

CORPORATE RESUME

C. R. CUSHING & CO., INC.

**Naval Architects, Marine Engineers &
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INTRODUCTION

C.R. Cushing & Co. is a firm of naval architects, marine engineers and transportation consultants, founded in New York in 1968. Over intervening years, the company has had branch offices in the U.S. (New Jersey), overseas subsidiary companies (Hamburg; Madrid, Piraeus), and foreign field offices (Korea; Spain, Japan).

C.R. Cushing & Co. has designed over 250 vessels that have been built in the U.S. and abroad. These vessels currently constructed and other vessels designed have main propulsion plants amounting to over 3,000,000 horsepower. We have been involved with vessel construction in more than 200 shipyards worldwide. Along with overseeing ship construction, we've performed conversion and repair negotiations with many of these shipyards. Our projects have involved analyses of shipbuilding methods, design services for shipyards, manufacture design of sub-assemblies, repairs, conversions, etc. In addition, C.R. Cushing & Co. has carried out analyses of shipbuilding industries and shipyards throughout the world to identify their strengths and weaknesses and presented solutions to our clients.

The company has designed, overseen building, converted and/or worked on all types of vessels: Passenger ships, Cruise ships, Motor Yachts, Containerships, Roll-on/Roll-off vessels, Container Feeder ships, Car Carriers, Crude and Product Tankers, Gas Carriers, OBOs, Offshore Oil Production vessels, Pipe Laying vessels and barges, Tank barges, Bulk Carriers, Chemical Carriers, Refrigerated Cargo ships, Heavy-lift ships, etc.

Our projects have involved all phases of ship design, ranging from concept and preliminary design to plan approval, construction supervision and contract management. Specific areas of our involvement include: the development of vessel arrangements and structural design; ship motions and loading; design of cargo handling equipment and arrangements; propeller design and propulsion analyses; heat balances and piping studies; design of electrical, HVAC, fire protection, navigation and communications systems; vibration calculations, structural and damage surveys; preparation of planned maintenance systems; design and implementation of condition monitoring, loading manuals, operating manuals and other shipboard support studies; and much more.

Conversion design work has included lengthening, widening and deepening hulls, adding sponsons, widening hatch openings, relocating bulkheads, removing and adding decks, re-engining, reflagging, relocating and rebuilding superstructures, strapping and strengthening ships.

In addition to traditional ship design work, CRC&Co. has performed ship valuations and cost estimating, economic analyses, safety audits, risk analyses, environmental impact assessments, port and terminal design and development, container design, and studies covering subjects such as transport, vessel stability, propulsion, intermodal logistics, energy conservation, and marine operations.

C.R. Cushing & Co. has carried out over 3,000 projects of varying size and type for both the private and public sector. Private sector work has included clients such as ship operators, leasing companies, major shippers, oil companies, shipping and railroad companies, and utilities. Among our public sector clients have been many agencies of the US government, including the U.S. Coast Guard, the U.S. Navy, the U.S. Army, the Environmental Protection Agency, etc., port authorities, municipal and state governments, foreign governments, as well as standards and safety organizations with international jurisdiction.

While the work CRC&Co. has performed has been extensive, our commitment to client satisfaction is paramount and is pursued on all projects.

CORPORATE FACILITIES

C. R. Cushing & Co., Inc. is conveniently located in downtown Manhattan, in the heart of the New York area shipping community. Classification societies, ship owners, shipyard sales offices, marine equipment salespeople and various marine services are often within walking distance, or located nearby in New Jersey or Connecticut. Three major local airports allow easy transportation anywhere in the world at short notice.

Within the office C. R. Cushing & Co., Inc. has extensive computer capabilities to support and enhance all the naval architectural, engineering and consulting services it offers. Our state-of-the-art computers and naval architectural computer software allow quick and detailed analysis of hull volumes, weights and moments, measures of stability, speed and power prediction, etc. Also the latest editions of computer aided design (CAD) software are used for drawing development. These programs enable our draftsmen, naval architects and engineers to provide drawings to our clients in both two and three dimensions. In addition to these programs the company utilizes a large library of software to meet our client's needs such as finite element analysis for structural design and analysis, pipe network analysis for pipe flow problems, container and trailer restraint system design and analysis, vibrations, ship speed and propulsion analysis, project management for PERT/CPM analysis and other requirements. Our engineers are all equipped with lap-top computers to use in the field at shipyards, surveying aboard ships, or when traveling so they are never out of touch with the office.

