The Elmer A. Sperry Award 1985

for advancing the art of transportation

The Elmer A. Sperry Medal

The Elmer A. Sperry Award

The Elmer A. Sperry Award shall be given in recognition of a distinguished engineering contribution which, through application, proved in actual service, has advanced the art of transportation whether by land, sea or air.

In the words of Edmondo Quattrocchi, the sculptor of the Elmer A. Sperry Medal:

"This Sperry medal symbolizes the struggle of man's mind against the forces of nature. The horse presents the primitive state of uncontrolled power. This, as suggested by the clouds and celestial fragments, is essentially the same in all the elements. The Gyroscope, superimposed on these, represents the bringing of this power under control for man's purposes."

Presentation of

The Elmer A. Sperry Award for 1985

to

Richard K. Quinn
Carlton E. Tripp
George H. Plude

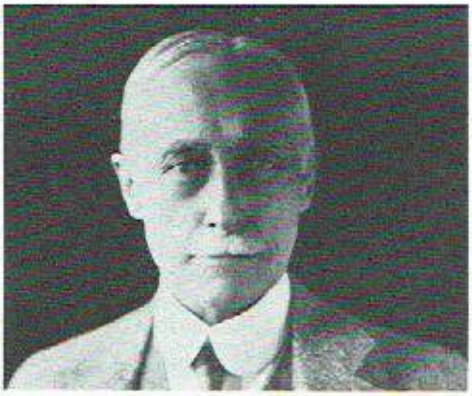
by

The Board of Award under the sponsorship of

The American Society of Mechanical Engineers
Institute of Electrical and Electronics Engineers
Society of Automotive Engineers
The Society of Naval Architects and Marine Engineers
American Institute of Aeronautics and Astronautics

At the 93rd Annual Banquet
The Society of Naval Architects and Marine Engineers

Friday, November 15, 1985 — New York Hilton Hotel, New York



Elmer Ambrose Sperry 1860 - 1930

Founding of the Award

The Elmer A. Sperry Award commemorates the life and achievements of Dr. Elmer A. Sperry (1860-1930) by seeking to encourage progress in the engineering of transportation. Much of the great scope of the inventiveness of Dr. Sperry contributed either directly or indirectly to advancement of the art of transportation. His contributions have been factors of improvement of movement of men and goods by land, sea and air.

The award was established in 1955 by Dr. Sperry's daughter, Mrs. Robert Brooke Lea, and his son, Elmer A. Sperry, Jr.

The 1985 Elmer A. Sperry Board of Award

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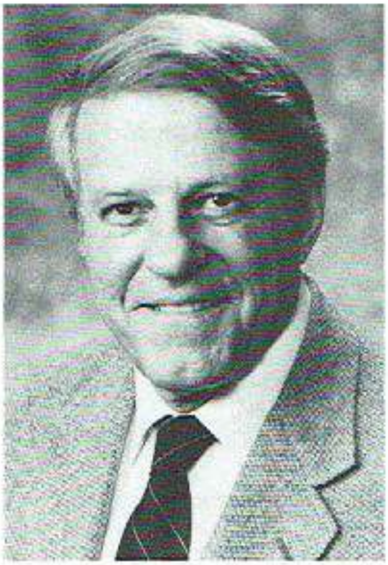


RICHARD K. QUINN

CARLTON E. TRIPP

GEORGE H. PLUDE

AWARD CITATION

To Richard K. Quinn, Carlton E. Tripp, and George H. Plude for the inclusion of numerous innovative design concepts and an unusual method of construction of the first 1,000-foot self-unloading Great Lakes vessel, the *M/V* STEWART J. CORT, which revolutionized the economics of Great Lakes transportation.

THE 1,000-FOOT SELF-UNLOADING VESSEL M/V "STEWART J. CORT"

HISTORY

Great Lakes transportation of iron ore commenced in 1850 when five barrels of iron ore were loaded on a sailing vessel at Marquette, Michigan, for delivery to the lower lakes. The ore was transferred at Sault Ste. Marie by unloading and trucking around the rapids and reloading on a second sailing vessel to complete the journey. The construction of the first locks in 1855 at the Soo Rapids led to the building in 1869 of the first prototype lake steamer, the J. R. HACKETT, a milestone which radically changed the bulk shipping industry and set new records at that time.

Ship size and efficiency increased so that by 1910 the standard 600- and 620-foot ships had been developed, and served the iron and steel industry through World Wars I and II. The high cost of ship operations following World War II resulted in the construction of larger vessels to meet competitive costs and to substantiate the economics of size. The change came at a time when the existing dock unloading equipment was becoming obsolete and required retirement or replacement. The self-unloading vessel was the answer. The result of these evolutionary changes was the completion of a new larger lock at Sault Ste. Marie in 1968 and the design and construction of the 1,000-foot self-unloader, the largest ship that could be accommodated by the lock under the existing criteria.

