 1 inch screw rods, to screw up under main deck.

Bow-Chock

A chock on top of the rail, of white oak, reaching from stem to aft side of windlass nits, sided 8 inches on rail, and 15 inches deep at stem, and 9 inches deep at aft end; iron warping-chocks fitted in top of bow-chock, and chock sheathed with boiler-iron (galvanized) for fishing the anchors.

Forecastle Deck

There will be a forecastle deck extending from stem to aft side of pall-bitt, outside of windlass-bitts. The center will extend to the forward lantern-house, as shown on plan. Beams of

yellow pine sided 6 inches and molded 5 inches; the after beam will side 9 inches and be 5 inches in depth. Deck-plank 3 inches thick, of white pine; at aft end a 4 inch plank across the beam to show the rail molding with molding across the beam. There will be furnished and fitted an iron capstan, about 3 feet high, as per plan, with capstan-bars complete; a large scupper leaded in aft corners of this deck; lodge-knees of hackmatack; sided 5 inches, and well fastened.

Pumps

The main pumps to be brass lined patent pumps of Gould's patent, with extra thickness galvanized suction pipe; around the heels of the pumps will be a large lead screen, and the filling and futtock will be cut down 6 inches, to bring the water to the pumps; framing in deck 6½ inches thick, and 1½ inches above the deck; a lead pipe from the nozzle to the outside of the outside of coaming on house of deck, or under the deck as per plan; brakes and handles, box-hooks, &c, complete for work; one spare set of boxes and sounding-rod; a bilge pump of 2 inch copper chamber, with deck plates, to which it can be screwed, and a lead pipe to reach to the after hold, as may be directed by the superintendent. A wash deck lift and force pump forward, (Snelling's or Gregory's patent,) with metal chamber and boxes, 4 inches I diameter, with 2 inch lead pipe leading to a suitable 2½ inch composition stop-cock to be properly and securely fastened to the side; hole leaded, and a heavy copper screen on the outside; 100 feet of rubber hose, 2 inches, with couplings, brass nozzle, pipe, spanner, &c., complete with this pump.

Scuppers

Three scuppers on each side on the upper deck, 3 by 7 inches in clear of leads; lead not less than ¼ inch thick, to flange over, on, in, and outside; composition lips on outside, and fitted with wooden plugs on inside.

Side and Deck-Light

Between decks there will be five side-lights on each side; composition frames, glass 6 inches diameter and 1 inch thick, properly fitted and secured. Holes to be leaded with not less than 6-pound lead, and flanged over inside and outside; in the upper deck there will be about fourteen deck-lights, located as directed by superintendent; prism glass, 3 by 12 inches, fitted tight in deck with white lead.

Cable-Bitts

Cable-bitts of white oak, from 4 feet above the upper deck to 1½ feet below, to be 18 inches by 16 inches, and thence tapering to the heel, on the timbers or ceiling to be 12 inches square, fastened to the beams and at the heel with bolts of 1 inch, and a chock on the after side. In the two spaces between the three beams, forward of the bitts, fore and aft pieces of yellow pine, 11 inches wide and 6 inches thick, will be let down 1 inch below the top of the beams and, as all other carlings, 1 inch into each beam. Over these pieces will be a white oak piece, in width 11 inches, in thickness next the bitt 2 feet above beam, and at the fore end 5 inches above the beam and reaching three beams, faying down on the fore and aft pieces, jogging over the beams, fastened to the fore and aft pieces, and to the beams with $\frac{7}{8}$ inch bolts, riveted on rings; the edges will be chamfered or rounded; in the after end of each piece, through the beam and bitt, and riveted on the aft side, will be a ring bolt; diameter of wire ring, $1\frac{3}{4}$ inches; ring in the clear, 5 inches. Through the next beam forward, another ring bolt, of same dimensions; and through the next forward beam, a ring or eye bolt, of $1\frac{1}{2}$ inches diameter of wire, all riveted on rings under the beams; cross-beam of white oak, 15 inches thick by 18 inches wide, and 16 inches clear of the deck, and in length, 2 feet beyond the sides of the bitts, fastened to the bitts, with two screw-bolts of $1\frac{1}{2}$ inch diameter in each bitt; the heads and corners of the bitts and cross=pieces to be

fitted with wrought iron chafing pieces; the corner pieces $\frac{3}{8}$ inch thick, and the flat pieces $3\frac{1}{2}$ by $\frac{1}{2}$ inches. Norman pins in cross-piece 2 inches diameter and 2 feet 8 inches long; all the iron-work to be galvanized.

Pall-Bitt

Pall-bitt of white oak, 18 inches square, running from 3 feet 2 inches above the forecastle deck to keelson; with fore and aft pieces properly framed into deck beams, as shown on plan.

Windlass-Bitts

Windlass-bitts of white oak, 19 inches wide by 7 inches thick, dovetailed into sole and fore and aft pieces; fore and aft pieces of yellow pine, 12 inches by 6 inches, to let down 1 inch below top of beams; sole piece of white oak, 12 inches by 6 inches, to jog over the beams 1 inch; knees of white oak, sided 7 inches, to be fastened with iron bolts, $\frac{7}{8}$ inch diameter, and riveted. One ring bolt, $1\frac{3}{4}$ inch iron and 5 inches in clear of ring, and one eye-bolt, $1\frac{1}{2}$ inch iron and 3 inches in clear of the eye, in each knee, and a similar eye-bolt at side of knee, through the beam; bolt forelocked or riveted.

Windlass

Patent pumping windlass, in diameter 26 inches, and in length 9 feet between the bitts; length of average not less than 3 feet 9 inches; all the castings of the best quality, and of extra thickness. Whelps of wrought iron, $1\frac{1}{2}$ thick and $3\frac{1}{2}$ inches wide, eight on each end; gudgeon, $4\frac{1}{2}$ inches square and 4 feet long; all the bands, hoops, brakes, handles, norman-pins, &c., completed for work according to plan; patent beam if required.

Hawse-Pipes

Hawse-holes to be leaded from the outside of the bow to the top of the deck with lead $\frac{1}{4}$ inch thick, coming out about 1 foot above the floating-line, and fitted with bolsters for securing

the flanges of the cast-iron pipes. Where the pipe comes through the deck there will be a yellow pine or white oak partner, let down 2 inches below the top of the beam, projecting 3 inches above the top of the deck, fastened with bolts of $\frac{5}{8}$ inch diameter. The pipes for the chain cables will be of cast iron, $1\frac{1}{4}$ inches in thickness, and made water tight in bow of vessel; the pipe to reach from the deck to the outside of the bow, with the outer flange attached to it; the deck flange to fit close to the pipe; and seam to be calked and made water-tight and well fastened to the deck frame. The outer or bow flange to be not less than $4\frac{1}{2}$ inches thick on the bottom, with an easy round, as per plan. Oak bolster under outer flange, 7 or 8 inches thick at after end. Flanges fastened with 1 inch and $\frac{7}{8}$ inch iron bolts. Pipes cased with 3 inch white pine, and fitted with wood plugs. There will be two hawse-piped through the bow on the upper deck, 9 inches in clear of the iron; holes properly leaded; also, two hawse-pipes in the stern, 8 inches in clear of the iron; holes leaded; all fitted with white pine plugs.

Deck-Pipes

Deck-pipes, as per plan, in two sections, with flange above and below, and leaded under the iron castings, $\frac{7}{8}$ inch thick, and 11 inches in the clear, and to have covers. Deck-frame of white oak, 26 inches wide and 18 inches deep; to show 6 inches above deck and $2\frac{1}{2}$ inches below beams; well fastened together with 1 inch and $\frac{7}{8}$ inch iron bolts. Cover with rings for deck-pipes.

Chain Compressors

Compressors of wrought iron, $3\frac{1}{2}$ inches thick by $1\frac{1}{2}$ inches, as per plan, with staple, eye-bolts, tackles, &c.

Rudder

Rudder stock of tough white oak; diameter of head, 15 inches, working close in the counter; width, 3 feet, fastened with copper bolts of $\frac{7}{8}$ inch diameter. There will be hoop below

and one above the tiller-hole, 4 inches by $\frac{1}{2}$ inch, and one hoop at the head, $2\frac{1}{2}$ inches by $\frac{1}{2}$ inch. A proper garland fitted to keep out the water. Braces, three in number, of composition, 3 inches wide and they will have a bolt in the bottom plank. Pintles of composition; in diameter, 3 inches; in width, 3 inches; all fastened with $\frac{3}{4}$ inch copper bolts, 6 inches asunder, to clear joints. The rudder will work to an angle of 46 degrees, and a portion of the bearding will be taken from the post. Rudder chains of $\frac{5}{8}$ inch thick galvanized iron; and shackled to an outrigger on back of rudder; in length, 5 feet more than sufficient to reach the counter, where it will be attached to composition staples; and thence the rope ends to lead to the quarter. A proper heel-rope will be made and leaded. The heel of the rudder will reach to the bottom of the main keel, and the false keel will be worked to prevent any rope getting between the rudder and the post. Rudder casing of 40-ounce copper.

Tiller

Tiller of iron; in length 3 feet 6 inches forward of rudder; size at rudder-head, up and down, $3\frac{1}{2}$ inches; in thickness, $2\frac{3}{4}$ inches; to be fitted with dogs to the hoops at the fore part of the rudder. It will cut into the hoops above and below the tiller $\frac{1}{2}$ inch; all the necessary eye-bolts and preventer-bolts to be fitted. Over the tiller will be a suitable grafting of ash, made in sections, upon which will stand a plain and substantial mahogany steering wheel, locust spokes, 4 feet in diameter, with wheel-ropes of $\frac{3}{8}$ inch galvanized chain, lignum-vitae blocks, &c., all complete, and to work under the grating. Chafing-irons on barrel of steering-wheel.

Platforms for Chain-Cables

Platforms for chain-cables, built in sections, as per plan. The top is formed of yellow pine strips, $1\frac{1}{2}$ inches thick by 4 inches wide, and kept 1 inch apart, and running fore and aft. They

will be nailed to cross-pieces of white pine, 1½ inches thick by 3 inches wide, and about 18 inches asunder.

Calking

The vessel to be thoroughly calked with new first-quality oakum, driven home; the seams payed with pitch and rosin, or with thick white lead where required, and scraped clean. One thread of cotton and two threads of oakum in the upper deck, and two threads of oakum in the lower deck.

Yellow-Metal Sheathing

The bottom to have a coat of half stuff, and then covered with the best quality tarred hair-felt, and sheathed with the best quality yellow-metal, 26, 28, and 30-ounce, in equal proportions, fastened with 1¼ inch nails. Sheets double punched; height on stem from bottom of keel, 13 feet; amidships, 12½ feet; at sternpost, 13 feet.

Joiner-Work

All the outside of the vessel, from keel to rail, decks, clamps, ceiling between decks, beams, knees, carlings, and all wood-work of every kind exposed to the weather, to be planed fair and smooth; corners rounded or chamfered where required. The arrangements of cabins, berths, lockers, water-closets, storerooms, &c., as per plan. The work to be plain and substantial, of well-seasoned, clear white pine. Sidings 1⅝ inches thick and not over 4 inches wide, tongued and grooved. Hardware of first quality, brass hinges, brass locks, and padlocks to all doors and companionways. All fastenings on deck and of work exposed to the weather, to be galvanized.

Master's Cabin

Two state-rooms on each side, fitted with one berth in each room, black-walnut berth-fronts, drawers underneath, washstands and stationary bowls, shelves, clothes-hooks, &c. Doors

with Venetian blind in the upper panel; pantry with sliding door and fitted with shelves; plate-racks, cup-hooks, &c., complete; against the bulkhead a walnut pitcher and tumbler-rack; box for stove, lined with zinc; ash companion-ladder, with brass eye-bolts for man-ropes.

Berth-Deck Forward

With open berths in three lengths on port side, and two lengths on starboard side, and two in height-in all, ten berths; hard-wood caps, shelf in each berth, ash companion-ladder, with brass eye-bolts for man-rope. An ash-top table for men. The bulkhead, next to the steam-boilers, to be built of two thicknesses of 1¼ inch tongued and grooved, dry white pine, in such manner as best to prevent coal-dust, &c., passing into the men's quarters.

Cook's Pantry

As shown on plan, fitted with plate-racks, hooks, &c., for men's crockery, &c.