In the course of forty years of business, C. R. Cushing & Co., Inc. has compiled an excellent library of books, annuals and other references on ship design and construction, containerization, intermodalism, general shipping subjects, port operations and terminal design, oceanography, ship's systems, naval subjects, general engineering practice and much more. The library also receives an abundance of international periodicals dealing with marine and marine related subjects. Useful information is also available from the thousands of files of past projects, research conducted for previous proposals, and the extensive collection of subject files and product literature.

TYPICAL PROJECTS -- Dry Cargo Vessels

- The design and construction supervision of the world's largest dry cargo containerships (12 vessels) in South Korea for U.S. Lines.
- The jumboizing of twelve large containerships, which included a coarse and fine mesh FEA analysis of entire ship in Japan for Sea-Land Service.
- Design for the reconstruction of a fleet of tankers into containerships.
- Conversion of Lighter Aboard Ship (LASH) ships into containerships.
- The design and construction supervision of a fleet of Ro/Ros, with the first diesel PTO-driven generator.
- Conversion of a fleet (eight ships) of the world's fastest merchant ships to naval auxiliary vessels.
- Prepared the concept design, contract specification and design, provided technical drawing review and supervised the sea trials for two 47,000 DWT Self-Unloading Bulk Carriers for Gypsum Transportation Limited.
- Develop conversion of a large containership of a Pre-positioned Logistics Support Vessel for the U.S. Marine Corps.
- Provided technical assistance, plan approval, and yard construction supervision of three new vessels for trans-Atlantic service, including the supervision of loading and container handling in all ports on the maiden voyage.
- Design and calculations, including preparation of specifications and contract plans, and solicitation of shipyard bids, for a mass-produced standard containership with numerous unique and patentable features, for a European steamship company.
- Provided design, plan approval, and construction of two classes of nine reefer ships built in Spain for an international fruit company.
- Prepared specifications and contract plans, gave general technical assistance, supervised yard construction, and inspected a fleet of high speed containerships, constructed in Germany for German owners.
- Prepared design and specifications, and supervised the construction of four large containerships, built in Korean yards for Korean owners.
- Supervised the construction of a high-tech combination reefer shipyard/automobile carrier in Japan. Provided considerable after-delivery support to insure proper operations of sophisticated refrigeration system and hydraulic car platforms and ramps.
- Developed contract design for large catamaran ro-ro barges.
- Developed preliminary steel weight and cost estimates for the conversion of four tankers to containerships.
- Evaluated new construction and conversion alternatives of self-propelled vessels, integrated tug-barges, and deck barges for a rail car ferry operation.
- Perform preliminary designs of rail car ITB and self-propelled vessel for short sea service.
- Prepared preliminary design studies for a post-Panamax containership for a U.S. container operator.
- Studied trim and stability on refrigerated cargo/container ships to analyze possible enhancements to container capacity.
- Analyzed and developed solutions to bottom shell cracking problems on a class of eight containerships.
- Plan review, calculation verification, structural design, and other aspects of detail design review to support Quincy Shipbuilding in converting the SL-7 class containerships to meet Military Sealift requirements as a TAKRX.
- Plan review, calculation verification, and specification review in support of American President Lines' offer for the conversion of C5 cargo ships to meet Military Sealift Command requirements as TAKRX pre-positioned ships.

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- Conducted design, specifications, plans, and engineering of the Roll on/Roll off vessel the *M/V Cape Edmont* for sale to the U.S. Federal Government.
- Plan review, design, and specification for the modification of LASH-type vessels to meet U.S. military requirements.
- Studied the conversion and reflagging of foreign-flag Roll on/Roll off vessels to U.S. flag specifications for the U.S. Maritime Administration.
- Conducted design, specifications, plans, and engineering for the reflagging of The *M/V American Eagle* to U.S. Coast Guard and American Bureau of Shipping standards for Military Sealift Command charter.
- Developed concept design for vessel to serve as a container crane transfer facility in conjunction with non-sustaining containerships to meet proposed requirements for the U.S. military.
- Conducted design, specifications, plans, and engineering for the reflagging and deck modification of the *M/V American Cormorant* to U.S. Coast Guard and American Bureau of Shipping standards for use as a Military Sealift Command chartered semi-submersible, heavy-lift vessel.
- Performed analyses of ro-ro decks to determine compliance with vessel charter requirements.
- Developed steel weight and cost estimates for ro-ro barge modification options to increase cargo capacity.
- Carried out rudder force and torque calculations to confirm suitability of rudder pintle dimensions.
- Developed a lashing system for two containerships chartered by the Military Sealift Command.
- Guided procurement of 3,500HP harbor tugboats for a Port Authority.
- Carried out numerous modifications of hatch covers and container restraint systems to suit new combinations of container stowage.
- The design (and patents) for a unique reel pipe laying vessel.
- The design of an oil spill recovery vessel.