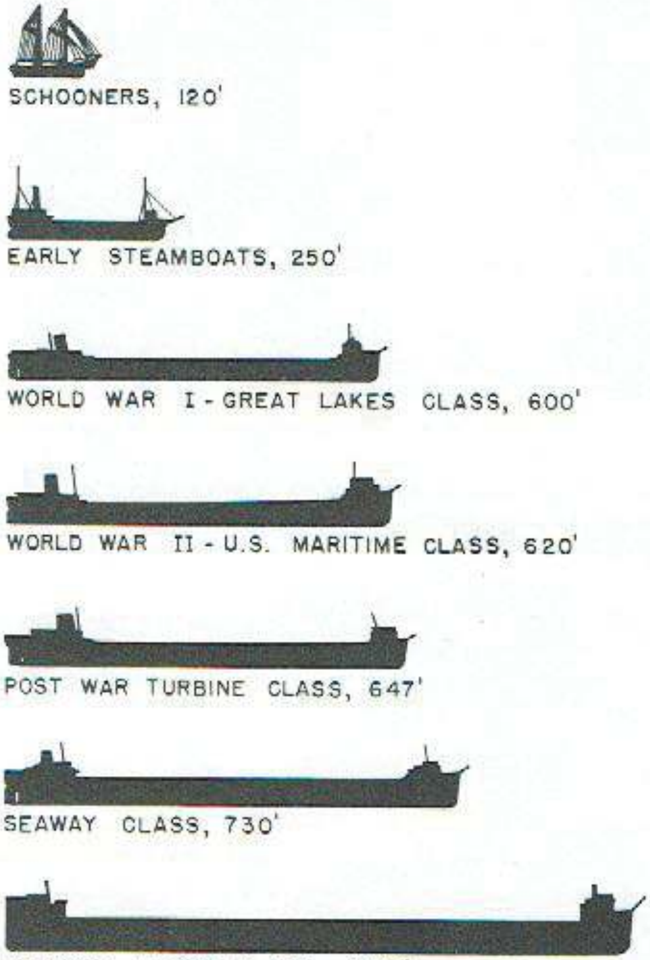
The 1,000-foot vessel set the standard for the industry and ore was shipped on the longer hauls by smaller vessels only when the 1,000-foot shipping capacity was fully utilized. The development of the Great Lakes bulk cargo ships over the past 130 years is shown in Figure 1.

THE VESSEL AND ITS IMPACT

The 1,000-foot self-unloader M/V STEWART J. CORT commenced service on the Great Lakes in May 1972 and is one of the most significant advances in the Great Lakes transportation of iron ore and coal since the first bulk cargo steamship was designed and constructed.

The ship pioneered a new design and transports cargo approximately three times the amount carried by the most modern lake ships then in service, and six times the cargo carried by the steel industry's standard 600 foot lake ships of World War I. It navigates the restricted connecting channels, maneuvers in harbors previously considered too small for a ship of that size, moors at docks without the aid of harbor tugs and can self-discharge cargo at the rate of 20,000 Long Tons per Hour (L.T./Hr.). The installation of both bow and stern thrusters was a first at that time and these, together with the twin screw and twin rudder arrangement, provide the maneuverability needed for a vessel of this size to navigate the congested waters encountered on the Great Lakes trade routes.

DEVELOPMENT OF GREAT LAKES BULK CARGO VESSELS



	YEAR	ANNUAL CAPACITY IN TONS
SCHOONERS, 120'	1850	3,000
EARLY STEAMBOATS, 250'	1869	25,000
WORLD WAR I - GREAT LAKES CLASS, 600'	1910	350,000
WORLD WAR II - U.S. MARITIME CLASS, 620'	1940	500,000
POST WAR TURBINE CLASS, 647'	1950	850,000
SEAWAY CLASS, 730'	1960	1,000,000
STEWART J. CORT CLASS, 1000'	1972	2,500,000

FIGURE 1. The schooners carried iron ore cargoes starting with fivebarrels per trip in 1850 and later averaged 3,000 tons a year. The first steamer in 1869 carried about 25,000 tons of cargo in one season. One hundred years later the 1,000-foot ship increased the annual season capability one hundred times to 2,500,000 tons.

The main diesel engine power plant has three times the power of previous diesel engine systems on the U.S. Great Lakes vessels. The design and automation of the engine machinery, unloading gear, hatches and other features allowed a crew reduction from the standard 35 to 26 despite the increased size.

The nature of the rock bottom of the Great Lakes and the limited draft in connecting river channels dictates a long and shallow draft vessel capable of loading large cargoes. New construction techniques were developed and new operational systems were devised to facilitate the proper distribution of ballast and cargo weights to minimize adverse stresses as the ship is loaded and unloaded. A new efficient and rapid ballast system provides for ship safety during cargo transfers and allows for increased cargo carrying capacity. The design of the ship provides for careful and precise vessel trim, which is critical since it is often underway in channels with as little as one foot of clearance over the channel bottom.

The extent to which the 1,000-foot self-unloading ship has revolutionized the iron ore trade on the Great Lakes is evident by the fact that it replaced the obsolete dockside unloading machinery systems as a means for transferring the cargo from the vessel to the dock for distribution. All Great Lakes iron ore cargoes in 1984 were transported by self-unloading vessels.

The operational and economic success of the CORT hurried the obsolescence of the previous standard ships sailing the Lakes. Ship owners ordered eleven additional 1,000-foot ships and one 1,000-foot tug-barge combination following the introduction of the CORT. The 1,000-foot self-unloader is the only ship contemplated for construction in the future, except ships for certain specialized trades requiring specific designs.

The 1,000-foot ship has advanced the concept of a superport to which 1,000-foot ships may deliver cargo and from which it can then be distributed by rail or small shuttle ships to steel mills. An example is the Lorain, Ohio transfer facility, which unloads 1,000-foot ships and transfers by rail to inland mills and by shuttle vessels to upriver mills in Cleveland inaccessible to the 1,000-foot vessels.

Connecting channels and some harbor depths were improved to allow the 1,000-foot vessel to serve more ports, thus expanding its role in replacing the less efficient small ships and antiquated dock equipment.

The self-unloading vessel as typified by the CORT has proved practical for the transfer of cargo directly to smaller ships for distribution to docks. Self-unloading vessels are also used for cargo transfer to larger ocean-going ships unable to enter the Seaway Transportation System and for the topping off of large coal carrying ships in the Newport News-Norfolk area.