Oil-Rooms

Oil-rooms fitted with a platform, rims, front bars, eye-bolts, &c., to secure the oil-tanks firmly; eight brass deck-plates for filling oil-tanks, 3 inches in clear of holes, and fitted tightly in upper deck, with white lead.

Sail Room

Sail-room built of slats 1½ by 3 inches; to have a slat floor, 4 inches, in clear of deck, and to ship and un-ship; a door with brass padlock and hasp.

Storeroom

Fitted with bins, drawers, shelves; panel-doors to all rooms, with brass hinges and locks.

Bread-Room

Bread-room with panel-door in two parts; floor to be 6 inches above the deck; sides, floor, &c., lined with tin; brass padlock and hinges on door.

Reflector-Room, Etc.

Rooms to be fitted for lamps, chimneys, reflectors, &c., as may be directed by the superintendent. A cross bulk-head, at fore-side of fore-hatch, with a door on each side, as per plan. Shelves fitted for spare rigging, blocks, ropes, &c. Paint locker, forward, as per plan. Platform for galley, as per plan, lined with galvanized iron or brick. An ash-top table for the cook's use, &c.

Skylights and Companion-Ways

Skylights and companion-ways as per plan; the after one with sash in sides and in forward end to open inwardly; all to have ash-frame gratings, and tight shutters fitted for bad weather; thick clear glass of double thickness, and small size, sliding tops with brass hasps and padlocks. These hoods for skylights and companions built of 2-inch thick, clear white pine, to rabbet into the coamings 2 inches deep, to ship and unship, and fitted with rings for lashing down; tops to be covered with canvas and well painted. All the hatches of the lower deck to be fitted also with ash grating, beside the tight hatches. The hood over the fire-room and galley-hatch to be built and fitted in the same manner, with a sliding-top over fire-room. The hood over forward hatch without sash, but will have a sliding top.

Ladders, Etc.

Of white ash, one to companion-way, and one to forward hatch; two ladders to forward lantern-house, and two at forecastle. Bucket-racks for 18 buckets, fitted at such place as may be decided on. Binnacle-box gangway ladder properly hung, and two man-rope stanchions, horse-reels, handspike racks, &c., all properly fitted compete for use.

Lantern-Houses

One at the foremast, built on a framework as shown on the plan; one at mainmast on combings on the deck as per plan; sidings of clear, seasoned, tongued-and-grooved white pine 1¼ by 4 inches, all the fastenings and fittings of galvanized iron, except the hinges, which will be of composition; a floor laid in this house; paneled doors with brass locks and hinges; plates 4 by 5 inches, studding 4 by 4 yellow-pine; a 1¼ inch rod at fore end of this, to screw up under main deck; roof in shutters, 6 feet 2 inches, in clear of opening; shutters to have a span with a ring to hook tackles into for opening, and check-chains on ends; roofs of both covered with canvas; doors, windows, ring-bolts, &c., as per plan; two trimming-stools to each house; each mast to have a saddle of oak 4 inches, tightened up with an iron band 3 inches by ¾ inches for lantern to rest on.

Water-Closets

One water closet forward and one aft; top rounded up from the rail, and covered with canvas; coamings of yellow-pine 5 by 5 inches, sidings 1¼ by 4 inches; doors with blinds in upper panel; hinges of composition straps; brass locks, each fitted with a 3½ inch patent valve-bowl; water-tank and deck-plate; leading-off pipe of lead, 4 inches in clear of the lead, and to come out about the copper-line; composition lips outside.

Painting

The vessel to be painted throughout, in such colors as may be determined upon; one coat of priming and three coats of best quality white-lead paint; spars, blocks, boats, tanks, casks, iron-work, &c., to be painted and dried before put down.

Salting

The vessel to be salted with the best quality Turks Island salt, from the tops of the water-ways of upper-deck to bottom edge of upper-deck clamps, and from underside of the air-strake to 2 feet below the lower deck; at the ends of the vessel, the salt will go down to the keelson, for which purpose the heels of cant-timbers will have a space of at least one inch between them.

Spars

Of white pine and spruce, free from bad knots, sap, and defects. Lantern-masts of white pine, 67 feet whole length, including the head, of 11 feet; diameter 16 inches, keeping the same size from partners to the hounds; to be left square at the hounds for the cheeks, through which the lantern hoist-chain will reeve. Cheeks of white oak, 6 inches thick, 18 inches wide, and 5 feet long, with cast-iron sheaves, steel pin, iron-work, &c., as per plan. Two trysail masts of spruce pine, 10½ inches in diameter, to be 12 inches above outrigger, and to tenon into step on deck; steps of yellow pine, 14 by 10 inches, kept 2 inches above the deck. Main-boom 42 feet long, 10 inches diameter. Main and fore gaffs 21 feet long, 6½ inches diameter, to be fitted tightly into the head of mast or fitted with a band on the outside of masthead, as may be desired, and to have a coat of lead worked around to prevent water passing in; flagstaff at stern, 18 feet long, 4 inches diameter; all fitted with trucks, each with two brass sheaves; two boat-spreaders for davits, four up and down fenders of spruce, fitted complete.

Rigging

Standing rigging of the best galvanized charcoal wire rope, set up with lanyards. Fore and main shrouds, three on each side, to each mast, 3½ inches, served the whole length and to be ratlined. Trysail mast shrouds, 2¾ inches each, two on each side of each mast; fore-stay 4½ inches, outer-stay 3¼ inches, spring-stay 3¼ inches, boom topping lift 2¾ inches; two jumper-

stays to main-mast leading forward and two leading aft, two jumper-stays to foremast leading aft, all of $2\frac{3}{4}$ inches; these stays will set up with lanyard to strapped dead-eyes in the deck, as marked on the plan. Fish-pendant $3\frac{3}{4}$ inches and 30 feet long. The wire rope to be fitted in the best manner with clean new parceling, and served with rounding or marline where required. Cat-head stoppers $\frac{5}{8}$, and shank painters $\frac{1}{2}$ inch galvanized chains. Running rigging of manila, of proper proportions, all complete and necessary for working sails and awnings. Boat-tackles, spans, guys, &c., fitted two devil-claws, one dog, one deck-stopper, and fish-hook. Fish and cat-tackles. Compressor-tackles, and all the necessary fixtures for working the cables. Signal-halyards, to have two relieving, two luff, one watch, one deck, one cargo tackles. One lightning-conductor to each mast, of $\frac{3}{8}$ inch copper-wire rope, to extend 6 feet into water, and fitted with fair-leaders, outriggers, and copper spears with platinum points.

Sails, Awnings, Etc.

Main and fore sails, and jib, of No.1 cotton canvas. One awning covering the whole length of deck, made in three parts, all fitted complete with stanchions, to ship and unship; ridge-rope, jigger-tackles, crowfeet, &c. Three wind-sails; hoods over companion-ways, tops of water-closets and lantern-houses, and house on deck, covered; and one mast-coat at partners, and one coat over rigging at each mast.

Blocks, Etc.

All the necessary blocks, dead-eyes, bull's-eyes, &c., of proper sizes to fit and rig the vessel complete in every part. Dead-eyes and bull's-eyes of lignum-vitae. Patent blocks, inside iron straps, galvanized; all the halyard, boat-tackle, and relieving-tackle blocks to be roller-bushed. Tiller-blocks of lignum-vitae, with brass sheaves. Dead-eyes for mast shrouds, 6 inches;

for trysail-mast-shrouds and jumper-stays, 6 inches. Hoops for trysail masts, galvanized hanks. Twenty-four locust belaying pins, $1\frac{1}{4}$ inches diameter. Six hickory handspikes.

Iron-Work

All the iron-work necessary for hulls, spars, rigging, &c., all ring and eye-bolts, wood and iron cleats, chocks, &c., to complete the vessel in every department, to be made according to the plans and instructions of the superintendent, and to be properly galvanized. Chain-plates for lantern-masts, 3 by $\frac{5}{8}$ inches. Two bolts of $1\frac{1}{8}$ inches and one bolt of $\frac{7}{8}$ inch in each plate. Chain-plates for trysail-masts, 3 by $\frac{5}{8}$ inches. Bolts 1 inch and $\frac{3}{4}$ inch diameter, three in each plate; all chain-plate bolts driven through and riveted or forelocked. Dead-eye straps, $\frac{7}{8}$ inch double-galvanized iron. Awning-stanchions, 2 inches square at rail and round above and below the rail, with bolts, staples, &c., Windlass-brakes, $2\frac{1}{2}$ by $1\frac{3}{4}$. Boom-crutch standard, two inches square, to step in composition socket. Braces, $\frac{7}{8}$ inch; band, 3 by $\frac{1}{2}$ inches, with awning stanchions and brace above boom. Main-boom sheet-band, $3\frac{1}{2}$ by $1\frac{1}{2}$ inches, with traveler, $1\frac{1}{8}$ inches diameter. Main sheet traveler, about 2 feet 6 inches long and $1\frac{3}{4}$ inches diameter, to be in thick strake under rail, either riveted or with nut and screw on outside. Goose-neck band on trysail-mast, $3\frac{1}{2}$ by $\frac{3}{4}$ inches. Two devil's-claws, of 3 by $1\frac{3}{4}$ inches, one for a 2-inch and one for a $1\frac{5}{8}$ inch chain, with hooks, &c., complete. Hatch-bars, with staples, locks, &c., where required. Day-marks, outriggers, bands for spars, &c., as per plans. Eye-bolts for jumper-stays, $1\frac{1}{2}$ inches diameter, of iron, riveted or forelocked. Anchor-lashing, eye and ring-bolts of $1\frac{1}{4}$ inches diameter, of iron. There will be on each side, in the deck or water-ways, and bulwarks, about ten ring-bolts of $\frac{3}{4}$ inch iron, for lashing spars, boats, &c., on deck. Ring-bolts at the corners of hatches. All to be galvanized.

Boat-Davits

Two pairs of iron boat-davits, 3½ inches diameter, with cast-iron socket to step in wrought iron plates on rail, and eye-bolts for spans, guys, &c., to be fitted with a band held by tap-screws under rail-plate to prevent davits from jumping up; spans and guys of wire rope.

Boats

Two boats 26 feet long, one 6 feet 6 inches beam and one 5 feet 6 inches beam, one a surf-boat and one a whale-boat, or as such form as may be decided on; boats built strongly of the best materials, cedar bottoms, oak gun-wale and binding strake, copper-riveted throughout; copper stem and skag bands, deck or cuddy, aft and forward; rudder, yoke, and tiller, gratings aft, foot-boards, eye-bolts for boat-tackles, and ring-bolts for painters; each boat to have six ash oars, 16 feet long, four galvanized iron rowlocks, one boat-hook and ash-staff, two sails with spars, rigging, and iron-work, one boat-cover and one anchor; one of these boats may require a center-board; both boats to be fitted to steer with an oar.

Bell and Belfry

One clear-sounding fog-bell, of 1,000 pounds, with U.S.L.H Establishment and year engraved or cast on it; clapper and clapper-spring, and hung securely in a cast or wrought-iron belfry.

Galley

A galley-range to have a capacity for twenty men, with the usual fixtures, pipes, &c. Copper water-cellar in deck, and copper pipe and head above deck; range to stand on a platform the bottom of which is 2 inches thick and 4 inches clear of the deck, lined with brick, and rim covered with heavy lead; all woodwork in close proximity of range and pipe to be covered with zinc; range secured to box with turnbuckles; one coal;-stove in after cabin, and one in ward-room

standing in boxes lined with zinc and firmly secured; water-cellars and pipes above deck of copper; woodwork to be protected with zinc.

Iron Water-tanks

Eight iron water-tanks located as on plan, and in shape to fit the vessel; to be made of $\frac{1}{4}$ inch best boiler-iron, fitted with man-holes, plates, and rubber gaskets; a 3-inch tap, screwed in plate, and an S-and-socket wrench furnished; each tank to have an air-pipe in it. Tanks to have three coats of best metallic paint before put in vessel, and properly secured by stanchions, chocks, &c.

Casks

There are to be furnished by the contractor twenty water-casks, of 12 gallons each; one scuttle-butt, 20 gallons; two harness-casks, each to hold a barrel of beef or pork, fitted with tops, hung with composition hinges, clasp, and brass padlocks. Beds or stands for casks where required. Twenty galvanized-iron-hooped fire-buckets. Six wooden deck-buckets, rope-strapped.

