

Exhibit E

Offshore Construction Experience Atlantic Sea Island Group LLC

May 2007

Exhibit E Offshore Construction Experience

Although the Atlantic Sea Island Group LLC (ASIG) management team members have no prior direct offshore construction experience, they do have significant experience in other facets of the energy business. Further, Atlantic Sea Island Group LLC either has hired or will hire consultants and contractors with significant experience in offshore construction, as set forth more fully below. This combined expertise will ensure that Safe Harbor Energy will be designed and constructed in accordance with all applicable laws, permits, and regulations.

ASIG has retained consultants to assist them in the design of this Project with offshore construction experience, including the construction of marine terminal facilities, offshore structures, underwater pipelines, and seabed foundations.

E.1 GAHAGAN & BRYANT ASSOCIATES, INC. – COASTAL AND DREDGING ENGINEERING

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E.1.1 Engineering Design, Dredging and Construction Experience

Overview

Gahagan & Bryant Associates, Inc. (GBA) was organized in 1975 to provide consulting and engineering services for port development, dredging, land reclamation, and coastal engineering projects. The principals, associates and staff have gained their skill and experience through years of service with major dredging, marine engineering and construction firms as well as the US Army Corps of Engineers.

With approximately 70 personnel distributed among our offices in Wilmington, Delaware; Baltimore, Maryland; Wilmington, North Carolina; Tampa, Florida; Houston, Texas; Los Angeles, California; Novato, California; and Oakland, California, GBA is the largest firm in the U.S. specializing in the engineering and management of large dredging and dredged material handling projects.

GBA personnel have an intimate knowledge of dredging and marine contracting industry capabilities, equipment and technology. Two of our associates were officers of large marine contracting companies and many of our associates have been chosen from the dredging industry. Members of our firm have operated hydraulic dredges, hopper dredges, clamshell dredges and their attendant fleet. Because of this background, GBA's approach to the Sea Island construction project will be practical, workable and cost effective.

GBA's innovative approach to dredging and marine construction goes back to 1963. As members of a design team, Bill Gahagan and Frank Bryant designed and built five (5) 4,500 cubic yards hopper scows, a 10,000 HP hydraulic barge unloader, and a second system that enabled the conversion of a hydraulic dredge to a

hydraulic barge unloader. This equipment was used to move 26,000,000 cubic yards of sand from south of Staten Island, 13 miles to the Port Newark, New Jersey area for landfill at Newark Airport, Port Elizabeth and portions of the New Jersey Turnpike. That same equipment design is being used in the Chesapeake Bay to place material at Hart-Miller Island (1100 acres) and Poplar Island (1100 acres). GBA personnel also developed the “spider barge”, for the hydraulic loading of scows, and the spud extender barge, to increase the width of a cut that can be taken by an hydraulic dredge. These innovations have become the standard throughout the dredging industry worldwide. GBA personnel also pioneered the use of hydraulic pipeline dredges in the open ocean for beach replenishment projects.

GBA's background as contractors and as engineers in all types of dredging, material transport and placement activities provides valuable experience with the actual costs of the work. Our construction cost estimates are developed from the perspective of a contractor preparing a competitive bid.

GBA has a broad range of experience and background in hydrographic surveying throughout the major port areas in the United States, with primary emphasis on port and navigation channels, dredging, landfill and coastal projects. Through continuing contracts with the Corps of Engineers, we have surveyed virtually every navigation channel in the New York Harbor and Long Island area multiple times during the past 20 years.

GBA has earned the respect and confidence of owners and contractors alike, for the quality and precision of our surveys and the integrity of our personnel. GBA was responsible for introducing multi-beam technology to the dredging industry and developed multi-beam survey techniques for measurement and payment purposes. The capacity of our equipment and software to perform accurate and repeatable surveys assures accuracy and competence in volume calculations and pay estimates.

GBA uses Terramodel Software for site planning. This engineering tool allows us to develop Triangular Irregular Network (TIN) models, generate contours, compute site volumes and interactively design in three dimensions. Updated design changes can be entered and new volumes, cut/fill maps, contours, cross sections and profiles can be generated in a short time even when utilizing large amounts of topographic/bathymetric data. The flexibility and speed of this system enables engineers and managers to optimize designs when assessing numerous site configurations.