The 1,000-foot ship provided the impetus for new and modernization of existing iron ore and coal loading facilities, channel improvements, and the activation of a new 1,200 X 110-foot lock at the St. Marys Falls Canal between Lakes Superior and Huron. Shipyards upgraded their building facilities for sectional construction and constructed three new drydocks to build and service the vessels.

The creation of the 1,000-foot self-unloader as the latest generation of lake ship transportation was important in stabilizing one element of the cost of iron ore and coal for U.S. steel producers and electric utility companies. The delivered cost per ton remained level at a time, preceding cost escalations, and was one factor in the steel industries' fight to remain competitive with foreign imports. The standard Great Lakes carrier could no longer compete with the prevailing rates and as a result, smaller ships have been either laid up or permanently removed from service.

The project concept and innovative construction methods for building the 1,000-foot ship were developed by Litton Industries and Marine Consultants & Designers, Inc.

The implementation and coordination of the 1,000-foot ship project was the responsibility of Richard K. Quinn, then Director of Great Lakes Operations for Litton Industries. He coordinated the engineering, financing, and planning necessary to combine the efforts of the Litton Yards at Pascagoula, Mississippi and Erie, Pennsylvania to build the ship. It is interesting to note that the bow and stern sections, built and temporarily joined in Pascagoula, were sailed under their own power in open waters to Erie. The bow and stern then were severed and joined to the mid-body assembly.

Carlton E. Tripp, then President, and George H. Plude, then Director of Engineering, of Marine Consultants & Designers, Inc. provided innovative ideas for the automated hull, navigation, unloading and power plant systems and were responsible for the coordination into a workable overall design unique to the construction method. The firm, Marine Consultants & Designers, Inc. with headquarters in Cleveland, Ohio, became a wholly owned subsidiary of Litton Industries during the construction phase of the project and later separated from Litton to again become independent naval architectural consultants and designers.

The coordination of the construction work in the two widely separated shipyards, the joining of the two sections, and the making of the new ship available for service at cost savings in both construction and operation is due to the management and engineering of the three awardees.

INNOVATIVE DESIGN

The CORT, pictured in Figure 2, was the first ship designed to take full advantage of the larger vessel dimensions permitted by the new Poe Lock at Sault Ste. Marie. The fact that the ship was built at a newly established, automated ship assembly facility offered the opportunity to incorporate many innovative design features. The vessel set the pattern for the additional 1000-foot ships that were subsequently constructed. Highlights of some of the major innovations and unique features follow.

FIGURE 2. The M/V STEWART J. CORT sails by the city of Detroit on first trip in May 1972.

HULL

1. **New Longitudinal Hull Strength Standards.** Strength standards current at the time were considered adequate for shorter vessels but no guidelines were available for Great Lakes vessels of this size at the time the design began. The design team worked closely with the Great Lakes International Load Line Committee to develop interim criteria based on fundamental structural principles that supplanted the previous Classification Society strength requirements. These criteria form the basis for the Classification Society rules currently in effect.

2. **Extensive Use Of High Tensile Steel.** Higher strength steels were used in the upper and lower flanges of the hull girder to reduce the light ship weight and gain 1,000 long tons of cargo over the use of conventional steel.

3. **Hull Form.** The vessel initiated the very full hull form and rudimentary cylindrical bow on Great Lakes vessels that led the way to increased displacements and deadweights and the even more pronounced cylindrical bows now common on recently built lake vessels. The profile and the midship section of the vessel are shown in Figure 3.

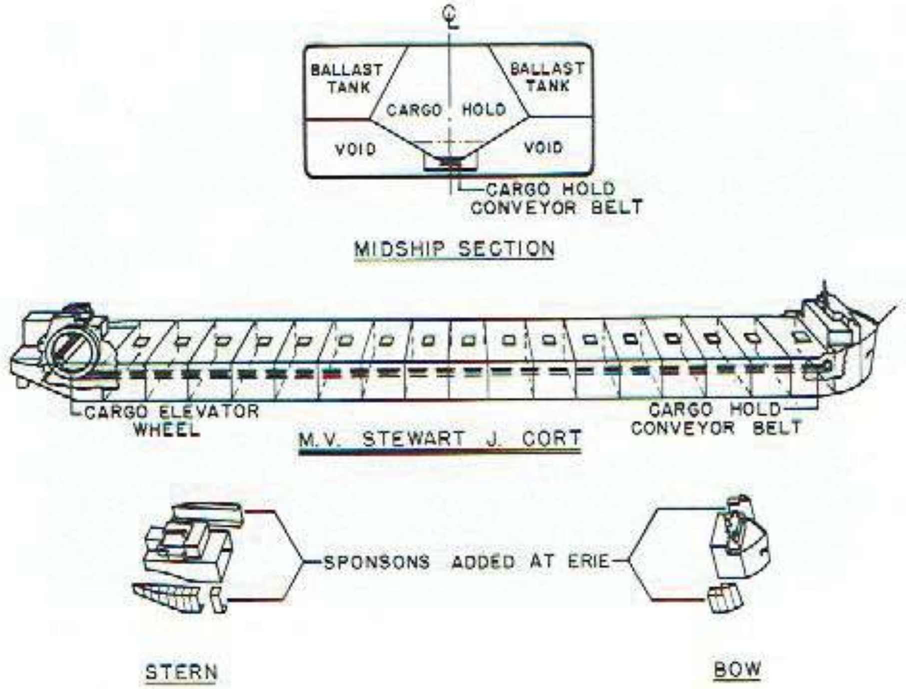


FIGURE 3. This isometric view of the M/V STEWART J. CORT shows the single cargo hold conveyor which carries cargo to the elevator wheel at the stern of the ship for transfer to the shuttle unloading boom.

The midship section of ship shows the unloading conveyor belt at the center of the cargo hold with water ballast tanks in the upper spaces, port and starboard. The lower spaces port and starboard are voids.