Whitewashing

The lower hold, from underside of lower deck, sides, &c., to have two coats of saline whitewash.

Foundation for Fog-Siren

Under the bed-plates or castings, and across from side to side of vessel, as represented on plan, will be laid a foundation of yellow-pine timber, close-jointed, 6 inches deep by 12 inches wide, to be bolted at ends into the ceiling, and to the keelson with $\frac{3}{4}$ inch galvanized iron bolts. In the intervening space of this foundation 3-inch plank may be used, but must be raised flush with the top of the foundation. In the main deck, will be on each side three coal-shutes; these will

be made of composition with gratings and cover, and have the top covering plate to screw tightly into them.

Stem-Chocks, Etc.

Stem-chocks fitted to side of vessel, and coming fair to outside of stem, about 5 feet long, and 6 inches in thickness; there will be one under the rail, one on top strake of wales, and one between this and water-line as per plan; each will have a band of iron 5 inches wide and $1\frac{1}{8}$ inches thick around the stem, and reaching to after ends of chocks, well bolted, all the iron to be galvanized; on each side of vessel six oak up-and-down fenders, sided about 7 inches, fitted to side, as per plan, and well bolted with galvanized iron bolts.

Life-Buoys

Four cork life-buoys, first class, marked U.S. Light-ship No. 41, painted and located as may be directed.

Ventilators

In the stringer, under the rail, will be a 2-inch hole bored into every space between the frames; these holes will have a white ash plug, 4 inches long, fitted into them; the plugs will have a hole through the center of their length, and a rope lanyard inserted, which will be secured to copper staples, driven into the stringer. A ventilating pipe, 12 inches in diameter, and extending from underside of main deck to 4 feet above forecastle deck, with bell-mouth revolving head; to be made of copper. The part above the forecastle deck to ship and unship.

Miscellaneous

The oil-tanks and hoisting winches and chains will be furnished by Light-House establishment but will be put in place and secured by the contractor; all the bulkheads in the lower hold, for the chain lockers, coal, &c., and bulkheads between decks, doors, &c., will be

placed as marked on the plans, and of suitable materials. There will be made and fitted two cranes for each boat, the top piece of oak 4 inches by 5 inches; to have the plates and bands, eye-bolts, and each two iron hooks, to prevent fore-and-aft motion; the iron support underneath of 1¾ inch iron; all to be galvanized. It is understood that all the carpenters, joiners, and other work, in every department, required to construct and equip the vessel in every respect as a light-vessel, is to be done, and furnished at the sole cost of the contractor; and anything omitted or not properly described in these specifications to so complete the vessel, is to be furnished by the contractor at his cost. Anchors, chains, hawsers, furniture, bedding, crockery, cooking utensils, flags, ship-stores and such ship chandlery ware, as not mentioned, will be furnished by the Light-House Establishment. The drawings and plans herewith attached, showing plans and sections of vessel to be constructed, are a part of the contract and must be followed in detail, accordingly, under the superintendent of the work, who will be assigned to this duty by the board, and who will be required to see that the work executed and the materials used, are in strict conformity to the plans and specifications and terms of the contract, and who must certify to the same, in writing, before the vessel will be received and payment authorized to be made. All the materials used must be the best quality of their several kinds, and the workmanship throughout of first class, and to the satisfaction of the superintendent. The machinery for fog-siren will be furnished by Light-House Establishment , but the fitting and all work requiring carpenters, joiners, caulkers, painters, to be supplied by contractor without extra cost. Any change in rooms or general arrangement, where no extra expense is incurred, is to be made if required by the Light-house Board. Any changes involving extra expense must be agreed upon before entering into the work. No extra bills will be allowed, except for work authorized by the Light-House Board (Light-House Board 1876).

APPENDIX C

APPENDIX C : SPECIFICATIONS FOR LV66

To be a steel frame with steel plate keel, steel bilge strake, and steel sheer strake, wood planking from the keel, up to the sheer line at the main deck. And from that point, up to the spar deck to be steel plate. The frames, doors, keelsons, stringers, beams, sheer strake, bilge strake, strapping, keel plate, etc., of steel; stem, sternpost, rudderpost, rudder, false keel, shoe, sheathing, grip on stern, bilge keels to be of white oak; keel, planking and deadwood to be of long-leaf Georgia or Florida pine. Fastenings in plank, keel, and deadwood to be of galvanized iron: in the wood sheathing, composition spikes. The metal sheathing to be of 26, 28, and 30 ounce metal, double punched. Also a propeller engine of about 350 horsepower, two main boilers of about 300 horsepower each, and two auxiliary boilers of about 40 horsepower each, with steam receivers and all necessary fittings. The keel plate to be amidships, 36 inches wide, 9/16 inch thickness and to be made continuous up the stem and at the stern as high as may be necessary. The frames to be of angle steel 4 by 3½ by ½ inches, spaced 18 inches from molding edge to molding edge. Frames will extend from centerline of keel to underside of spar deck stringer plate, and to be 3½ inches above main-deck stringer alternately, so as to make a proper fastening for outside waterway angle on deck. Reverse angles will be 3 by 3 by ¾ inches and will butt on alternate sides of the center keelson. There will be four belt frames fitted on either side of the vessel to be located as directed; width of plate 12 inches by 5/16 inch in thickness with double angles 2½ by 2½ by 5/16 inches, to run from underside of main deck stringer to center of vessel. From the forward collision bulkhead to the stem of the vessel, there will be fitted intermediate frames the size of main frames, to run from about 5 feet below water line to about 4 feet above. Cant frames to be 3½ by 3 by ¾ inches and of sufficient number to insure the proper construction of the overhang of the stern, properly and securely riveted to the transom floor plate

on frame No.1. The floor plates will be in one length from bilge to bilge; they will be of steel, 18 inches in depth amidships, $\frac{7}{16}$ inch in thickness, tapered in accordance with Lloyd's rules. The main deck beams will be *T* bulb steel beams on every alternate frame, 7 inches vertical height by $\frac{3}{8}$ inch flange of beams $4\frac{1}{2}$ inches. Spar deck beams will be bulb angles 6 inches vertical height by $\frac{3}{8}$ inch on every alternate frame. Lower deck beams will be of angle steel 4 by 3 by $\frac{5}{16}$ inches and fitted to frames with bracket knees 15 by 15 by $\frac{5}{16}$ inches, and securely riveted to frames. Center keelson to be in depth 12 inches above the top of floor and to extend from bulkhead on frames No.9 forward to stem of vessel and to connect therewith. The vertical keelson plate will be 11 inches in width and $\frac{11}{16}$ inches in thickness, to be connected with foundation plate $\frac{1}{2}$ by 24 inches wide laid on top of floor, and reverse angles in center of vessel and riveted to reverse frames with $\frac{7}{8}$ rivets and double angles $3\frac{1}{2}$ by $3\frac{1}{2}$ by $\frac{7}{17}$ inches. On top of center keelson will be two angles 3 by 3 inches riveted on each side: on top of these angles there will be a rider plate $6\frac{3}{4}$ by $\frac{7}{16}$ inches riveted to both flanges: this plate to be counter sunk on the top and to extend the full length of the keelson. The bilge keelson will consist of a $3\frac{1}{2}$ by 3 by $\frac{3}{8}$ inch angle and a bulb angle 3 by 7 by $\frac{3}{8}$ inches. The spar deck stringer plate will be of steel 21 inches wide for about two-thirds of the vessels length to be 15 pounds per square foot and at each end $12\frac{1}{2}$ pounds. The main deck stringer plate to be of steel and to extend all around the vessel. Lower deck stringers will be 21 inches in width, of 10 pound steel. Breast hooks will be fitted at both ends of spar, main and lower decks. An intermediate stringer of steel angles will be fitted 3 feet above main deck stringer. Main deck tie plates to be run fore and aft, from end to end, or to meet plates at fore hatch for mast partners, on each side of vessel, parallel with centerline and side of hatches. There will be bulkheads on frames NOS. 10, 20, 47, 66, and on frame 41 will be a coal bunker bulkhead, extending about 10 feet either side of centerline,

connecting with fore and aft coal bunkers. The bilge strake to be of steel, in width 38 inches and in thickness $\frac{1}{2}$ inch. The plating will be of steel. Stanchions in hold and on lower deck to be of solid round iron $2\frac{1}{2}$ in diameter, with neatly made feet and heads. Sheer molding of yellow pine. Rivets to be of iron throughout vessel. Wood keel will be of Georgia long-leaf yellow pine, sided 12 inches and molded 12 inches, in not less than three lengths. False keel to be of white oak, 3 inches in thickness and not less than 18 feet in length. Show on keel to be of white oak, 2 inches in thickness, fastened with composition spikes not less than 5 inches. Stem to be of white oak, sided 12 inches except at the point where the mooring pipe at the main deck comes through; at this point it must be enlarged to receive a pipe 11 inches in the clear inside. Sternpost to be of white oak, sided 15 inches at keel and 12 inches at head, molded 15 inches, free from all defects and properly secured to keel by a knee forming the part or post of the deadwood. Rudderpost to be of white oak, sided 12 inches, molded 15 inches, free from defects. Rudderstock will be of the best quality of white oak, free from all defects, and to be 14 inches in diameter. Deadwood to be of Georgia or Florida long-leaf yellow pine, sided 12 inches. Garboard strakes to be of Georgia or Florida long-leaf yellow pine, 5 inches in thickness and in width, 15 inches. Wales to be of Georgia or Florida long-leaf yellow pine, 4 inches in thickness and molded 6 inches amidships. Planking to be of Georgia or Florida long-leaf yellow pine, 4 inches in thickness and in width to conform to the requirements of the form of the vessel and the number of strakes shown on plans. Bilge keels to be of white oak, in length 60 feet and in thickness 9 inches next to bottom plank. Wood sheathing will be of white oak, $1\frac{1}{2}$ inches in thickness, to extend from the keel up 14 feet amidships and at the ends 14 feet 6 inches. Metal sheathing will be put on after the vessel is watered or has launched and taken out of the water again, to insure against leaks (United States Light-House Establishment 1895a:2-22).

APPENDIX D

APPENDIX D : GENERAL SPECIFICATIONS FOR THE LAST IRON LIGHTSHIPS

The vessels will be built of iron to stand the tests specified, constructed as per plans and specifications. There will be four main bulkheads extending up to the main deck, built thoroughly water-tight. The vessels will have a bar keel and a sternpost forged solid with the rudderpost, and arranged for propeller shaft in the usual way, as shown on plans. All plates in the shell of the vessels, the bulkheads, bulwarks, etc., shall be machine planed, and no other method of fairing the strakes or preparing edges for calking will be allowed. The plating will be run in inside and outside strakes, perfectly fair, and smoothly fitted up and riveted. The vessels will be provided with one outside bilge keel on each side of the vessel, extending for about 55 feet, constructed as shown on plans, and the run of these keels shall conform with the natural run of the water when the vessel is in motion. Under the main deck, commencing aft, storeroom, cabin, with four staterooms, coal bunkers, engine and boiler room, crew space with ten berths, lockers, wardrobes, tables, etc., pantry, oil room, sail room, and the forepeak will be fitted up as a storeroom with necessary lockers and shelves. Under lower deck, forward, will be located water tanks, chain lockers, fore hold, and a store room for paint, oil, etc. On the main deck aft will be placed steering gear, skylight, and companionway for cabin, and the main deck house consisting of a lantern room, pump and fog whistle machinery room, and galley. Forward of this house and under the forecastle deck, will be located a steam windlass with elastic chain stoppers, and lockers, as shown on plans. On the forecastle deck will be located a lantern house, hoisting engine, bell, etc., and on top of the main deck house will be placed a steam fog whistle and a hoisting engine; both the top of the deck house and the forecastle deck will be surrounded by a strong and neatly built iron railing. On the main deck will also be located two boats, necessary ringbolts, bitts, chocks, fairleads, scuppers, two hard wood stairs leading to the forecastle deck,

and all other fittings for all purposes required by the service. The vessel will be rigged with two masts and trysail masts arranged as shown on plan.

Stem

The stem will be forged with an eye similar to a common sternpost in single propeller vessels; this eye or hub will be inclined as shown on plans. The stem is to be of the best hammered iron, 7 by $1\frac{5}{8}$ inches, and provided with an eye and hub of proper dimensions for the hawse pipe.