TYPICAL PROJECTS -- Product, Crude, and Chemical Carriers

- Carried out major conversion and upgrading of a product/chemical tanker to new vessel standards of the U.S. Coast Guard, including the joining of a tanker stern to an ITB forebody.
- Prepared conversion designs for several classes of tankers.
- Carried out reconstruction design of 120,000 ton deadweight tankers from single to double hull configuration.
- Prepared concept design of a forebody for a class of 125,000 ton deadweight tankers.
- Carried out design of 20,000 ton deadweight tankers for U.S. flag operation.
- Developed design of double hull VLCC's.
- Evaluated several existing single hull tankers for operation in U.S. jurisdiction, including determining options for modification to carry desired products.
- Designed a 225,000 ton deadweight double hull oil tanker.
- Carried out the design, shipyard drawing review and construction supervision of a fleet of OBOs.
- Designed and supervised the construction of an 80,000 DWT OBO, with the first Sulzer RTA diesel.
- Prepared plans and specifications, and carried out technical, safety and environmental studies for the construction of three 125,000 cubic meter LNG vessels.
- Carried out preliminary design for lengthening of a U.S. flag oil tanker.
- Performed preliminary design of a 30,000 DWT clean product tanker for a U.S. owner.
- Developed conversion designs for tankers to meet requirements of IOPP and MARPOL, including implementation of inert gas systems, segregated ballast systems, spill detection systems, crude oil washing and crew training procedures.
- Carried out plan approval for a 40,000 barrel double hull tank barge.
- Determined suitability of various noxious liquid substances (NLS) with the features of existing product or chemical carriers and advised about the modifications which would be necessary to carry the desired product.
- Prepared a design for the conversion of a petroleum tanker to a sulfur tanker.
- Developed preliminary and contract design for a 24,000 ton deadweight, U.S. flag sulfur carrier; carried out shipyard bid analysis, and negotiated specifications
- Carried out numerous on tanker damage and condition surveys on tankers.
- Analyzed the circumstances concerning the sinking of several tankers.
- Prepared re-engining studies on several tankers.
- Investigated the conversion of a tanker for the transport of tallow.
- Developed a fendering system for a class of OBOs.
- Performed preliminary concept design for conversion of a product carrier to an asphalt carrier.
- Evaluated a class of new tankers for a major ship financing institution.
- Investigation and repair of a major structural failure in a double bottom hull of an ITB tank barge.
- Prepared tank barge cargo oil heating retrofit with thermal fluid system.
- Redesign the rudder on a VLCC.
- Designed a floating storage tanker.
- Carried out a survey of floating storage tankers.
- Studied the corrosion rates in tankers.
- Studied and surveyed a VLCC for causes of contamination of product cargoes.

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- Designed a series of oil spill recovery vessels, oil spill pick-up equipment, and oily water separators.
- Provided inspection and owner's representation for re-activation of LNG carriers.
- Concept design development of a 20,000 - 30,000 DWT clean product tanker to meet the requirements of the U.S. Navy's Replacement Program.
- Obtained U.S.C.G. approval of vapor recovery system installed on a tanker.
- Prepared tanker freeboard calculation.
- Prepared damage stability response system for a fleet of LNG tank vessels.
- Provided technical assistance on the first series of Double Eagle Tankers.