With over 45 years experience in the New York area, GBA personnel have the first hand experience, knowledge and capabilities to provide the engineering services for the materials management and placement required in connection with the construction of Atlantic Sea Island Group's Safe Harbor project. As contractors, GBA personnel have been involved in the dredging, transportation and placement of material for construction of the Newark Airport, Port Elizabeth, portions of the New Jersey Turnpike (26 MCY) and the expansion of runway 4L at Kennedy Airport (8 MCY).

GBA has a broad background and many years of experience in managing and constructing complex, multi-disciplined marine construction and material management projects. The types of projects that the firm and its personnel have been involved with encompass every aspect of dredging and long-distance transport and placement of large quantities of material for construction purposes. We have the in-house capability and experience to meet or exceed the Client's requirements for construction of this project.

E.1.2 Selected Projects

As engineers, GBA personnel have been or are currently involved in project design, construction supervision, cost estimating, feasibility analyses and/or peer review on the following major dredging and landfill projects:

Poplar Island, Chesapeake Bay, Maryland
Maryland Port Administration, Baltimore, Maryland

As the managing firm in a joint venture, GBA led a design team of 8 firms to conduct an environmental study, preliminary coastal & dredging engineering concepts, and a final coastal engineering design with construction plans, specifications, and cost estimates for the restoration and environmental enhancement of approximately 1,110 acres at Poplar Island in the Chesapeake Bay. This two-phase project consists of clean dredged material from the navigation channels of the Chesapeake Bay being used to create a combination of wetland and upland habitat.

GBA's work included studies, evaluation, and design of:

- 37,000 feet of rock protected sand dike with approximately 1,000,000 tons stone
- Bathymetric and topographic surveys
- Geotechnical investigation including borings, sampling, laboratory testing, and analysis of data
- Environmental assessment survey to NEPA guidelines, including sediment quality, water quality, aquatic ecology, terrestrial ecology, and shellfish
- Participation in hearing presentations
- Environmental assessment report
- Cultural assessment as well as terrestrial and marine archeological investigations
- Planting and seeding schedules and plans
- Three alternative site layouts and a final design of the selected layout
- Coastal engineering assessment and hydrodynamic analysis
- Cost estimates and specifications for all aspects of the project, including construction, dredging and placement, transportation, operations, habitat development, and maintenance
- Methodologies for the construction of the dikes, filling the facility, in addition to establishing wetland and upland habitats
- Procedures for managing the project site, after completion of placement operations, to achieve desired characteristics of the developed habitats

Phase I & II Construction Review:

GBA was retained by the Maryland Port Administration (MPA) to provide construction oversight. The project includes 30,000 feet of dike construction (4 million cubic yards of sand and 600,000 tons of rock), sand filled geotextile bags, spillway structures, rock reefs, and a pier structure. GBA created a database to track construction progress, payment, and the quality of work. The data included focused on critical construction issues. GBA attended weekly site progress meetings and reviewed the contractor's construction schedules. Quality Control reports, site survey data, and requests for partial payment were also reviewed. A report of the findings and recommendations was presented to MPA. GBA prepared monthly construction oversight reports to monitor construction progress. Principal elements of the project covered in these reports were the contract schedule, borrow, hydrographic, and topographic surveys, aerial photography, daily production reports, materials, toe dike, sand stockpile, hydraulic fill, stone quality, and placement, payments to contractor, estimated percent completion of work, and survey data.

**MPA Study of Inner Harbor Sites
MPA, Baltimore, Maryland**

As the managing firm in a joint venture, GBA led a design team of 8 firms to perform studies of potential sites within Baltimore harbor for use as dredged material placement sites. The comprehensive studies included: environmental & geotechnical investigations, hydrodynamic & sedimentation modeling, coastal & dredging engineering, and cost estimates. A study program was developed to assist MPA in carrying their dredged material management plan (DMMP) forward to address dredging issues for a 20-year period. The study program provided for technical assistance to stakeholders in their evaluation efforts. Conceptual, reconnaissance and feasibility studies were undertaken based on recommendations by state sponsored groups or agencies. Final engineering design with construction plans, specifications, and cost estimates for recommended sites are provided. Operation plans and analysis is provided as well. GBA's work included studies, evaluation, and design of:

- Dike construction methods and alternatives
- Bathymetric and topographic surveys including sub-bottom profiling
- Geotechnical investigation including borings, sampling, laboratory testing, profiles and analysis
- Environmental assessment survey to NEPA guidelines, including water and sediment quality, aquatic and terrestrial ecology, biological, historical and recreational resources assessments.
- Participation in hearing presentations and public meetings
- Cultural assessment as well as terrestrial and marine archeological investigations
- Planting and seeding schedules and plans
- Alternative site layouts, analysis and final design of the selected layout.
- Coastal engineering and hydrodynamic analysis
- Cost estimates and specifications for all aspects of the project, including construction, dredging and placement, transportation, operations, habitat development, and maintenance
- Methodologies for the construction of the dikes, filling the facility, in addition to establishing wetland and upland habitat
- Operational procedures and analysis for managing dredged material placement sites to maximize placement operations, and achieve desired characteristics of the developed habitats in economical methods.

**Houston Ship Channel Modernization Project, Houston, Texas
Port of Houston Authority**

GBA provided technical assistance for selected aspects of the widening and deepening of the 51-mile Houston Ship Channel (HSC) Project. In addition to Engineering Services, GBA helped develop an award-winning plan for beneficial use of dredged material from the channel. In March 2001, GBA received an Engineering Excellence Award from the Consulting Engineers Council of Texas for designing and implementing a plan for effectively using dredged material from the shipping channel deepening project to restore and create wetland habitat in the Houston-Galveston Bay. GBA assisted the Port and the USACE in developing a technically and economically feasible environmental restoration plan that used the dredged material from the HSC. The approved plan included establishing 4,650 acres of intertidal marsh in the Galveston Bay section, restoring an island in the Bayou section, creating a 8-acre bird island habitat in the bay section, and the creation of a berm for fish habitat in the offshore section of the HSC.

**Pier J Expansion, Long Beach, California
Port of Long Beach**

GBA performed hydrographic surveys for all phases of the Pier J Expansion Project, an \$84 million undertaking. Our services included condition surveys, before and after dredging pay surveys, before and after rock placement surveys, as well as daily surveys to assist in the control of the project. Rock was barged from a quarry on Catalina Island and placed in position, in 55 feet of water, forming a pyramid-like dike over 12,000 lineal feet in length and 70 feet in height. The enclosed area was then filled with 13,750,000 cubic yards of dredge material, to form 147 acres of new land area in Long Beach Harbor.

**Port of Los Angeles Channel Deepening Project Design & Surveys
Port of Los Angeles & USACE Los Angeles District, Survey Branch**

The primary purpose of the project is to deepen the Main Channel, berths and turning basins to -53' MLLW to improve deep-draft navigation and maximize the beneficial use of dredged material. The project consisted of dredging, landfill, rock dike construction, removal of utility crossings, vertical wick drain installation and associated demolition in fill areas. GBA was part of the design team and reviewed geotechnical investigations to optimize material types within each dredge element, developed dredging and rock dike schedule and prepared dredging cost estimate. GBA provided design, review and comment for contract modifications, attended design team meetings to address Contractor's RFI's and to review Contractor's schedule, prepared volume calculations and reviewed and commented on Contractor's claims. GBA also provided hydrographic surveying and quality assurance to the USACE-LA.

**New York Harbor
The Port Authority of New York & New Jersey**

Gahagan & Bryant Associated, Inc. (GBA) has been retained by the Port Authority since 1996 with multiple year contracts for Expert Professional Services for Dredging Technology and related Engineering Services as requested on a "Call-in" basis.

GBA services include:

- Provide a detailed review and analysis of the Ports 45' and 50' deepening programs. Developed schedules and cost estimates for dredging, including rock drilling and blasting, with recommendations for significant savings to the program.
- Provide a professional engineer on staff in the Port Authority offices since 2003.
- A dredging, cost analysis, and review of contract documents for Newark Bay Confined Disposal Facility (NBCDF)
- Led a team of skilled professionals in the performance of geophysical/geotechnical investigations in the New York Harbor for the New York District USACE and for the Pennsylvania New York & New Jersey.
- Dredging analysis and cost estimate for Kill Van Kull Channel and Newark Bay with Elizabeth Channel. Developed alternative dredging and disposal methods, which have provided significant savings to the project.
- Performed a sub channel placement (SCP) study for dredging material at various New York Harbor terminals and channels.

The New York District Corps Of Engineers

Under an IDC contract, GBA provided QA reviews and recommendations to several contractors' rock drilling and blasting plans for Kill Van Kull dredging projects. GBA also conducted a seminar on drilling and blasting rock for Corps' personnel.