Bulkheads

There will be four bulkheads, arranged as per plan, and built thoroughly water-tight; they are to be tested by a hydrostatic pressure not less than that equal to a head of water of 16 feet (this is a PSI measurement). The bulkhead shall be fitted with patent radiating stiffeners, the distance between the stiffeners decreasing toward the bottom and also toward the centerline of the vessel. The plates shall therefore not be increased in thickness in the lower part of the bulkhead, but be of a uniform thickness, weighing 8 pounds per square foot.

Hawse Pipes

There will be two, cast iron hawse pipes, with warped flanges of semi-circular form at the outboard and inboard ends, fitted in place, as shown on drawings, or as will be necessitated by the location and construction of the windlass; the hawse pipes are to be secured in place in a substantial and neat manner, and are to be properly proportioned to suit the size of chain and stand the shocks of the cables paying through them.

Windlass

Each vessel will be furnished and fitted by the contractor, with an iron steam pump brake windlass of either of the following patterns: The American Ship Windlass Company pattern; the

Joseph Manton, Providence, RI pattern, or Bath iron Works pattern, and capable of doing the work required efficiently by steam or hand power. The windlass will have three wildcats as shown on plan, two wildcats for two, 2 inch chains, and one for 1½ inch chain; all two winch heads of proper dimensions; the pump brake will be arranged so as to be worked by hand below the fore-castle deck on the main deck. All pipes and connections from boilers and all necessary fastenings and fittings to be furnished and fitted in place by the contractor in complete working order, satisfactory to the representative of the Lighthouse Board. Elastic chain stoppers of suitable dimensions, located as per plan, will be furnished, fitted, and properly fastened. Suitable wrought iron pipes of about 12 inches diameter for leading the chains to the lockers are to be fitted and fastened in place.

Engine and Boilers

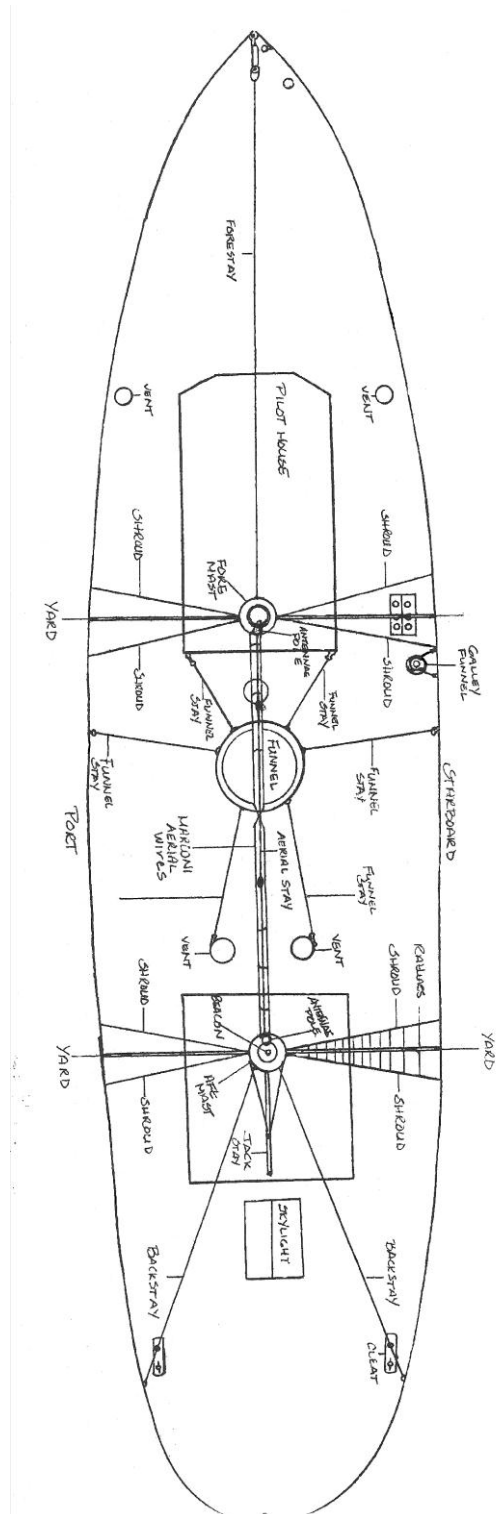
There will be one right handed, two bladed, cast-iron screw-propeller of about 6 feet diameter and suitable pitch, driven by a compound surface-condensing vertical two-cylinder engine, the cylinders are to be 14 and 24 inches in diameter, and a stroke of 16 inches. There will be two cylindrical, single-ended steel boilers of the Scotch type, 8 feet in diameter and 9 feet long, provided with a Fox's patent corrugated furnace, 36 inches diameter, in each boiler. Also, a donkey boiler, 7 feet 3 inches in height, and 4 feet 6 inches in diameter. There is to be furnished and fitted in place, one horizontal, non-condensing engine, of about 5 inches diameter of cylinder and 6 inches stroke, with properly attached machinery for operating the steam whistle. Also, one Baird's No.3 distilling apparatus, with necessary evaporator, filter, pumps, etc., all to be arranged as shown on plans and as will hereinafter be described and specified.

Trail Trip

In addition to the necessary trials of the machinery at the dock, a trial trip is also to be made of about eight hours duration, at the expense of the contractor, and all the machinery must work on this trial trip to the entire satisfaction of the Lighthouse Board representative. If any defects should develop on the trial, subsequent trials, at the expense of the contractor and as described above, will be made until every part of the machinery has proven to be in accordance with the requirements of these specifications. All bearings, journals, and other parts of the engine when working under a pressure of one hundred pounds per square inch must show no tendency to heat or grip, but to run smoothly without shock or noise (Lighthouse Board 1891).