TYPICAL PROJECTS -- Ferries and Passenger Vessels

- Prepared a preliminary design for a 2,200 passenger cruise ship for an American company.
- Performed surveys, ship evaluations, and modification designs of the U.S. flag passenger ships *S.S. Constitution* and *Independence*.
- Carried out survey and conversion design of the *S.S. America*.
- Provided technical services relating to the preliminary design of a 300 passenger ferry.
- Prepared preliminary design, specifications, working drawings and yard supervision in the conversion of the *Theodore Herzog* to the cruise vessel *Mardi Gras*.
- Prepared plans and specifications for the conversion of a cargo vessel for the Eastern Mediterranean.
- Carried out design and specification negotiation, plan approval, and construction supervision of a 35 meter luxury motor yacht.
- Conducted technical and safety assessments aboard *SSC Radisson Diamond*, the world's first SWATH cruise ship.
- Conducted condition surveys and feasibility studies for the sale of passenger vessels for use in the Mediterranean Sea as a foreign flag vessel.
- Carried out on-hire survey of *Vera Cruz I* and condition survey of *T.S.S. Santa Rosa* for Bermuda Star Line.
- Review design and approve plans for Hong Kong high speed ferries.
- Condition survey of the *M/V Independence*, 138 passenger commuter ferry converted from a crew boat, to determine the suitability of ferry operation in New York harbor.
- Surveyed numerous passenger ferries as candidates for conversion for a ferry in the Port of New York.
- Conducted safety and technical assessments aboard various cruise ships for Commodore Cruise Line.
- Conducted both safety and technical assessments aboard the cruise ship *M/V Future Seas*.
- Developed and approved design of sponsons and modifications to a 40 year old passenger vessel to meet statutory requirements.
- Analyzed intact and damage stability aspects and provided technical support in arbitration concerning a major modification of a passenger ship.
- Supervised stability test, prepared sea trial agenda, supervised sea trial, prepared sea trial report and maneuvering diagrams and information for navigation of a modern cruise ship.
- Evaluated the stability and supervised the stability test of a 63 ft. passenger ferry for U.S. Coast Guard approval.
- Measure and evaluate stern and shaft vibrations on the *S.S. Caribe*.
- Surveyed existing and analyzed proposed ferry services between Yucatan and Cozumel.
- Obtained U.S. Coast Guard approvals for ferry *Oliver Twist*.
- Accomplished contract design for modernization of steering system of the U.S. Coast Guard Governor's Island ferry *M/V Tide*.
- Surveyed and prepared valuations of U.S. ferries for a major U.S. bank.
- Performed preliminary conversion design of a crew boat to a ferry.
- Studied feasibility of a high speed steel U.S. flag car ferry.
- Provided contract design, general arrangement, and specifications to the National Park Service for an all-weather ferry in New York Harbor.
- Provided design services for modification of prison ferries at Riker's Island for the New York City Department of Corrections.
- Provided engineering services to RCCL for cruise vessels *Sovereign of the Seas* and *Monarch of the Seas*.

TYPICAL PROJECTS -- Hull Form, Stability, Sea keeping, & Maneuvering Studies

- Developed alternative hull forms for comparative evaluation of resistance, propulsion, sea keeping, ship motions, and maneuvering characteristics for numerous ship design projects.
- Carried out sea keeping studies on a large, oceangoing catamaran.
- Supervised parametric tests on optimum bulbous bow forms for a variety of ships.
- Developed different stern form designs, including conventional waterline flow and buttock flow (Pram) type sterns.
- Carried out systematic studies and model tests to develop optimum trim.
- Carried out designs, investigations and model tests on a series of broad beamed, large containerships with pram-type sterns.
- Designed vessels for various grades of ice class.
- Prepared model test agenda for each phase of hull form design for many projects.
- Evaluated model test facilities for conduct of model testing on several occasions based upon the model test agenda contemplated.
- Evaluated model test quotations and carried out selection of model test facility on many different projects.
- Worked with major model test facilities of the world, including MARIN (Wageningen), HSV A (Hamburg), SSPA (Gothenburg), IHI (Yokohama), MHI (Nagasaki), the University of Michigan (Ann Arbor), and Davidson Laboratory (Hoboken).
- Evaluated model test results and prepared corresponding performance predictions.
- Carried out study of different thruster arrangements for evaluation of necessary ship maneuvering capability.
- Carried out numerous evaluations of maneuvering capability based on principal particulars and rudder type and area.
- Evaluated and selected thruster type and size based on vessel mission requirements and life cycle cost analysis.
- Performed calculations to reconstruct the tracks of vessels in shoal waters.
- Developed data on a number of vessels, including tankers and passenger ships on squat.
- Analyzed vessel performance, including power, speed, and vessel motions in varying ocean weather systems.
- Performed a systematic series of designs of breakwaters and bow forms for low freeboard vessels operating in waves.
- Analyzed the ship motions of containerships and compared with computer program predictions.
- Carried out wave refraction and diffraction calculations to assess wave height and period in marina.