AE Services for Various Dredging Projects NWS Earle, Colts Neck, New Jersey Northern Division, NAVFACENGCOM

Since 1987, GBA has had continuing contracts to provide A/E services at Naval Weapons Station (NWS) Earle, located in Lower New York Harbor. These services included site investigations, engineering plans and specifications, construction cost estimates, construction oversight, and hydrographic surveying for measurement and payment of dredged material quantities. Projects at NWS Earle over the past 20 years include:

- Pier 4, Phase I - Deepening and improvements to existing terminal channel, berths, and turning basin from a 35 ft project depth to a 45 ft depth to accommodate the homeporting of larger supply vessels.
- Pier 4, Phase II - Channel deepening and improvements to Sandy Hook Approach Channel to the 45 ft project depth. GBA's design incorporated the beneficial use of the channel sands as beach nourishment to the Sandy Hook Gateway National Recreation Area. GBA's innovative design called for hopper dredges to bottom dump the channel sands offshore of the beach, creating a berm that a hydraulic dredge then pumped onto the beach. This was done for \$5.00 / cy measured in the fill versus \$9.00 / cy scow measurement from a previous contract. A savings of \$4.00 / cy.
- Piers 2, 3, & 4 – GBA engineered several maintenance dredging projects, both 35 ft and 45 ft project depths during this period.
- Pier Complex Replacement – GBA developed the design for the berth deepening and improvements for the Pier 3 replacement, and is currently providing construction oversight and hydrographic surveys for measurement and payment of the dredged material quantities.

Masonville CDF Maryland Port Administration, Baltimore, Maryland

The Maryland Port Administration (MPA) has applied for a permit to construct a 140-acre Dredged Material Containment Facility within Baltimore Harbor waters. This facility is needed to provide capacity for 1.5 Mcy of material dredged annually to improve and maintain shipping channels for the Port of Baltimore. The proposed facility would be constructed using perimeter sand dikes and a cofferdam section to enclose the 140-acre area. Sand for construction would be dredged from borrow areas both onsite and from a dredging project to be performed at the Seagirt Marine Terminal.

GBA led the project team responsible for the conceptual, reconnaissance, and feasibility studies for the Masonville project. The team also prepared the environmental impact statement, which is currently under review. Through the project team's diligent efforts, MPA has been able to follow an accelerated schedule through the State and Federal permitting processes. This accelerated schedule is necessary if the Port of Baltimore is to continue to provide safe passage for ships that call on its berths.

The Masonville project design phase is running concurrently with the permitting process so that construction of the project may begin immediately following a favorable permit decision. GBA is currently planning the construction schedules and preparing the final design plans and specifications.

GBA is providing the MPA with the following services for the Masonville project:

- Overall project management, including program objectives and project scopes

- Permitting, mitigation and community enhancement design, and public relations
- Plan formulation & alternatives analysis
- Combined feasibility/EIS report preparation
- Identification of construction materials (borrow source investigations)
- Project schedule baseline & cost estimates
- Hydrographic/topographic surveys & probes
- Pre-construction engineering & design – including technical reviews, preparing a site operations manual, cost estimates and schedule, plans & specs

E.2 INTEC – PIPELINE ENGINEERING, PROCUREMENT, PROJECT AND CONSTRUCTION MANAGEMENT

Company Name: INTEC Engineering Partnership Ltd. (INTEC)
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USA
Telephone Number: 281.987.0800
Point of Contact: John Stearns
Citizenship: United States

E.2.1 Offshore Construction Experience

Description of Anticipated Role

Technical and permit support for the marine facilities and related systems for deepwater port license application preparation.

Qualifications

Iroquois Pipeline Extension

Client: Iroquois Gas Transmission Operating Company
Location: Long Island Sound
Duration/In-Service Date: Two-year project
Company Contribution: Prime Design and Construction Management Contractor (100%)

INTEC was responsible for all aspects of the marine pipeline route survey and designed a 24-inch gas pipeline for Phase 1 FERC permit application for the Eastchester Marine Pipeline for the Iroquois Gas Transmission Operating Company. The Eastchester Marine Pipeline is a planned gas sales expansion across Long Island Sound from Northport, Long Island, to Eastchester, a 27-mile pipeline extension. INTEC worked closely with an environmental consultant to evaluate and assess project environmental impact during engineering, construction and operations. The FERC permit application was successfully submitted within nine months after project kick-off. The pipeline was brought ashore in a heavily populated area close to the Bronx and Westchester, New York county lines. The routing crossed shorelines with parks, residential areas, wildlife preserves and other environmental restraints. The offshore geology was complex and variable, with boulder-laced glacial fills and rock outcrops. The survey was conducted in heavily trafficked waterways and in constricted tidal zones with shallow submerged rocks.