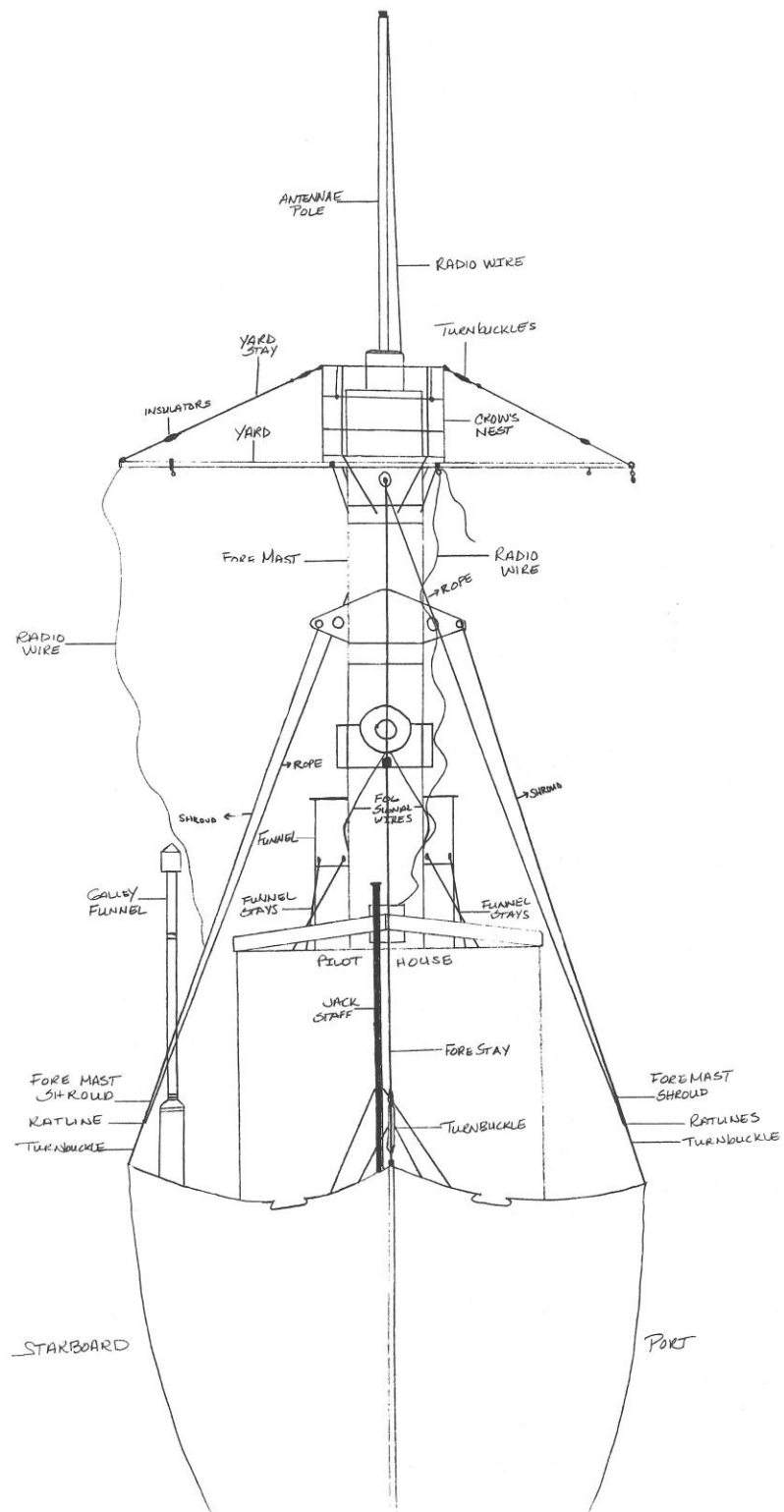
APPENDIX E

PLAN VIEW

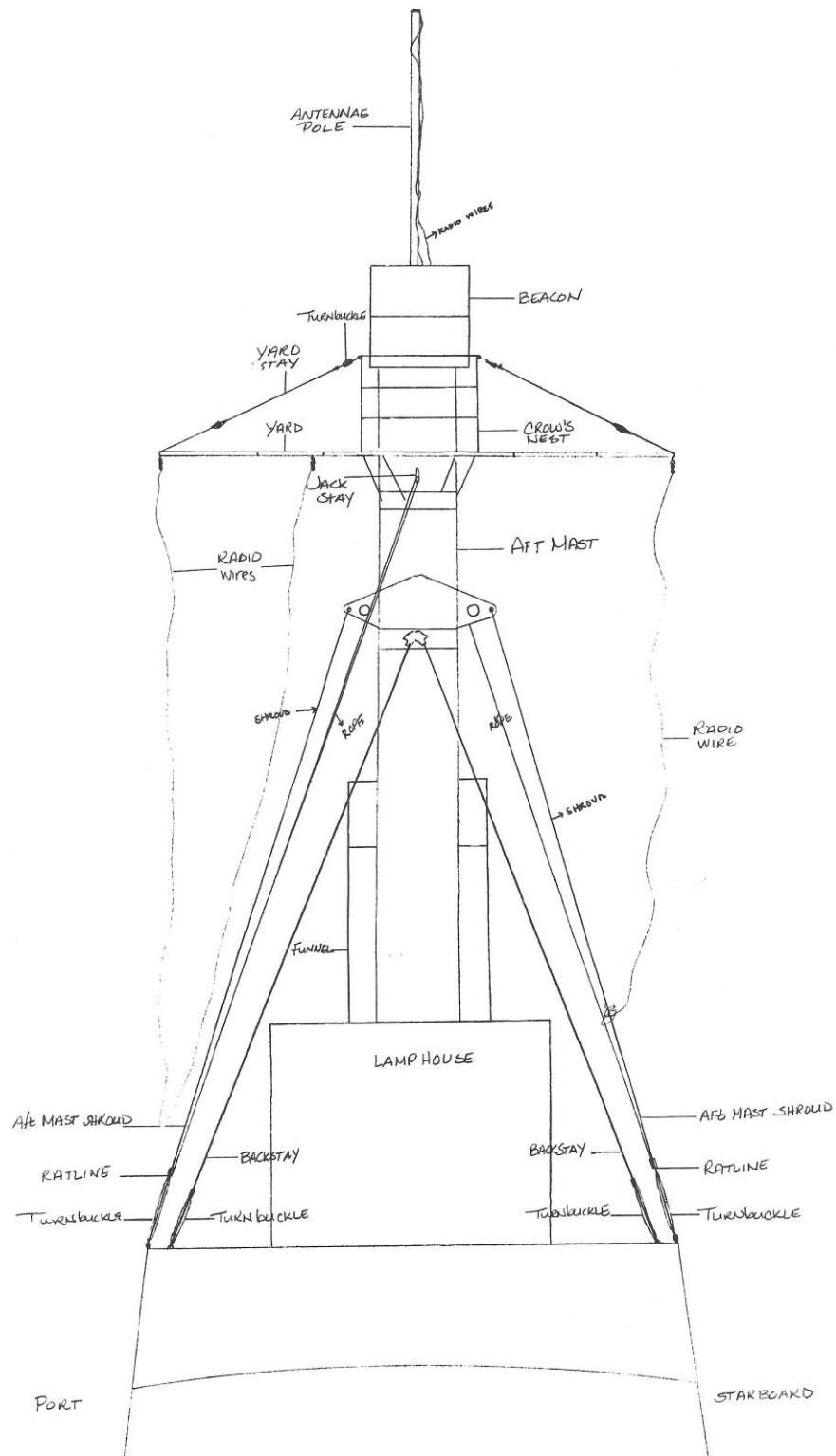


APPENDIX E : RIGGING PLANS

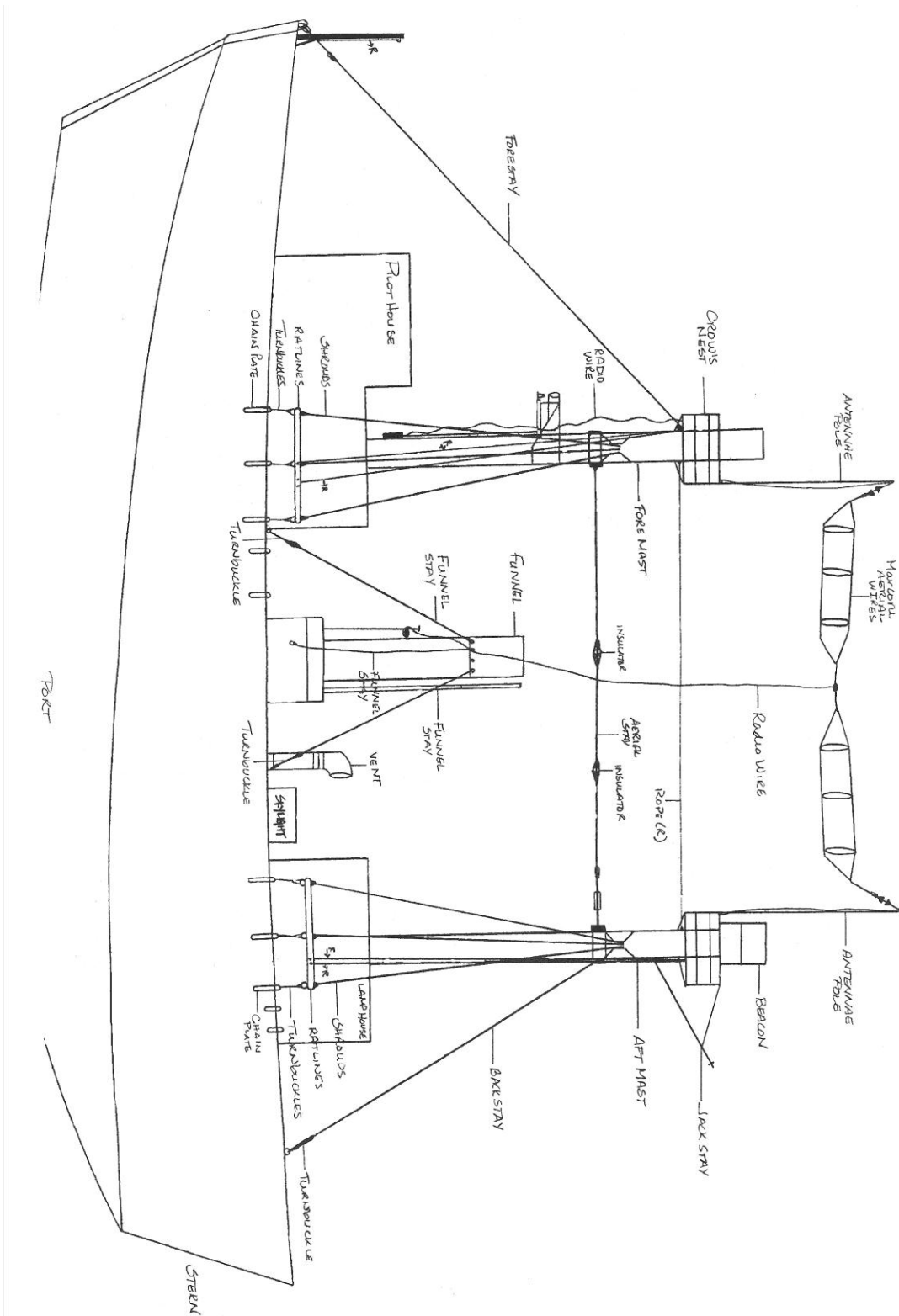
BOW VIEW



STERN VIEW



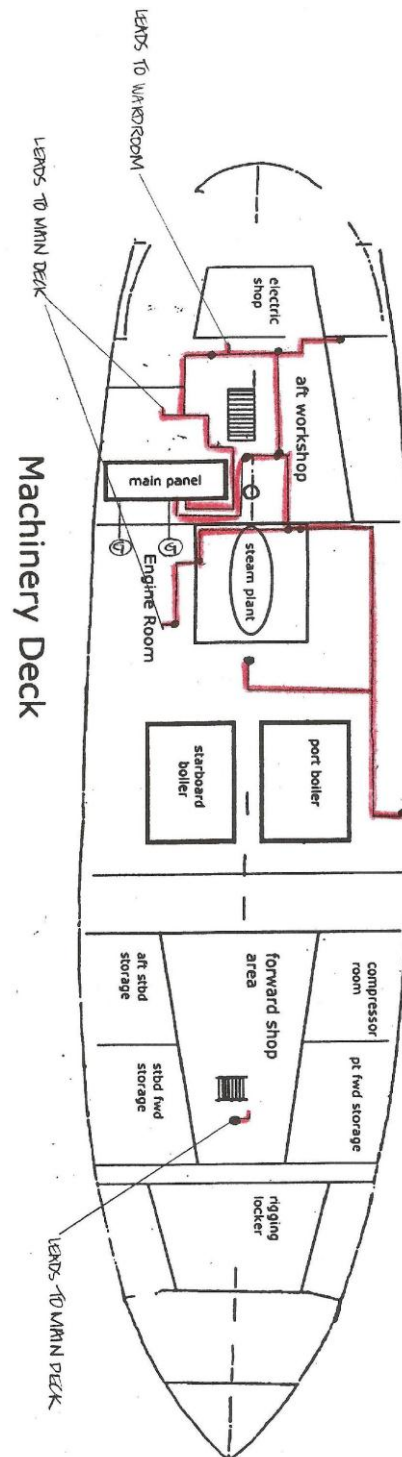
PORT PROFILE VIEW



APPENDIX F

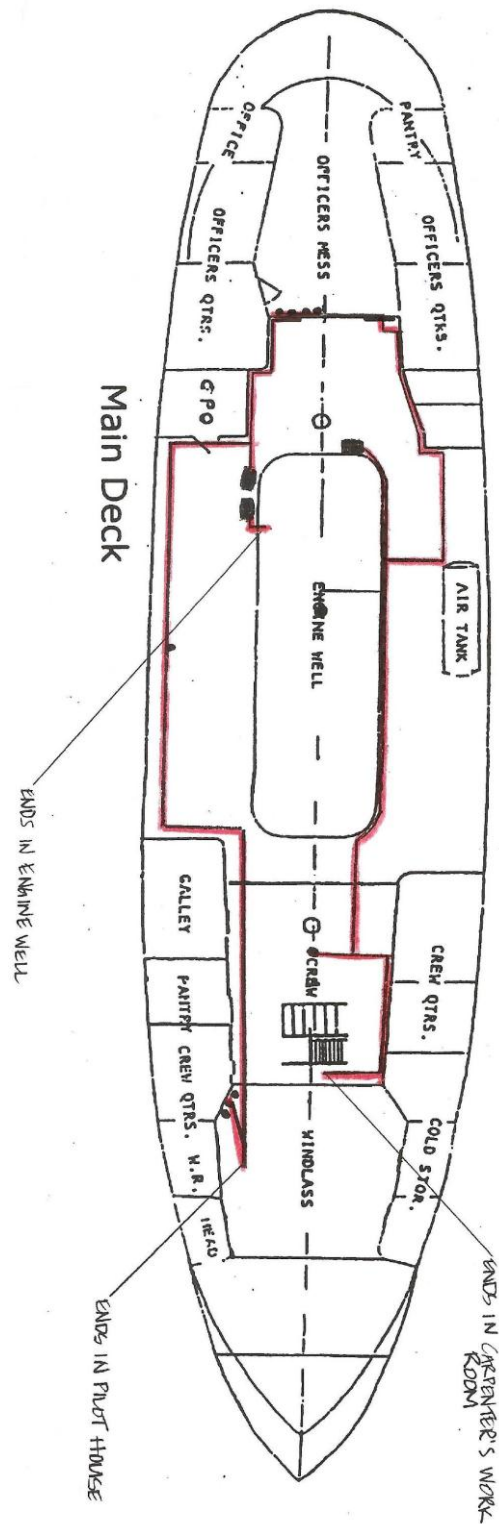
APPENDIX F : COMMUNICATION WIRING PLANS ON LV83

MACHINERY DECK



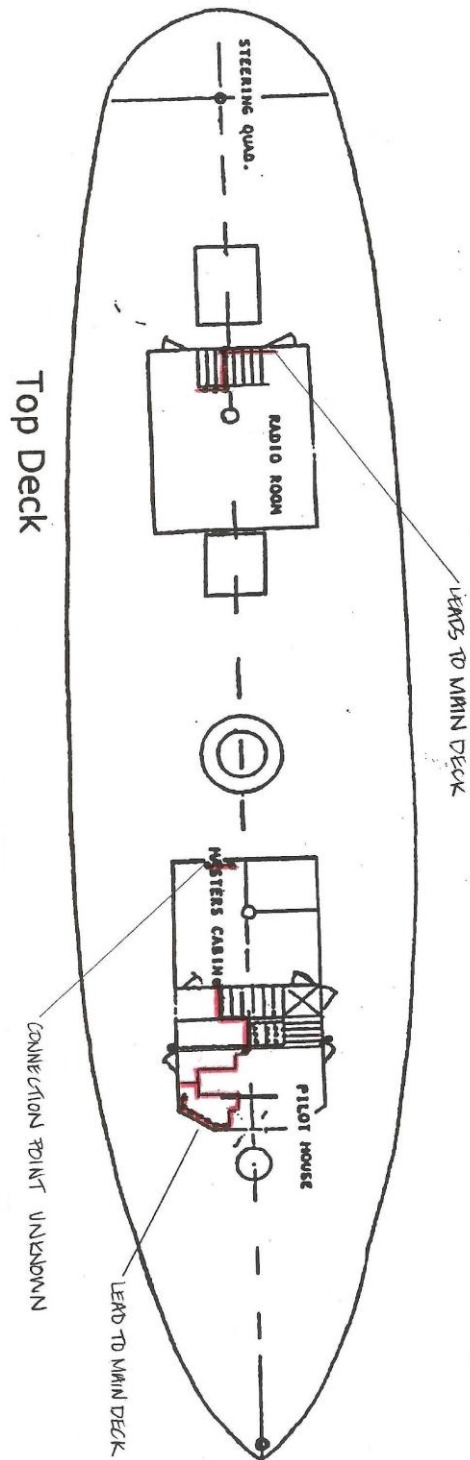
APPENDIX F : COMMUNICATION WIRING PLANS ON LV83