TYPICAL PROJECTS -- Ports and Terminals

- Prepared the preliminary design for a large multi-use container terminal in New York.
- Planned, specified and acquired all container handling equipment and cranes for a New York terminal.
- Carried out the planning and Phase One design of a container terminal for Prince Rupert, Canada.
- Designed an automated ship unloading and rail container handling system.
- Designed barge mounted crane and container terminal system for Port Said, Egypt.
- Developed Container and refrigerated terminal facilities for Del Monte's ports in Central America and the U.S. East, Gulf and West Coast.
- Consultant to and part owner of container handling terminal facilities in New Orleans.
- Consultant to European Container Terminus (ECT).
- Consultant on numerous shipboard and shore gantry container cranes.
- company for an investment group, including all owned port and cargo handling facilities, all vessels, evaluation of the company management, and determination of the competitiveness of the company in future operations.
- Prepared a time and motion study relating to the loading and discharge of containers, using both shipboard and shore cranes for a large container operator.
- Carried out a survey of ports and terminal facilities for a new container operation, including an analysis of port charges, labor costs, new facilities costs, and transportation and distribution systems serving the ports.
- Prepared preliminary design of a container handling facility in Haifa.
- Developed the port development and expansion plans for Tin Can Island in Lagos, Nigeria.
- Performed the design of a marine terminal expansion including analysis of warehousing facilities, railroad spur access, traffic flow patterns, maintenance and repair facilities and cargo handling rates and throughput.
- Investigated and analyzed the loading and discharge operation of paper newsprint for the New York Daily News, at a consolidated plant, including the preparation of the design for equipment for discharging the ships, moving the paper into the warehouse, stacking the rolls, and automatically withdrawing the rolls from storage for automatic feed to the press rooms.
- Planned the development of a major oil terminal in the Virgin Islands.
- Studied the interface options between a rail car ferry and shore ramp.
- Carried out a study and design of specialized mechanical equipment to efficiently unload grain in bulk.
- Develop several alternatives for a trailer ramp for interface with a large ro-ro barge.
- Provided technical assistance in the conceptual design and layout of a marine container terminal for a terminal operating company.
- Performed research project for the U.S. Government for improving the efficiency of container terminals, including a detailed cost analysis of all costs in the containerization system external to direct marine costs.
- The design of crude discharge and product loading facilities for a 200,000 barrel per day refinery.

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- Performed a marine facility feasibility study for a major U.S. energy supplier including analyses of meteorological, climate and oceanographic data, geographic studies, ocean wave and current measurement surveys and marine environmental impact assessments for several proposed sites.
- Developed plans for the expansion of the port of San Juan, Puerto Rico.
- Provided consultation on the expansion of a floating tennis facility at the 79th Street boat basin and marina on the Hudson River in New York.
- Engineering oversight of an automated grain loading facility in Galveston including the design & manufacturing of spiral loaders, conveyers, bagging equipment, palletizers, etc.
- Engineering services in connection with the concept and contract design of a limestone port in Mexico handling 10,000,000 tons of stone per year.
- Technical, safety, operational and economic audit of bulk bauxite and alumina terminal.

TYPICAL PROJECTS -- Environment and Safety

- Prepared the Tankerman's Manual for the U.S. Coast Guard.
- Prepared oil spill response manuals.
- Studied the collision resistance of tankers.
- Developed oil pipeline inspection procedures for the U.S. Coast Guard including identification of oil spill risk components.
- Investigation of maneuvering deficiency for a 225,000 DWT tanker.
- Prepared of a tanker operations manual for a U.S. owner and operator.
- Carried out a study of the technical, environmental, safety and operations aspects of an offshore platform in 130 feet of water to receive tank vessels up to 500,000 DWT.
- Studied deep water port mooring (CALMS and SALMS) and crude oil transfer systems for the U.S. Department of Transportation.
- Development of an operating manual for a tanker company, including safety procedures, pollution control, regulatory requirements, spill containment and collection.
- Development of environmental criteria and guidelines to assess the environmental impact plan submitted as part of the oil purchase/transport contract for U.S. Department of Energy, Strategic Petroleum Office.
- Compared the damage stability characteristics of double hull and mid-deck/hydrostatically balanced concept tankers.
- Analyzed stability aspects of trunk deck double hull tankers.
- Design of trolley, wave maker and trolley towing winch system for the EPA's Oil and Hazardous Materials Test Tank facilities (OHMSETT) in New Jersey.
- Studied the operational intact stability difficulties of double hull tankers.
- Technical, environmental, safety, and operational aspects of single point mooring facilities for tankers up to 500,000 ton DWT at an offshore platform in 130 feet of water for the U.S. Coast Guard in 1979.
- Prepared a prevention and control program for oil pollution in the San Francisco Bay area for the California Water Control Board.
- Performed studies on existing ships to assess new IMO damage stability regulations for cargo ships.
- Conducted a container safety study for the U.S. Coast Guard, examining a variety of containers and rating their overall safety features, entitled "A Study of Intermodal Container Safety."
- Studied the reported on the relative resistance of FRP containers to sustain side and top panel damage and the suitability of FRP containers to carry hazardous materials.
- Conducted a dry cargo vessel subdivision study to International Maritime Organization safety regulations for the U.S. Coast Guard.
- Studied the problems related to tanker navigation in ice.
- Conducted a Roll on/Roll off vessel dry cargo subdivision safety study for the U.S. Department of Transportation/ Transportation Systems Center.
- Development of acoustic emission hose failure detection system for deepwater port including effects of environmental factors on system reliability and maintainability.
- Developed a computer simulation technique for risk evaluation to augment existing experimental simulation.
- Safety analysis for LNG terminal and marine facilities for the State of New Jersey.
- Performed analysis of LNG cargo handling to assess problem of product spills.
- Measurement of airborne asbestos on vessels in port and at sea.
- Measurement of toxic gases and indoor air pollution on vessel.