Sponsons were added to the bow and stern after the arrival of "STUBBY" in Erie, Pennsylvania and are shown schematically at the lower left and right. St. Lawrence Seaway limitations prevented "STUBBY" from locking through to the Great Lakes from the Atlantic at the full, final beam of the finished vessel.

4. **The First Vessel To Have Both Bow And Stern Thrusters.** The wind effect on such a large vessel, where the exposed or "sail" area is greater than the underwater area due to the restricted shallow draft, is critical in negotiating the many narrow and restricted channels on the Great Lakes, particularly those encountered in the Soo area. The need and the effectiveness of the thrusters are shown graphically by Figure 4. The four fixed pitch thruster units (two forward and two aft), combined with the twin screw configuration, one of which is shown in Figure 5, helped to provide a hull that is efficient, vibration free and one which has excellent maneuverability.

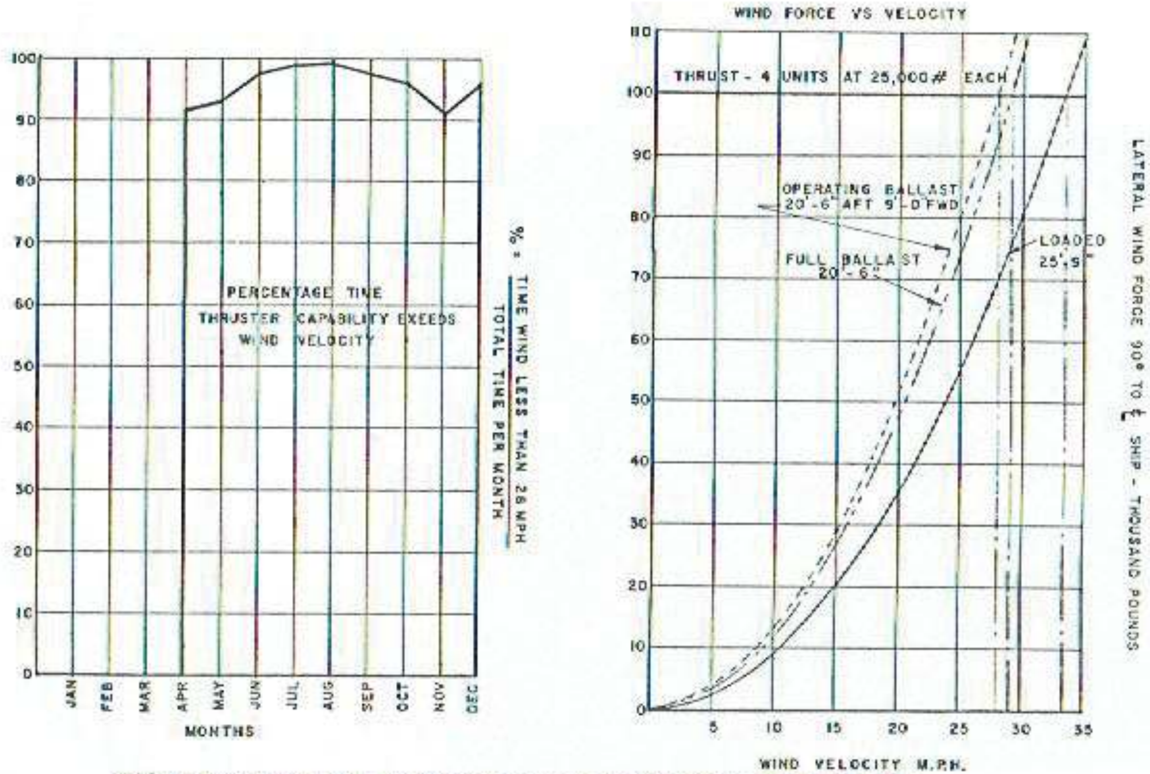


FIGURE 4. Extensive model tests were conducted to measure the thrusters' capability. The maximum beam wind against which the thrusters can hold the vessel for three different draft conditions is shown above. A review of the wind history data indicated that the thrusters are fully effective an average of 94 percent of the season.

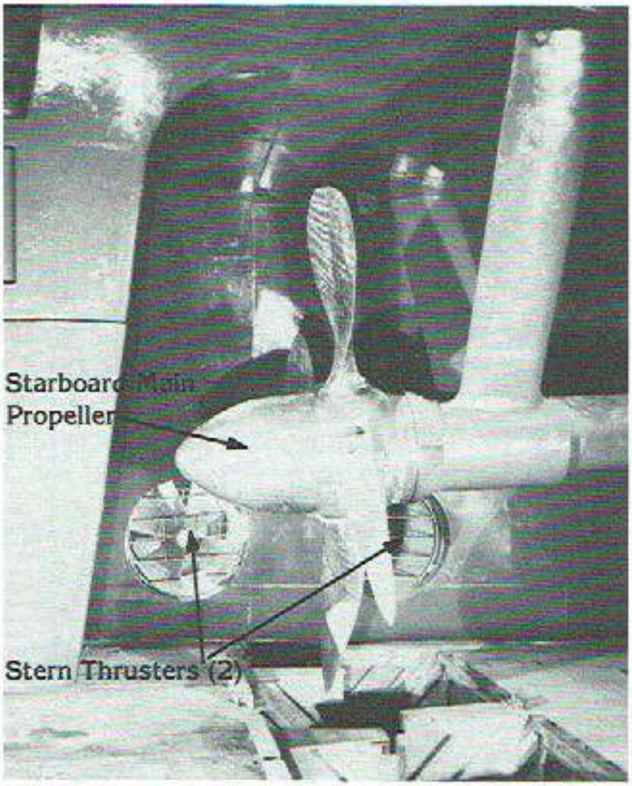


FIGURE 5. The first stern thruster installation on a large ship consists of two propellers electrically driven providing 2,000 HP from the aft portion of the ship and controlled from the pilothouse. A similar arrangement is provided in the bow giving the vessel 4,000 HP of thruster capability.