MAIN DECK



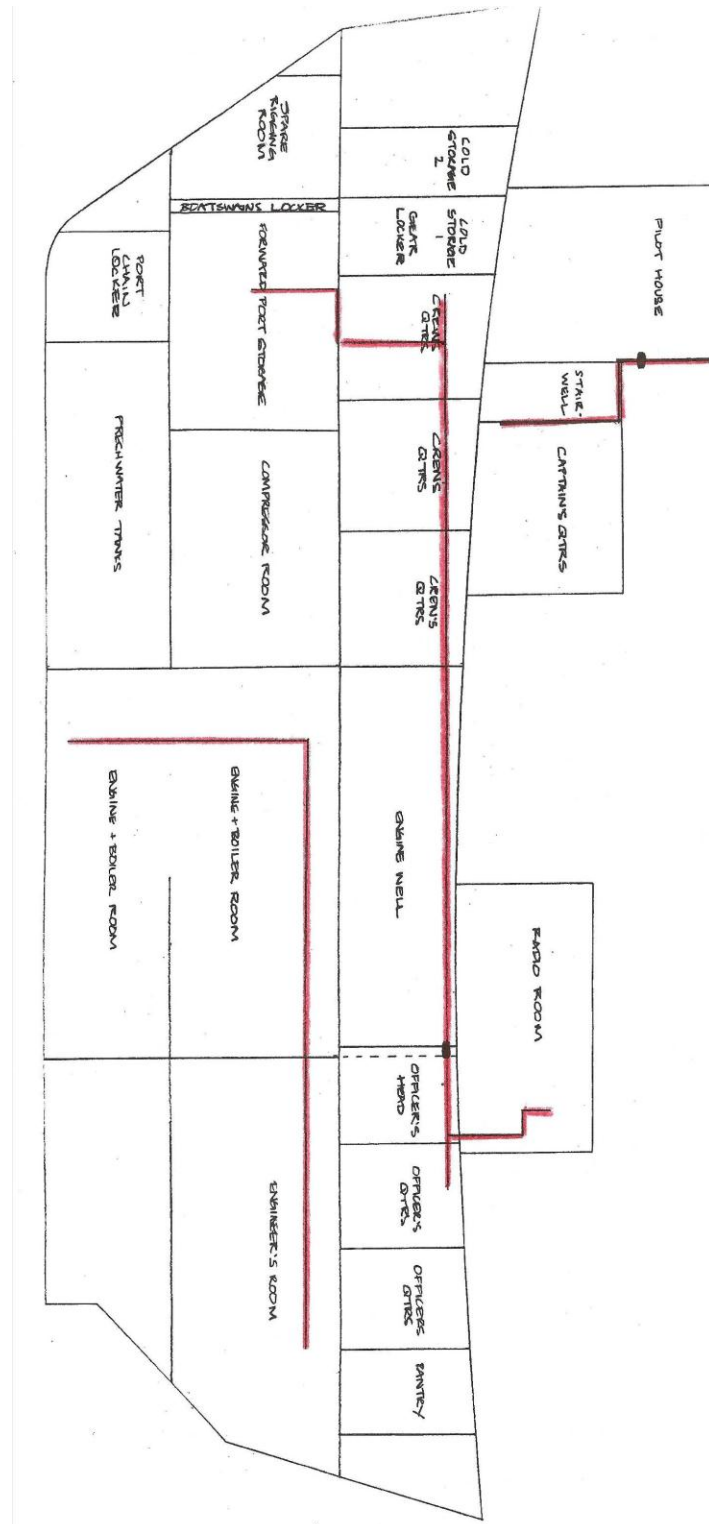
APPENDIX F : COMMUNICATION WIRING PLANS ON LV83

SPAR DECK

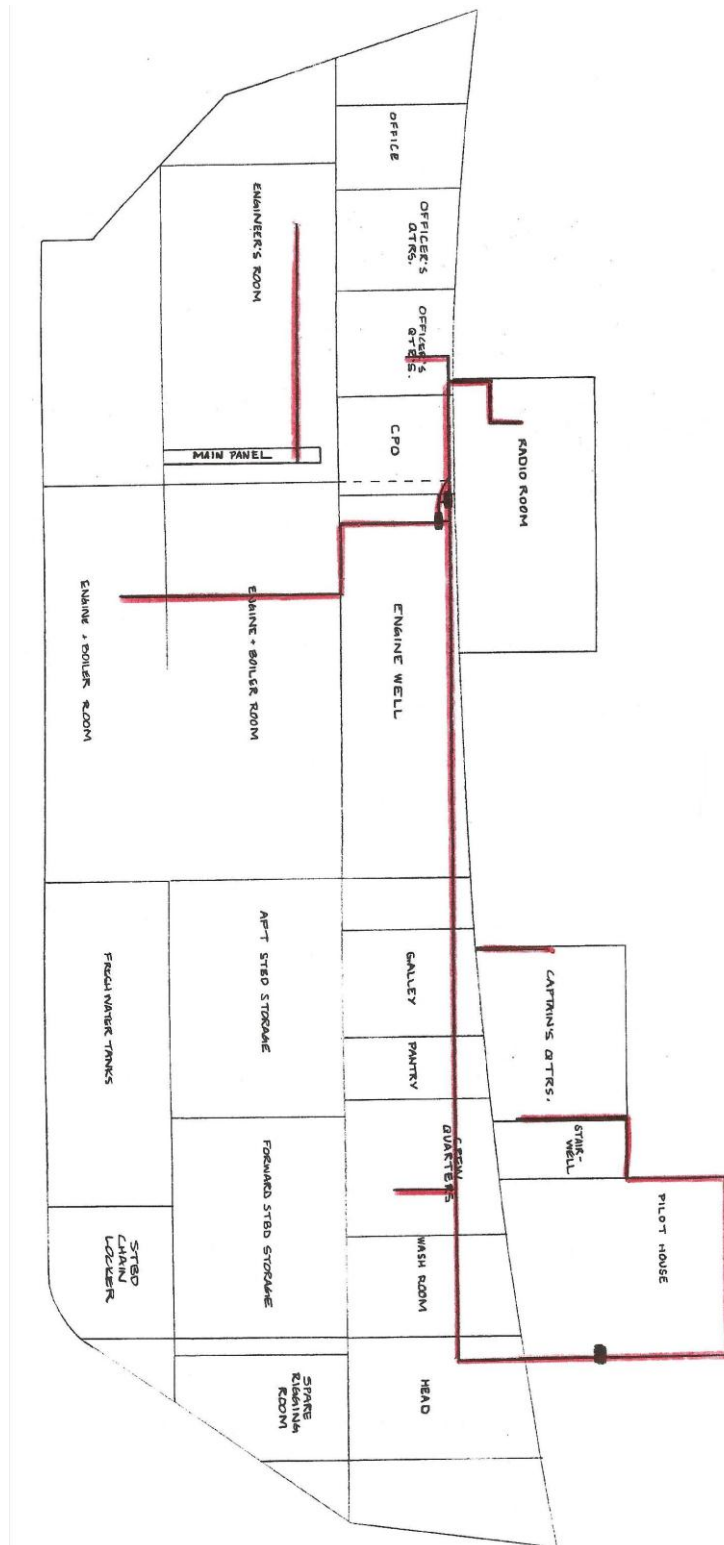


APPENDIX F : COMMUNICATION WIRING PLANS ON LV83

PORT PROFILE PLAN



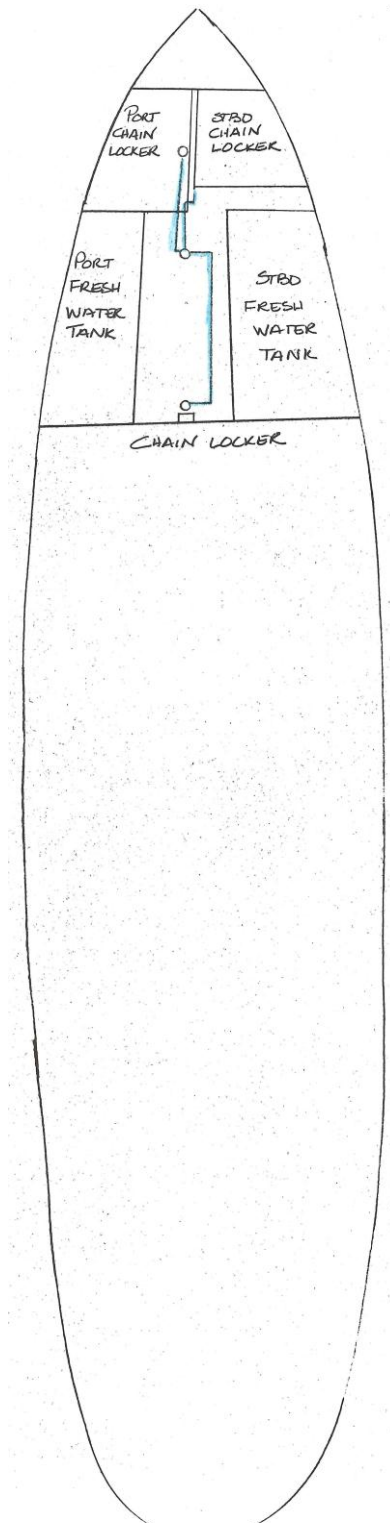
STARBOARD PROFILE PLAN



APPENDIX G

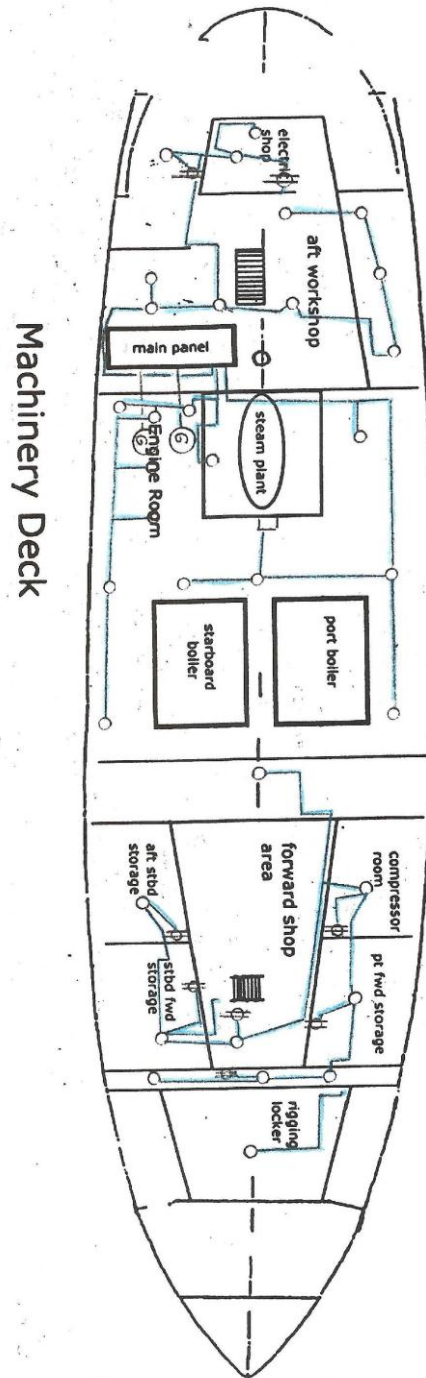
APPENDIX G : LIGHTING WIRING PLANS ON LV83

FORWARD HOLD PLAN



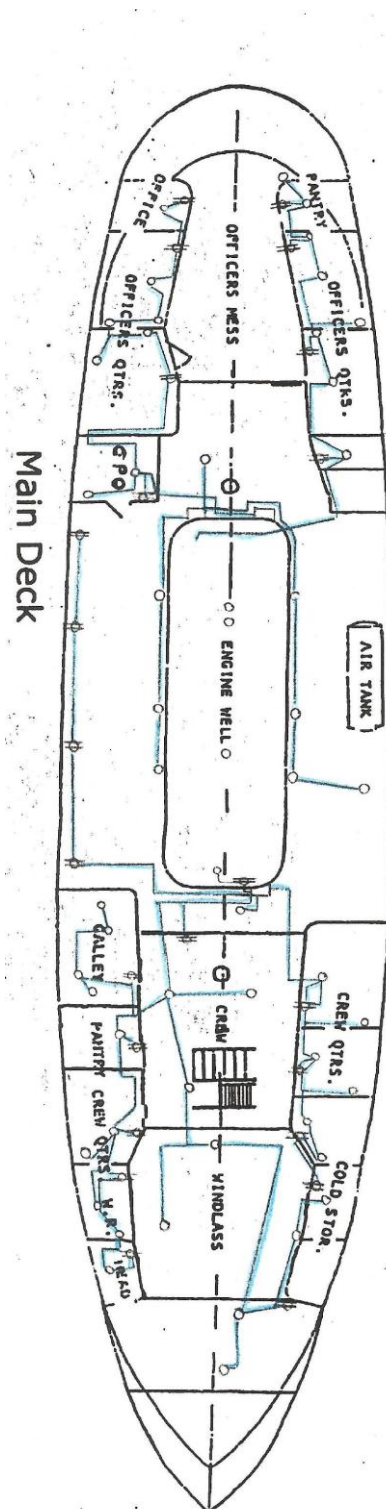
APPENDIX G : LIGHTING WIRING PLANS ON LV83