TYPICAL PROJECTS -- Containers

- Design and structural analysis on numerous types of containers, including dry cargo, tank, refrigerated, open top, folding, etc.
- Prepared purchase specifications, negotiated and/or acted as owner representative and inspectors for the procurement of thousands of containers for such companies as Sea-Land, Seatrain, Delta Lines, U.S. Lines, Columbus Lines, Fabre Lines, Meri Shipping, Maersk Lines, and many others.
- Inspected, type approved, load tested and damage surveyed, thousands of containers over the last 32 years.
- Developed container cranes, container straddle carriers, container spreaders, container power boxes, container dehumidification and refrigeration systems, stores containers, containerized test labs, containerized gas turbine transport system, container securing and restraint systems.
- Designed container factories in Ireland, India and Yugoslavia, and analyzed/evaluated such facilities in the U.S., China, Japan and elsewhere.
- Designed containers in aluminum, stainless steel, flat and corrugated steel, filament wound plastic, honey combed sandwich panel, and other materials.

Distinctions within the Container Industry

- The first to apply finite element analysis techniques to the structural analysis of containers.
- Dr. C. R. Cushing has been a member of the American Standards Committee continuously since 1960. This is the committee that developed the strength and dimensional standards for the ISO containers.
- Dr. C. R. Cushing has been a U.S. delegate to the International Standards Organization TC104 meetings over the last 38 years.
- Dr. C. R. Cushing has been a member of the American Bureau of Shipping container committee since its inception 18 years ago.
- C. R. Cushing & Co. has been delegated authority by the Commandant (G-MSO), U.S. Coast Guard, to approve containers as complying with the International Safe Container Act in accordance with Title 49, U.S. Code of Federal Regulations, Part 450, since 8 Sept. 1981.

TYPICAL PROJECTS -- Accident Investigations

- Study of the structural failure and sinking of a tanker for the Liberian government.
- Investigation, analysis and solution to bottom shell cracking problems on a class of eight containerships.
- Study and repair design of a major structural failure in a double bottom of an ITB tank barge.
- Study of the sinking of the tanker *Spartan Lady*.
- Investigation into the structural failure of a tanker which grounded in the Houston Ship Channel.
- Study of the grounding and damage to the tanker *Sea Saint*.
- Investigation of the corrosion rates of ULCCs and VLCCs.
- Investigation of the capsizing and subsequent sinking of containerships, including the *Munchen*, the *Poet*, and the *Tuxpan*.
- Studied the alleged grounding and total collapse of the hull girder of a tanker.
- Investigation of buckling and subsequent break up of a bulk carrier.
- Studied the alleged break up and disappearance of a four year old containership.
- Investigated the cause of the capsizing of a cruise ship subsequent to a grounding.
- Carried out several investigations of incidents where ocean barges had capsized or sunk while under tow.
- Investigated numerous cargo losses, cargo damages and personal injuries.
- Analyzed the arrangement of mooring lines and mooring line strength for containership on which mooring lines broke.
- Sinking of the Ukrainian bulkcarrier *Salvadore Allende*.
- Loss of containers containing highly toxic chemicals from the *Santa Clara*
- *Exxon Valdez* grounding and track analyses, causes for grounding, double hull analysis, testimony cases held in Anchorage and in Houston.
- *Sundancer* sinking analysis.
- The sinking of the *M/V Golden Chariot*.
- The loss of the tanker *Hawaiian Patriot*.
- Seaworthiness of the tanker *Alsterstern*.
- Risk analysis and testimony in asbestos and benzene cases.
- Causes for the grounding of the *M/V Mantinia*.
- Causes for the loss of the deck cargo from the *M/V Captain Panos*.
- A study of the fire on the passenger ship *Rotterdam*.
- Technical assistance concerning the charter party dispute on the *M/V Dan Xia Shan*.
- Technical analysis of the sinking of the tanker PRESTIGE.
- Analysis of the hull failure and sinking of the M/V MSC CARLA.
- Analyses on the fire and explosions on several vessels due to the spontaneous combustion of calcium hypochlorite.
- An analysis of the capsizing of the pilot boat GALTEX.
- A study on the cause of the sinking of the tanker PRESTIGE.
- Collision *M/V Virgo*
- Grounding *M/V White Sea*
- Stand alone (Independent) collision investigations involving these vessels: *Nirint Progress*, *Linda E*, *M/V Jorita*, and a Hess Barge.