MACHINERY

1. **A New Concept In Main Propulsion Machinery And Installation.** The power plant consists of four locomotive diesel engines with standard locomotive generators which supply all propulsion and electrical power needs (Figure 6). Each is mounted on a common skid foundation for easy exchange of equipment. They were manufactured by the Electro-Motive Division of General Motors and consist of essentially standard production line components, providing for easy and economical maintenance. The basic prime mover output of the main engines is programmed to completely satisfy the power needs of the vessel operation; it fulfills multiple function requirements underway and at dockside by providing 14,000 shaft horsepower; rectified electrical D.C. power for bow and stern thrusters, and unloading and electrical A.C. power for ballasting and ship's

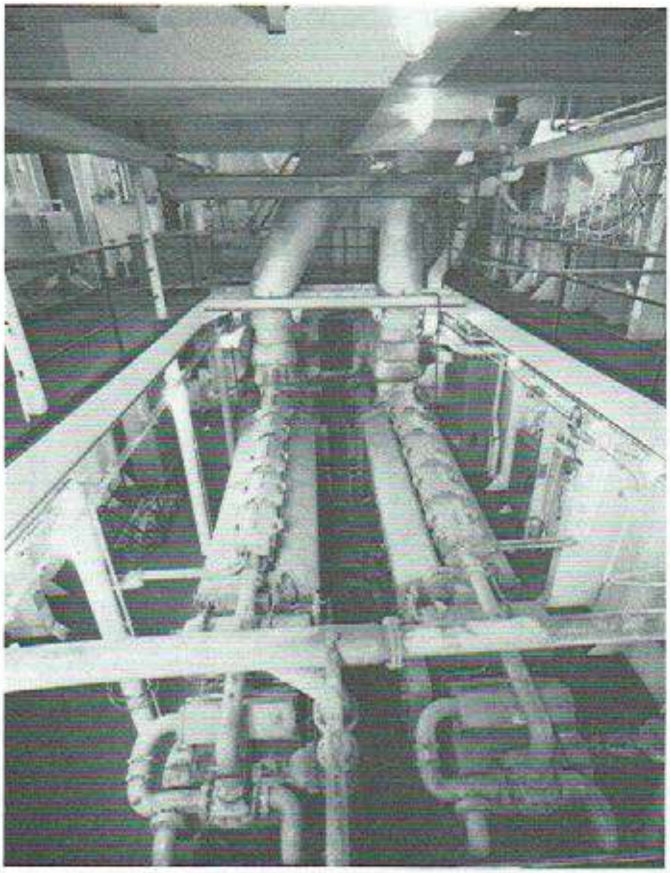


FIGURE 6. There are two main engine rooms separated by the unloading rotary elevator and its casing (not shown in photo). Pictured above is the Port Engine Room showing the twin EMD main diesel engines.

service use. Figure 7 shows three modes for the power plant operation with the propulsion mode shaded.

2. **A Unique, Efficient And Rapid Ballasting System.** The system uses a single intake and single discharge pump for each of its 18 ballast tanks. All valving has been eliminated with the exception of one shut-off valve at the sea connection for each tank. The ballast system is capable of pumping in at a rate of 12,500 L.T./Hr. and discharging at rate of 14,500 L.T./Hr.; the vessel can be completely dewatered in about three hours. The ballast tank bottoms are sloped and free of all internal stiffeners to ensure interference-free flow to the sumps for deballasting and removal of the mud that enters the tanks with the ballast water. The sea connections are conical in shape and eliminate the necessity of layup fittings for greasing and steaming out.