INTEC provided the following services:

- Marine survey;
- Pipeline route selection;
- Shore crossings designs;
- Preliminary pipeline design;
- Construction cost estimating;
- FERC permit preparation;
- Route survey management and supervision;
- Preliminary pipeline engineering design;
- Detailed pipeline engineering design;
- Construction cost estimating; and
- FERC permit application technical support.

Eastchester Pipeline

Client: Iroquois Gas Transmission Operating Company
Location: Long Island Sound
Duration/In-Service Date: Two year project
Company Contribution: Prime Design and Construction Management Contractor (100%)

INTEC provided engineering, construction, and project management services for the Eastchester Extension, the first major natural gas transmission pipeline to be built into New York City in some 40 years. The pipeline negotiates many onshore and offshore environmentally sensitive areas, power cable crossings, subsea hazards and recreational areas. In addition, the pipeline runs under two major Interstate bridges crossing the East River. The marine pipeline is 35 miles long, 24-inch outside diameter and is tied into a transmission system at Northport on Long Island and a metering station at Hunts Point, Bronx County. The pipeline has two horizontal directional drilled (HDD) shore crossings, 0.6 miles and 0.85 miles long, respectively.

INTEC provided the following services:

- Onshore and offshore route evaluation and recommendation;
- Input into FERC and U.S. Army Corps of Engineer permit applications;
- Geotechnical and geohazard assessment;
- Pipeline system design;
- Construction scope of work preparation;
- Cost estimates and execution schedule preparation;
- Procurement support for pipeline steel and coatings; and
- Preparation of bid documentation for pipeline installation and HDD execution.

INTEC implemented a risk-based program management and construction implementation approach for the final stages of the project, which consisted of company-wide alignment process for all areas of the development.

Exxon MB 61-1 Flowline

Client: Exxon Company, U.S.A.
Location: Mobile Bay, Alabama
Duration/In-Service Date: One-year project
Company Contribution: Prime Design and Construction Management Contractor (100%)

INTEC was responsible for the preliminary and detailed engineering to expand the gas production development in Mobile Bay, Alabama. The high-temperature, high-pressure sour gas would be routed 2.6 miles via a new 4-inch by 8-inch insulated pipe-in-pipe flowline from the planned remote well template to existing 62A production platform, and then continue to shore through existing pipelines. A 3-inch diesel/dilution water flowline and power cable umbilical would be installed with the flowline. The pipe-in-pipe flowline was to utilize existing surplus pipe-in-pipe consisting of 4-inch corrosion resistant alloy carrier pipe due to the high hydrogen sulfide content of the gas, with an X65 8-inch jacket pipe.

INTEC provided the following services:

- Sizing and design of the diesel/dilution water line;
- Survey of surplus material and recommendations for surplus material refurbishment;
- Preliminary confirmation of the suitability of the surplus material;
- Redesign of flowline risers, as they were not available from surplus material;
- Preparation of a cost estimate for detailed engineering, procurement and construction;
- Update of previously developed specifications;
- Preparation drawings, construction and material bid packages, and permit application; and
- Provision of support for permitting, bidding, fabrication and construction.

This project had a challenging schedule, which was achievable with the utilization of prior project experience, particularly from continued involvement in the Exxon Mobile Bay Field Developments.

BP Alaska Liberty Pipeline

Client: BP Exploration, Alaska
Location: Alaskan Beaufort Sea
Duration/In-Service Date: Two-year project
Company Contribution: Prime Design and Construction Management Contractor (100%)

INTEC was the pipeline design contractor and provided the pipeline design services through project development and continued pipeline-permitting support. The BPXA Liberty Oil Field is located 6 miles offshore the Alaskan Beaufort Sea coast. It was evaluated for development using a new gravel island constructed to support drilling, production facilities, and living quarters. Oil production would be exported through a 12-inch pipeline to shore and then connected to the existing North Slope Prudhoe Bay pipeline infrastructure. This was planned to be the second subsea arctic pipeline in the Beaufort Sea. Limit state strain design criteria would be used to meet the challenges of an arctic environment and marginal field economics. INTEC, BP, and six other companies participated in an alliance agreement whereby the parties would share in a bonus/penalty arrangement based on an agreed target price and project schedule.