OTHER PROJECTS

- Carried out numerous valuations of vessels of all types.
- Planned, scheduled, and conducted sea trials for numerous vessels of all types, including passenger ships, containerships, ro-ro ships, tankers, bulk carriers, tugs, tug-barge combinations, private yachts, etc.
- Instrumented vessels with accelerometers, pressure transducers, strain gauges, velocity flow meters, torque meters, revolution counters, etc. and reduced data for use in finite element and longitudinal stress programs.
- Performed wind tunnel tests on shore gantry cranes to obtain information about forces on tie-down forces, stability information and performance of equipment in high winds.
- Designed, built, and positioned buoys in selected locations near the coast of St. Croix to set up and record wave patterns and amplitudes over a three month period. This information was used to assess the most appropriate site for an oil refinery.
- Carried out numerous analyses of model tests using scale models of ship designs in developmental stages, including resistance, self-propulsion, open water propeller cavitation, sea keeping, and maneuvering.
- Developed data for and produced trim, stability, and loading manuals for vessels of all types, including computer programs.
- Performed an analysis of the shipyards of China and recommendations concerning modifications to individual yards and the Chinese commercial industry.
- Analyzed the shipbuilding industry of Argentina for a major bank.
- Surveyed and analyzed the shipbuilding industry of Turkey for a major bulk carrier owner.
- Obtained and reviewed proposals for the privatization of the Curacao Shipyard.
- A review of the plans, layout, work flow, production methods and shipbuilding equipment selection for a major South Korean shipyard.
- Carried out a detailed transportation study for the transportation of aggregate commodities between Central America and the U.S.
- Prepared transportation network model for comparing the economics of various transportation techniques and modes of different bulk commodities for development of an ITB operation.
- Designed and supervised the construction of a container manufacturing factory in Poona, India.
- Planning and analysis of a petroleum transshipment terminal in the Caribbean.
- Prepared conceptual design booklets describing various conversions of vessels for use as U.S. military transports (RRMS and RAPS).
- Conducted a lashing study for the U.S. Maritime Administration in 1983.
- Conducted a bulk handling study for the MARAD 1981, entitled "A Guide to Selecting Shipboard Container and Trailer Restraint Systems."
- Conducted a container optimization study to develop an equipment stowage scheme in aircraft for the U.S. Air Force, including the examination of container equipment, handling techniques, and logistical support.
- Conducted an engineering study for flat rack containers for the U.S. Army.
- Completed NAVFAC drawing corrections and participated in the plan review of marine control console drawings for causeway sections. Completed research, analyses, and text in association with a number of marine engineering firms for the U.S. MARAD's "Ship of the Future" study.

Representative List of Clients, NYC Office

A.P. Moller
Admiral Cruise Lines
Aimcor
Alabama Shipyards
Alcoa
Alfa Laval, Inc.
Ambassador Cruises
American Automar, Inc.
American Bulk Carriers
American Bureau of Shipping
American Cruise Lines
American Hawaii Cruises
American Heavy Lift
American President Lines
Anchor Marine
ARCO Marine
Argent Marine
Association of Danish Shipbuilders
Atlantic Container Line
Bank of America
Bath Iron Works
Belcher Towing
Beltship Management Limited
Bermuda Star Lines
Bethlehem Steel Corp.
Bigham, Englar, Jones & Houston
C I T
C T I
Cabot LNG Corporation
Cardillo & Corbett
Carnival Cruise Lines
Central Gulf Lines
Century Shipping
Chalos, English & Brown
Chandris Cruise Lines
Chargeurs Renunis
Chase Manhattan Bank
City of Alameda
City of Philadelphia
Coastal Ship
Colonial Marine Industries
Columbus Line
Commodore Cruise Line
Connell, Foley
Consolidated Edison
Continental Bank
Continental Illinois
Continental Oil
Coordinated Container Transport
Crowley Marine Transport
CSAV
Cushman & Wakefield
Cypress Financial
Del Monte Fresh Fruit Co.
Delta Steamship Lines
DeOrchis, Walker & Corsa
Derby, Cook, Quinby and Tweed
Diamond Radisson
Dixie Carriers
Dock Express Contractors
Dole Fresh Fruit International Ltd.
Don Jon Marine
Donovan Maloof, Walsh & Kennedy
Dyer, Ellis
E.K. Traders Pty., Ltd.
Eastham, Watson
Effjohn International
Egyptian Refrigerated Transport
Eletson Tankers
European Container Terminals, E.C.T.
Exxon Corporation
Fabre Lines
Farrell Lines
Federation Navigation
First National Bank of Minneapolis
Freehill, Hogan
Freehill, Hogan, Mahar
Freeport Cruise Lines
GE Capital
Gelco CTI Container Services
Global Terminal & Container Services
Graham & James
Great American Lines
Great Lakes Transport
Greyhound Leasing
Gypsum Transportation Limited
Haight, Gardner, Holland & Knight
Halley, Calkins & Avallone
Hamburg-Sud
Hanjin Transportation Co.
Healy & Bailey
Hill, Betts and Nash