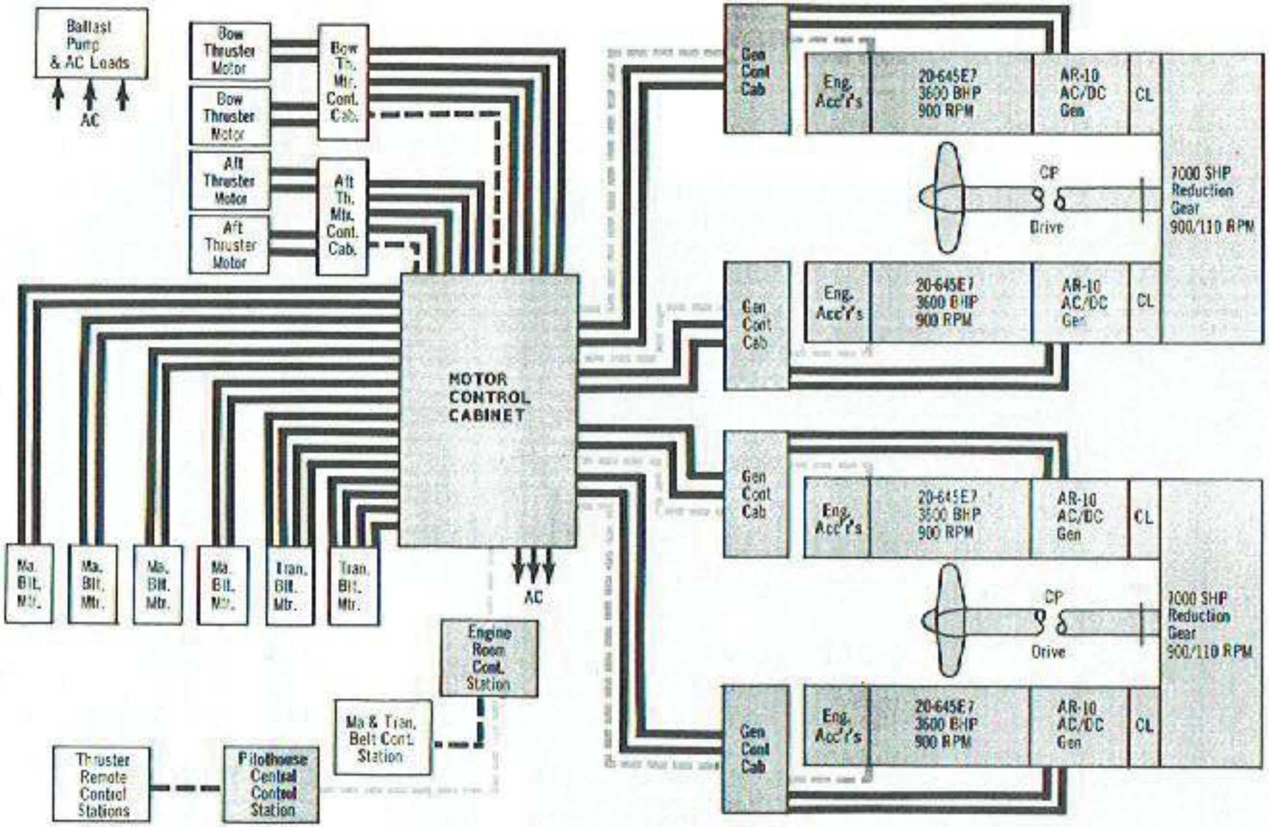


FIGURE 7. There are three basic modes of the vessel's power plant operation. The four main diesel engines furnish power for propulsion, maneuvering and unloading. The shaded areas in the above figure indicate the equipment that is in use during the propulsion mode.

3. **A Fully Automated Unloading System With Single Man Control.** The unloading system was designed by Litton's Hewitt-Robins subsidiary and provides an unloading rate of up to 20,000 L.T./Hr. This was the highest incorporated in any vessel constructed prior to the CORT (Figures 8, 9 and 10). This, together with other automated features incorporated in the vessel, allows for a reduced crew and fast turnabout times. The main components of the unloading system consist of 105 specially designed metering feed gates, a single 10-foot wide steel cord conveyor belt, a 60-foot diameter wheel elevator, a 98-foot long, 10-foot wide transverse boom conveyor, and a centrally located programmed control station.

FIGURE 8. Pictured above is the unloading of iron ore pellets during testing at Erie, Pa. The unloading boom projects from the stern section of the ship and is capable of complte withdrawal within the sides of the ship. The unloading system on the vessel is designed for controlled output tonnage of a maximum 20,000 L.T./Hr. either into a hopper or to a dock surface.

FIGURE 9. The unloading control station is located on certerline aft and provides good visibility of the boom point in its extended, unloading position and houses the control console pictured above. The boom is extended or retracted at this point, the unloading rate set and maintained, the conveyor operated, and the feed gates opened and closed.

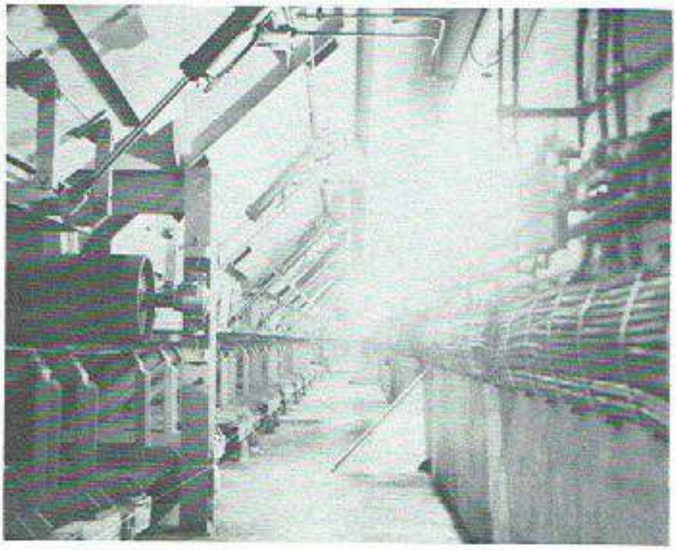


FIGURE 10. The longitudinal conveyor belt tunnel extends on centerline under the cargohold throughout its length. The belt is fed by 105 metering type gates. It operates at 600 feet per minute for unloading rates below 12,000 L.T./Hr. and at speeds varying between 600 and 1,000 feet per minute for rates from 12,000 to 20,000 L.T./Hr.

CONSTRUCTION

The parallel middle body of the vessel was designed to be constructed of seventeen 48-foot long sections, or modules. These were successfully joined, each to its adjacent module, all at one massive interior work station, until 816 feet of mid-body stretched from the protected work station into the adjacent exposed graving dock. The manufacturing took place at the Erie Marine shipyard in Pennsylvania, a yard arranged for production line flow utilizing highly automated equipment and assembly procedures, which allowed the use of mass production techniques in the building of the standardized modules. This resulted in a substantial reduction in labor man-hours per ton of steel erected. The modular construction technique was developed and patented by Richard A. Myers, now deceased, of Litton Industries. The automatic welding of panels is shown in Figure 11 and the unique construction method of module fabrication and rotation is shown in Figure 12.