INTEC provided the following services:

- Conceptual evaluation and system design;
- Preliminary pipeline design;

- Detailed design of the offshore pipeline system including: upheaval buckling analysis, strudel scour, seabed ice gouge protection, and subsea permafrost thaw subsidence;
- Detailed design of the overland pipeline including: insulated pipeline, expansion loops, and vertical support members;
- Permitting assistance for all permits required for pipeline construction onshore and offshore Alaska;
- Operations, maintenance and repair procedures; and
- Evaluation of pipe-in-pipe system configurations as a potential means for providing secondary oil spill containment as requested by the environmental permitting agencies.

AES Ocean Express Pipeline

Client: AES Corporation
Location: From the Bahamas across the Florida Straits to the Fort Lauderdale Power Plant
Duration/In-Service Date: One-year project
Company Contribution: Prime Design and Construction Management Contractor (100%)

INTEC performed the front-end engineering and design (FEED) study that included routing, flow assurance; sizing and preliminary design of the gas pipelines for both onshore and offshore, and also prepared cost estimates. The routing onshore went through populated areas, crossed highways and waterways, and the nearshore route avoided environmentally sensitive areas (coral reefs) mainly with the use of HDD methods. On both ends of the pipeline, metering station and pipeline instrumentation were required.

INTEC scope included:

- Project management, QA, and HSE;
- Preparing FEED design basis;
- Pipelines system routing;
- Shore approach and landfall;
- Flow assurance and hydraulics;
- Metering stations and instrumentation;
- Pipeline mechanical design;
- Pipeline protection evaluation;
- Offshore pipeline installation study;
- Pipeline specifications preparation;
- Pipeline cost and schedule; and
- Bid package preparation.

The major challenges included the routing of the pipeline and satisfying the requirements of innumerable agencies of Federal, state, local, and other interested parties.

E.2.2 Other Information

Since its foundation in 1984, INTEC Engineering has been at the forefront of offshore technology development and is recognized as an industry leader in the design and management of energy industry projects. INTEC employs over 350 staff worldwide and provides engineering services to the exploration and production, construction, and transportation sectors of the energy industry worldwide. INTEC's areas of technical expertise include marine pipelines and risers, marine terminals, subsea production, floating production, flow assurance,

and liquefied natural gas, which enable INTEC to play a key role in the development of offshore oil and gas reserves. INTEC has provided services from concept through commissioning to most every major oil and gas producer whether onshore, shallow, or deepwater. In addition to crude oil and petroleum products, INTEC has proven technology and expertise in terminals used for handling liquid propane gas and various types of slurries. INTEC also provides technical expertise in custody transfer and crude quality monitoring, leak detection and supervisory control, and the development of operating and maintenance procedures. INTEC also offers specialized engineering support for permitting and compliance with regulatory requirements, risk and environmental impact studies, and HAZOP assessments. Additional qualifications are available upon request.

E.3 MOFFATT & NICHOL – TERMINAL ISLAND DESIGN

Company Name:	Moffatt & Nichol
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Telephone:	212.768.7454
Point of Contact:	John Headland
Citizenship:	United States
Principal Business Activity:	Full-service engineering and consulting firm specializing in engineering solutions for the complex environment where land and water meet.

E.3.1 Overview

Moffatt & Nichol (M&N) is an internationally-recognized leader in the planning and design of ports, harbors and marine terminals. Founded in 1945 to provide engineering services to the growing marine infrastructures of southern California, M&N now operates from 22 offices throughout the United States, Canada and the United Kingdom which serve a variety of public and private clients throughout the world.

M&N offers these clients extensive marine, civil, structural, mechanical, electrical and coastal engineering and construction experience. Based on over 60 years of experience, M&N is well-versed in the unique challenges of waterfront, offshore and marine oil terminal projects.

This depth of knowledge includes extensive inspection and engineering experience with marine oil terminals worldwide. Through their knowledge and experience, they are sensitive to operational requirements and practices specific to the oil business and have acquired an industry-wide reputation for providing practical, cost-saving solutions.

M&N's wide range of in-house engineering disciplines are combined to provide well-coordinated and efficient projects that avoid problems associated with the multiple firm (team) approach to project completion.