C. R. Cushing & Co., Inc.

Ingenieros Civiles Asociados (ICA)
Integrated Container Services
International Terminal Operating Co.
Interocean
ITEL Container International Corp.
Johnstone, Adams
Kadampanattu Corp.
Keystone Shipping
Kirk Line
Lamont, Doherty Geological Observatory
LNG Ltd.
Lockeed Corporation
Maersk Container Line
Marine Transport Lines
Maritime Capital Corporation
Massport
Mattioni, Mattioni & Mattioni, Ltd.
May Ship
McAllister Towing & Transportation
McArdle, McMaster, Meighen
McDonald, Douglas
Mexican Line
Meyerwerft
Minneapolis Honeywell
Mitsubishi Heavy Industries
Moffat Nichol
Moore-McCormack Bulk Transport
Moran Towing & Transportation
Morgan Guaranty Trust
NASSCO
National Maritime Research Center
Navieras de Puerto Rico (PRMMI)
Network Shipping
New York City Dept. of Corrections
New York City Fire Department
New York City Police Department
New York Daily News
Novoship
Odense Shipyard
Oilmorphic
Oiltest Inc.
Orient Overseas Container Service
Osprey-Acomarit
Overseas Shipholding Group
Pacific Alaska LNG Company
Pacific Indonesia Company

Pacific Lighting and Electric
Peck & Hale, Inc.
Penn Tankers
Pepsico
Polish Ocean Lines
Port Authority of Jamaica
Port Authority of Jebal Ali
Pratt and Whitney
Prince Rupert Port Corporation
Prudential Lines
Raytheon
Red River Shipping
Reefer Express Lines
Royal Caribbean Cruise Line
Royster, Razor, Vickery, Williams
San Francisco Drycok
Sante Fe International Corporation
Sea River Maritime
Sea-Land Services
Sedgwick, Detert
Skagit Corporation
Soros and Associates
Southern Cross Overseas
Southern Ship Management, Inc.
Southwest Marine
Stolt Nielsen
Sulphur Carriers
Sumitomo Corp. of America
Texaco
TMT
Trailer Bridge
Trans Oceanic Cablesip
Transporta Mexicana
U.S. Air Force
U.S. Army
U.S. Army Corps of Engineers
U.S. Coast Guard
U.S. Department of Interior
U.S. Federal Energy Administration
U.S. Maritime Administration
U.S. Army Corps of Engineers
U.S. Coast Guard
U.S. Department of Interior
U.S. Environmental Protection Agency
U.S. Federal Energy Administration
USG Corp.

PROFESSIONAL DEVELOPMENT

C. R. Cushing & Co., Inc.

- To encourage personnel development and education, C.R. Cushing & Co. supports a graduate education tuition reimbursement plan. Company personnel do participate, or have participated, in professional and governmental technical activities, including:
- International Maritime Organization (IMO) - U.S. Delegation to Subcommittee on Stability, Load Lines, and Fishing Vessels Safety
- International Maritime Organization (IMO) - U.S. Delegation to Subcommittee on Bulk and Hazardous Cargoes;
- National Academy of Science - Ship Structures Committee
- American Bureau of Shipping - Member and Technical Committees
- Lloyds Register of Shipping - North American Committee member
- Society of Naval Architects and Marine Engineers - Member and Technical Committees
- International Cargo Handling Coordination Association - Governing Board
- American National Standards Institute - Technical Advisory Group
- International Standards Organization - U.S. Delegation
- U.S. Coast Guard - Advisory Group on Petroleum Terminals; Advisory Group on Hazardous Cargo

Other organizations in which C.R. Cushing & Co. personnel participate in are:

- The Royal Institution of Naval Architects
- The Institute of Marine Engineering, Science & Technology
- American Boat and Yacht Council
- Japan Society of Naval Architects and Ocean Engineers
- Korean Society of Naval Architects
- American Society of Mechanical Engineers
- American Society of Naval Engineers
- The Society of Naval Architects & Marine Engineers
- American Society of Heat, Refrigeration, Air Conditioning Engineers
- National Fire Protection Association
- National Safety Council
- Refrigerated Transportation Foundation
- Truck Trailer Manufacturers Association
- International Standards Organization (ISO) TC-104 Committee on Containers
- World Maritime University (Faculty)
- Royal Institute of Navigation
- Alumni associations of MIT, Michigan, Webb, Kings Point, Fort Schuyler, and other universities.