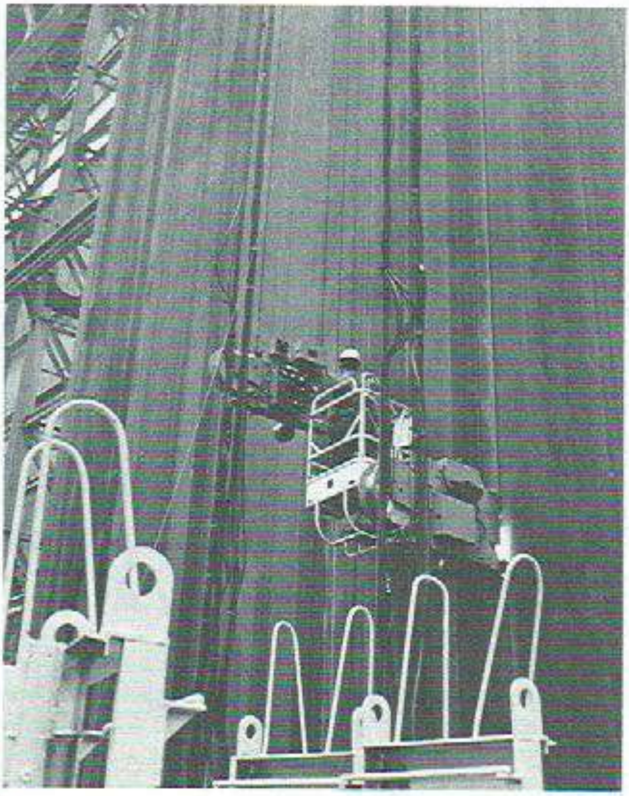
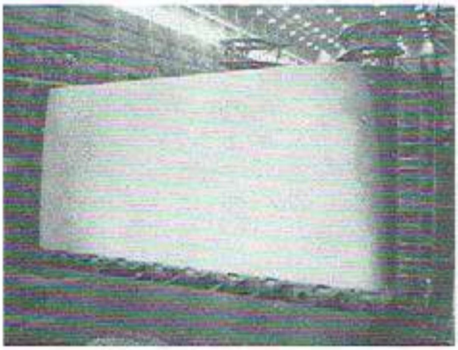
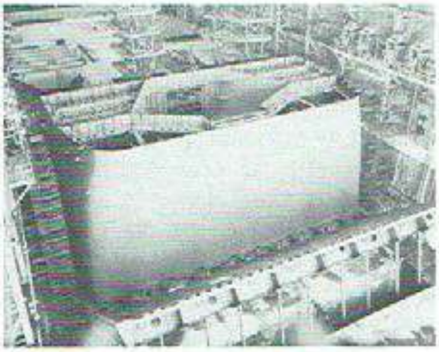


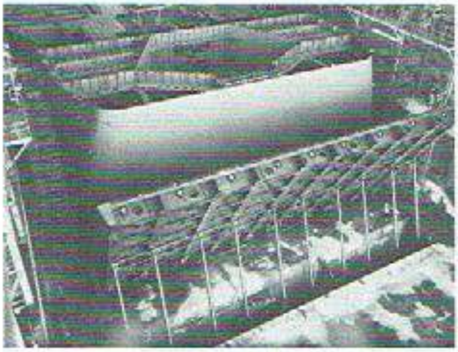
FIGURE 11. Automatic electro-gas panel welding allowed the welding of adjacent plate without beveling, thereby reducing cost and man-hours.



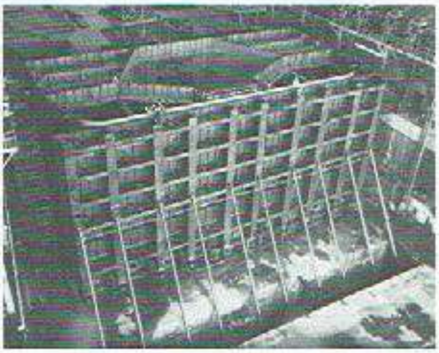
MODULE READY FOR ROTATION



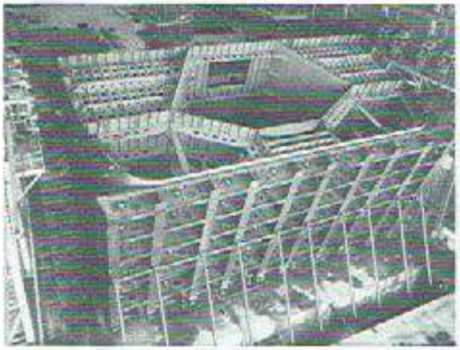
LAUNCH PLATEN RISES TOWARD MODULE



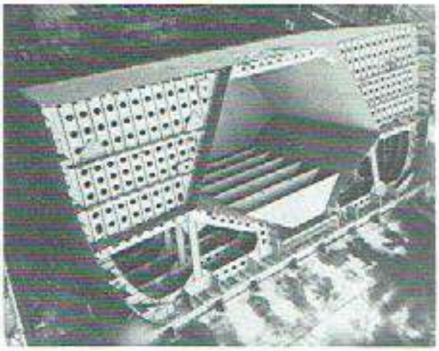
LAUNCH PLATEN NEARS MODULE



LAUNCH PLATEN IS SECURED TO MODULE



MODULE IN ROTATION TO GRAVING DOCK FLOOR



MODULE NEARS GRAVING DOCK FLOOR

FIGURE 12. The unique construction method with the module oriented vertically allowed the use of the electro-gas process of welding. It facilitated the positioning of subassemblies and it permitted the concentration of labor and tools in a small area.

Construction operations, without the repeatable production line characteristics of the mid-body and which were not amenable to these mass production and automation methods, were confined to the bow and stern areas. These were built at Litton's Ingalls conventional shipyard in Pascagoula, Mississippi. The bow and stern portions were designed to match each other, as well as their connecting points on the mid-body, so that they could be, and were joined as an integral vessel. This 184-foot long vessel, known as "STUB-BY", sailed under its own power from Pascagoula, via the Atlantic Ocean and the St. Lawrence Seaway, to Erie, Pennsylvania (Figure 13). There it was separated and joined with the mid-body to form the completed 1,000-foot vessel.