MACHINERY DECK PLAN



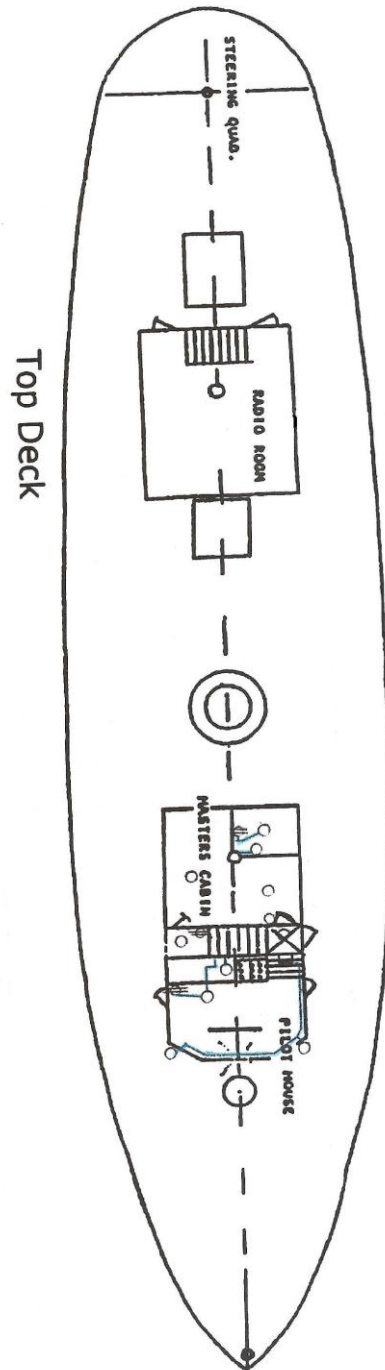
APPENDIX G : LIGHTING WIRING PLANS ON LV83

MAIN DECK PLAN

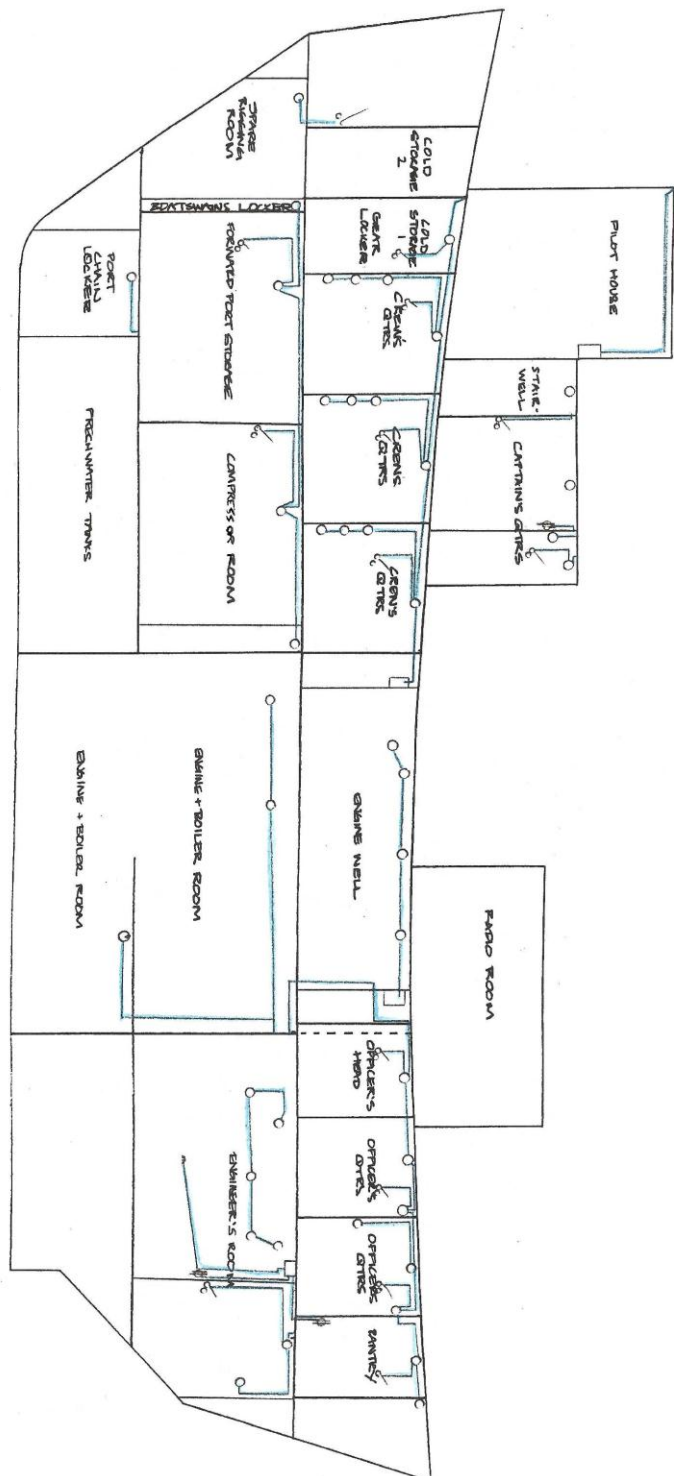


APPENDIX G : LIGHTING WIRING PLANS ON LV83

SPAR DECK PLAN

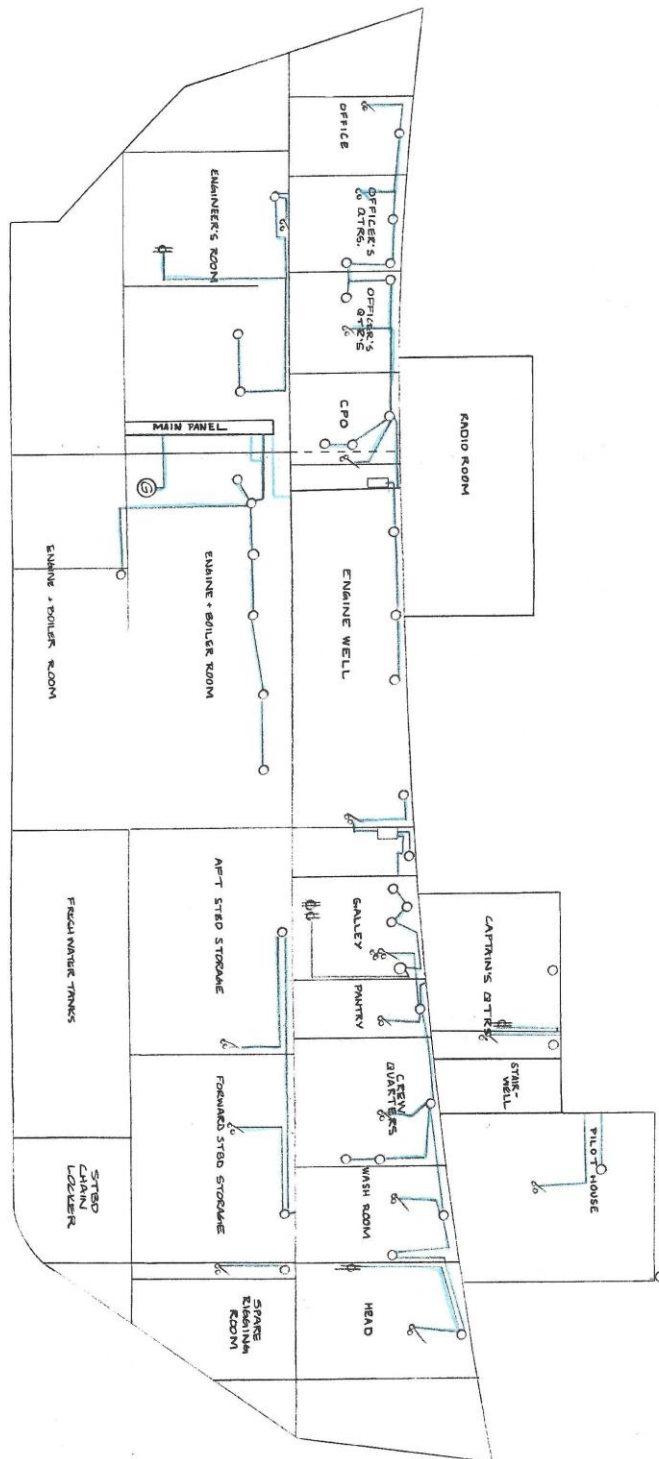


PORT PROFILE PLAN



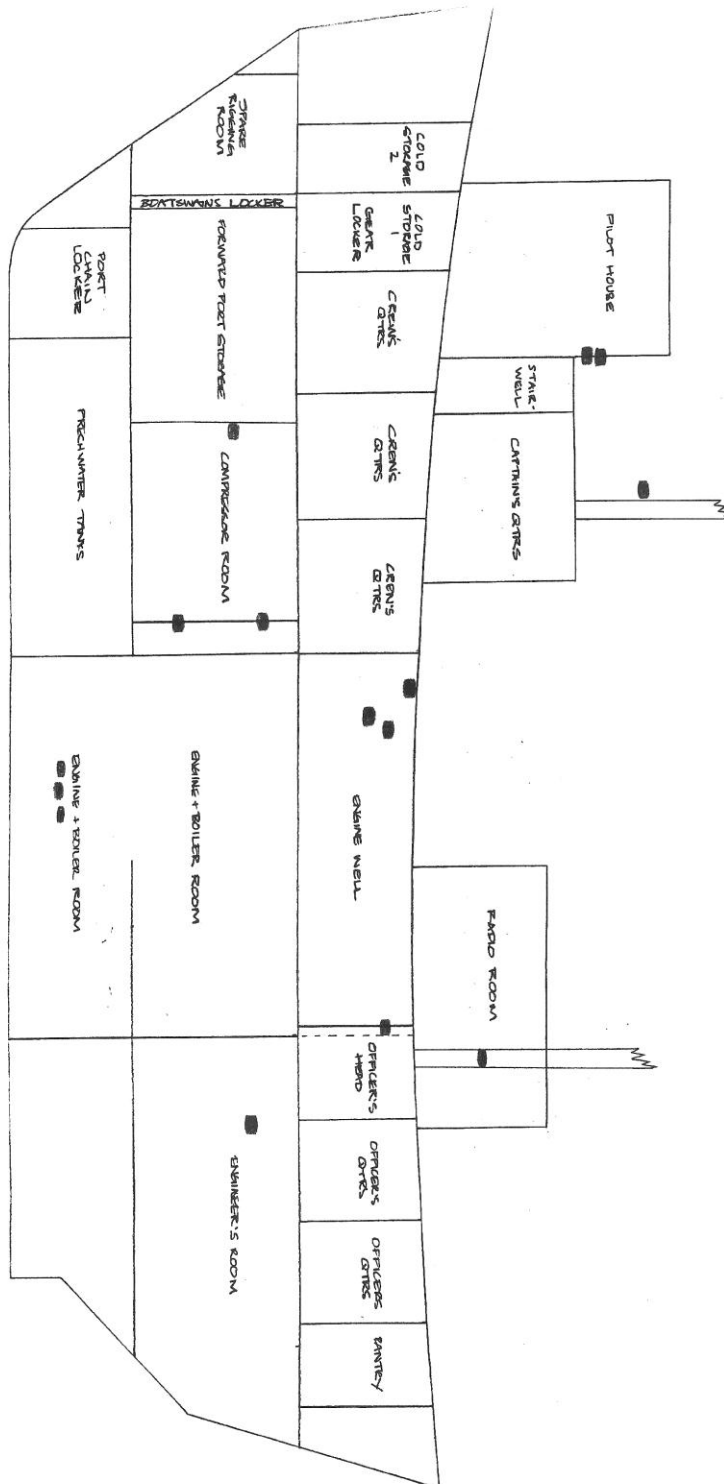
APPENDIX G : LIGHTING WIRING PLANS ON LV83