FIGURE 13. The bow and stern sections were constructed in Pascagoula, Mississippi by the Litton Ingalls Shipyard and were joined to make a ship capable of sailing from the Gulf along the Atlantic Coast and into the St. Lawrence Seaway to be joined with the mid-body at Erie, Pennsylvania.

BIOGRAPHIES OF THE AWARDEES

RICHARD K. QUINN

Richard K. Quinn was born January 2, 1929 in Tacoma, Washington. He was graduated from the University of Washington with a B.A. degree in 1952 and a J.D. degree in 1955. He also did graduate work in law at the University of Southern California in 1965 and 1966. He became a member of the general counsel's staff at Litton Industries in Beverly Hills, California in 1964 after several years of private practice. He became involved in Litton's project to develop a 1,000-foot self-unloading ore carrier for service on the Great Lakes, when Litton asked him to head the development project in 1967. While he served in this capacity, the STEWART J. CORT was purchased by Bethlehem Steel Corporation. As President of Litton's Great Lakes Corporation and Project Director for Litton's Great Lakes program, Mr. Quinn coordinated the activities of Marine Consultants & Designers, Inc. and Litton's Erie, Pennsylvania shipyard in developing and building the 1,000-foot carrier. Mr. Quinn is now engaged in the private practice of law in Eugene, Oregon. He is a member of the Washington, California, Oregon and American Bar Associations, and The Society of Naval Architects and Marine Engineers.

CARLTON E. TRIPP

Carlton E. Tripp was born April 4, 1918, in Huntington, West Virginia. He was graduated from the U.S. Naval Academy with a B.S. degree in 1941. He served as an officer in the U.S. Marine Corps throughout World War II. He obtained an M.S.E. degree in Naval Architecture and Marine Engineering from the University of Michigan in 1950 and spent a year in the Machinery Scientific Section of Ingalls Shipbuilding Corporation before joining Marine Consultants & Designers, Inc. in 1951. He was appointed Chief Engineer in 1952, Vice President and General Manager in 1955, and served as President from 1959 to January 1985. He is now Chairman of the firm.

He was Chairman of The Society of Naval Architects and Marine Engineers' Technical Panel HS1-2 which studied the wave stresses on Great Lakes ships. It was the work of this panel that made important contributions to the establishment of the present strength standards for the 1,000-foot Great Lakes vessels.

In addition to membership in the Society of Naval Architects and Marine Engineers, Mr. Tripp is a member of the American Society of Naval Engineers, the American Bureau of Shipping Great Lakes Technical Committee and Propeller Club of America. He is a Registered Professional Engineer and former council member of The Society of Naval Architects and Marine Engineers, the National Society of Professional Engineers, and the Ohio Society of Professioal Engineers. He also is a past chairman of The Society of Naval Architects and Marine Engineers Great Lakes Section.

GEORGE H. PLUDE

George H. Plude was born April 12, 1932, in New York, New York. He attended Webb Institute from 1950 to 1953 and the University of Michigan from 1953 to 1954, graduating with a B.S.E. in Naval Architecture and Marine Engineering. He was an officer in the U.S.Navy and served on active duty as a naval aviator from 1954 to 1958. He is currently a Lieutenant Commander in the Naval Reserve. He joined Marine Consultants & Designers, Inc. in 1958 as a naval architect, served as a Project Manager, was promoted to Chief Naval Architect in 1972, to Director of Engineering in 1978, and to Vice President in 1985.

Mr. Plude is a member of The Society of Naval Architects and Marine Engineers and a Fellow of the Royal Institute of Naval Architects. He is a Registered Professional Engineer and Past Chairman of the Great Lakes and Great Rivers Sections of The Society of Naval Architects and Marine Engineers.

Previous Elmer A. Sperry Awards

1955 to *William Francis Gibbs* and his Associates for development of the S.S. United States.

1956 to *Donald W. Douglas* and his Associates for the DC series of air transport planes.

1957 to *Harold L. Hamilton, Richard M. Dilworth and Eugene W. Kettering* and Citation to their Associates for the diesel-electric locomotive.

1958 to *Ferdinand Porsche* (in memoriam) and *Heinz Nordhoff* and Citation to their Associates for development of the Volkswagen automobile.

1959 to *Sir Geoffrey De Havilland, Major Frank B. Halford* (in memoriam) and *Charles C. Walker* and Citation to their Associates for the first jet-powered aircraft and engines.

1960 to *Frederick Darcy Braddon* and Citation to the Engineering Department of the Marine Division, *Sperry Gyroscope Company*, for the three-axis gyroscopic navigational reference.

1961 to *Robert Gilmore Letourneau* and Citation to the Research and Development Division, *Firestone Tire and Rubber Company*, for high speed, large capacity, earth moving equipment and giant size tires.

1962 to *Lloyd J. Hibbard* for application of the ignitron rectifier to railroad motive power.

1963 to *Earl A. Thompson* and Citation to his Associates for design and development of the first notably successful automobile transmission.

1964 to *Igor Sikorsky* and *Michael E. Gluhareff* and Citation to the Engineering Department of the Sikorsky Aircraft Division, *United Aircraft Corporation*, for the invention and development of the high-lift helicopter leading to the Skycrane.

1965 to *Maynard L. Pennell, Richard L. Rouzie, John E. Steiner, William H. Cook* and *Richard L. Loesch, Jr.* and Citation to the Commercial Airplane Division, *The Boeing Company*, for the concept, design, development, production and practical application of the family of jet transports exemplified by the 707, 720, and 727.

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