STARBOARD PROFILE PLAN



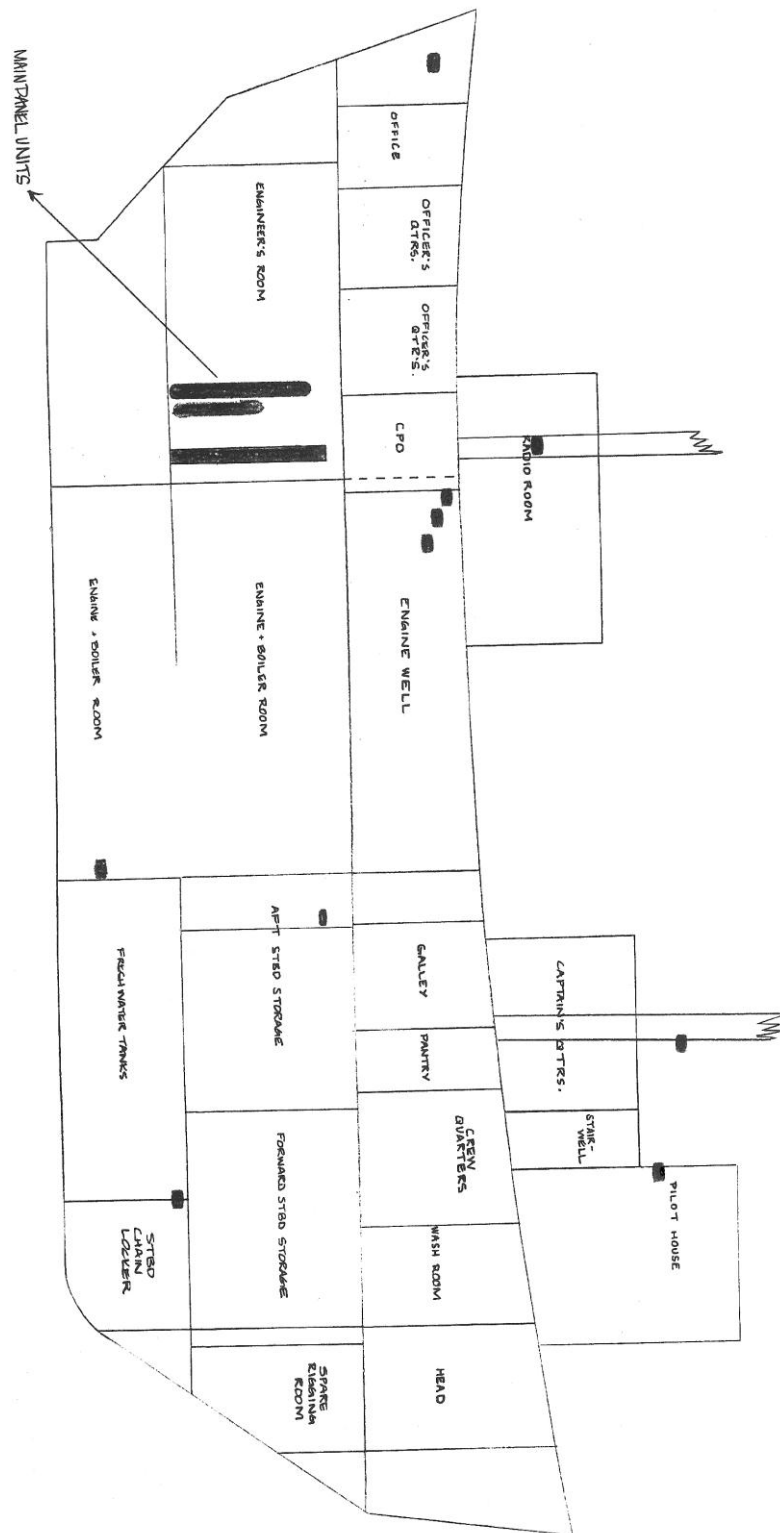
APPENDIX H

PORT PROFILE PLAN



APPENDIX H : LOCATIONS OF JUNCTION BOXES ONBOARD LV83

STARBOARD PROFILE PLAN



APPENDIX I

APPENDIX I : ARTIFACT ACCESSION FORM FROM THE 2010 LV83
DOCUMENTATION PROJECT

Accession Form
(LV83 Swiftsure artifacts)

Accession Number: 2010. LV83 / 40
(year.collection #.object #)

Date: 6/28/2010

Photograph: 004b

Artifact Description:

AEROLOGICAL PLOTTING BOARD
US NAVY 1938

Material(s): METAL + PLASTIC

Location: WHEEL HOUSE CABINET

Condition: _____

Value: _____

Remarks: _____

APPENDIX J

APPENDIX J : ARTIFACT PHOTO LOGS FROM THE 2010 LV83 DOCUMENTATION PROJECT

Artifact Photo Log

Photo Log

1/4

Pic	Description	Location	Date	Recorder
0001	2010.LV83/1 - GREEN LANTERN	ELECTRIC SHOP WORK BENCH	6/28/10	LS
0002	2010.LV83/2 - AC AMPMETER			
0003	2010.LV83/2 - AC AMPMETER			
0004	2010.LV83/3 - GLASS GLOBE COVER			
0005	2010.LV83/3 - GLASS GLOBE COVER			
0006	2010.LV83/4 - PHONE, HANDPIECES			
0007	2010.LV83/5 - "SANKA" TINCAN	ELECTRIC + MECHANIC CLOSET		
0008	2010.LV83/5 - "SANKA" TINCAN			
0009	2010.LV83/6 - "VAN-CAMP" TINCAN			
0010	2010.LV83/6 - "VAN-CAMP" TINCAN			
0011	2010.LV83/7 - "HILLS BEDS." COFFEE CAN	AFT STBD ROOM IN ENGINEER'S ROOM		
0012	2010.LV83/8 - LIGHT COVERS (4) (WIRES)	ELECTRIC SHOP WORK BENCH		
0013	2010.LV83/9 - TOOLBOX (WOODEN)	AFT STBD ROOM IN ENGINEER'S ROOM		
0014	2010.LV83/10 - "TEXACO" OIL DRUM	ENGINEER'S ROOM		
0015	2010.LV83/11 - MOP BUCKET			
0016	2010.LV83/12 - "DELPHOS" OIL CAN W/ SPOUT			
0017	2010.LV83/13 - "ELECTRIC SHOP + ELECTRICAL DECK" SIGN			
0018	2010.LV83/14 - WRENCH SET (4 on Right)	ENGINEER'S ROOM FWD WALL		
0019	2010.LV83/14 - WRENCH SET (5 on left)			
0020	2010.LV83/15 - SPACE HEATER	ENGINEER'S ROOM		
0021	2010.LV83/16 - GASOLINE DRUM			
0022	2010.LV83/17 - RED METAL CANISTER			
0023	2010.LV83/18 - CARNAGEE BRICKS			
0024	2010.LV83/19 - TEA CUP	OFFICER'S PANTRY		
0025	2010.LV83/20 - TEA SAUCER			
0026	2010.LV83/21 - DRAWER OF SETS			
0027	2010.LV83/22 - RESCUE APPARATUS	STBD CORRIDOR ENGINE WEL		
0028	2010.LV83/23 - ROUND METAL LAMP	CREW MESS		
0029	2010.LV83/24 - RECTANGULAR METAL LAMP			

Artifact Photo Log

Photo Log

2/4

Pic	Description	Location	Date	Recorder
0030	2010.LV83/25 - HURRICANE LAMP	CREW MESS	6/28/10	LS
0031	2010.LV83/26 - GALLEY CHINA	CREW GALLEY		
0032	2010.LV83/26 - MORE CREW DISHES	DISH HOLDER		
0033	2010.LV83/27 - METAL PORTHOLE	CREW GALLEY		
0034	2010.LV83/28 - BLUE HURRICANE	SHELF		
0035	2010.LV83/29 - SM WOODEN BLOCK	CREW QUARTERS		
0036	2010.LV83/30 - MED WOODEN BLOCK	STBD 1		
0037	2010.LV83/31 - RED WOOD CHAIR	WINDLASS ROOM		
0038	2010.LV83/32 - WOOD CHAIR	WINDLASS ROOM		
0039	2010.LV83/33 - UNKNOWN OBJECT	SPARE RIGGING ROOM		
0040	2010.LV83/34 - PEWTER PITCHER	CAPTAIN'S QUARTERS		
0041	2010.LV83/35 - SPOT LIGHT			
0042	2010.LV83/36 - LOG BOOK (WOOD)			
0043	2010.LV83/37 - MULTIPURPOSE SIGNAL KIT			
0044	2010.LV83/38 - OVERHEAD LIGHT			
0045	2010.LV83/39 - NAVIGATION CHART DEVICE			
0046	2010.LV83/40 - AEROLOGICAL PLOTTING BOARD			
0047	2010.LV83/41 - RULES OF CONDUCT			
0048	2010.LV83/42 - LATEST GUARD SURFACE PLOTTER	WHEEL HOUSE	6/29/10	MM
0049	2010.LV83/43 - 3 ARM PROTRACTOR			
0050	2010.LV83/44 - MAP COLLECTION			
0051	2010.LV83/44 - MAP COLLECTION			
0052	2010.LV83/45 - OPERATION FILES			
0053	2010.LV83/46 - GUN HOLSTERS			
0054	2010.LV83/47 - MEGAPHONE			
0055	2010.LV83/47 - MEGAPHONES			
0056	2010.LV83/48 - FLAGS			
0057	2010.LV83/49 - SPEAKING TUBE			
0058	2010.LV83/50 - LISTENING TUBE			

Artifact Photo Log

Photo Log

3/4

Pic	Description	Location	Date	Recorder
0059	2010.LV83/51 - COMMUNICATION TUBE	WHEEL HOUSE	6/29/10	MM
0060	2010.LV83/52 - SHIP'S TELEGRAPH.			
0061	2010.LV83/53 - BINNACLE			
0062	2010.LV83/54 - SHIP'S WHEEL			
0063	2010.LV83/55 - WHEEL HOUSE PHONE			
0064	2010.LV83/56 - MISC. ARTIFACTS			
0065	2010.LV83/57 - MISC. PULLEYS			
0066	2010.LV83/58 - WOODEN BOX ON WALL	↓		↓
0067	2010.LV83/59 - WOODEN BLOCK (1)	SPARE RIGGING ROOM		JM
0068	2010.LV83/60 - WOODEN BLOCK (2)			JM
0069	2010.LV83/61 - LARGE WOODEN BLOCK			MM
0070	2010.LV83/62 - SMALL WOODEN BLOCK			
0071	2010.LV83/63 - SMALL WOODEN BLOCK			
0072	2010.LV83/64 - ROPE COLLECTION			
0073	2010.LV83/65 - SMALL WOODEN BENCH			
0074	2010.LV83/66 - WOODEN BLOCK			
0075	2010.LV83/67 - WOODEN BLOCK	↓		
0076	2010.LV83/68 - RED LIGHT CORNER LAMP	BOATWAIN'S LOCKER		
0077	2010.LV83/69 - GREEN LIGHT CORNER LAMP	↓		
0078	2010.LV83/70 - OIL CAN	↓		
0079	2010.LV83/71 - METAL LIGHT COVER	PORT FWD OIL ROOM		
0080	2010.LV83/72 - GLASS LIGHT COVERS	↓		
0081	2010.LV83/73 - ANCHOR	CARPENTER'S WORK ROOM		
0082	2010.LV83/74 - SAW	↓		
0083	2010.LV83/75 - WOODEN LADDER	STARBOARD CHAIN LOCKER	↓	↓
0084	2010.LV83/76 - SHUTTERED SIGNAL LANTERN	AFT OF STBD WHEELHOUSE	6/30/10	LS
0085	2010.LV83/77 - WHITE HANGING WOOD BLOCK	STBD SPARDECK		
0086	2010.LV83/78 - MED WHITE WOODEN BLOCK	STBD HATCH/ACCESS		
0087	2010.LV83/79 - "LAD" MISC ARTIFACT	BOW	↓	↓

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Photo Log

Pic	Description	Location	Date	Recorder
0088	2010, LV 83/80 - MEGAPHONE OR HORN	AFT WALL OF WHEELHOUSE	6/30/10	LS