E.3.2 Oil and Gas Expertise

In addition to its varied expertise in waterfront related planning and design, M&N also addresses the deep water and shore related marine terminal needs of the oil and gas industry. Today that practice has taken M&N to all parts of the world to support the highly specialized requirements of their clients.

M&N's multi-disciplined approach utilizes the firm's leading position in coastal engineering, vessel maneuvering, mooring analysis, and marine structures to support a variety of clients. This work includes the design of breakwaters, land reclamation, artificial islands, pier/jetties and marine terminal mooring systems.

Engineering Disciplines include coastal, naval architecture marine, civil/structural, mechanical/electrical as well as cost estimating, scheduling and procurement.

M&N's highly-skilled engineers use the latest modeling techniques to support their design. All engineering disciplines are highly integrated in order to provide clients with comprehensive engineering solutions. State-of-the-art software is utilized by M&N's structural engineers to analyze marine structures including complex seismic analysis. M&N's coastal engineers further support the needs for dredge fill and dredge channel designs. M&N's risk analysis capabilities provide for stochastic, time domain simulations of marine transportation and operations systems to evaluate all aspects of marine terminal projects.

M&N uses these skills to support our client's requirements for liquid bulk terminals, onshore cryogenic production facilities (LNG, LPG and GTL), offshore storage (FPSO and FSO), and offshore cryogenic facilities (FSRU and GBS).

M&N services generally include:

- Screening and evaluating potential sites,
- Transforming remote metocean data to the site (design water levels, wave heights, winds, etc.),
- Calculating coastal process hydrodynamics (scour, sedimentation, dredging vs. trestle length, etc.),
- Evaluating tanker maneuvers and tug requirements with fast-time simulations,
- Optimizing mooring and breasting dolphin arrangements for full range of vessel sizes,
- Establishing vessel motions, and line and fender loads, in the time-domain,
- Calculating operations downtime and requirements for breakwaters with Monte Carlo simulations,
- Designing / analyzing potential marine structures for all loadings including time-history seismic and fatigue,
- Estimating reliable construction costs and schedules, and evaluating constructability,
- Specifying, procuring and interpreting metocean, bathymetric, topographic and geotechnical data necessary for FEED and EPC bid packages, and
- Developing specifications and other documents for EPC bid package.

E.3.3 Selected Projects: LNG Experience

M&N has completed dozens of LNG assignments including planning, design, and construction services for all of the Major Oil and Gas Companies. Most of these assignments are highly confidential and the firm keeps its commitments to confidentiality. Accordingly, we only list a few representative assignments below.

Gateway Project VLCC Oil Export Terminal, Kitimat, British Columbia Enbridge Pipelines, Inc.

Enbridge's proposed Gateway Project will begin a new era for Western Canada's oil and gas industry seeing, for the first time, the offshore export of crude oil. M&N, from its Vancouver and San Francisco offices, is providing Front End Engineering and Design (FEED) studies for the marine components of the terminal near the town of Kitimat. Components include a crude oil export berth, a condensate import berth and associated causeways. The facility will be designed to accommodate Very Large Crude Carriers (VLCCs) in the 320,000 dwt class and condensate carriers in the 160,000 dwt class. There are currently no major oil and gas export - or import - marine terminals on the west coast of Canada. M&N is also assisting with regulatory application support, including the execution of select Termpol studies, as well as the development of a project management plan and an operational budget for the facility.

**Kitimat LNG Terminal, Kitimat, British Columbia
Kitimat LNG Inc.**

M&N completed site selection, navigation assessments, regulatory application support and preliminary design for the marine component of a new facility at Emsley Cove near the town of Kitimat. This facility will be a cornerstone of the BC North Coast's economic rebound proposed.

M&N is currently completing the detail design for the marine works which includes the primary off-loading berth for 200,000 cu.m. LNG carriers, a tug support berth, a temporary construction jetty and shoreline protection for the main plant. The work requires careful coordination with the upland EPC design team based in Belgium. The firm has also been retained to provide tendering services and field supervision for the construction phase of the marine terminal.

**Feasibility Study, LNG Import Terminals, Altamira & Lazaro Cardenas, Mexico
El Paso Energy**

M&N performed a detailed evaluation of two ports (Altamira and Lazaro Cardenas) with respect to LNG vessel maneuvering; Altamira is on Mexico's Gulf Coast while Lazaro Cardenas is on mainland Mexico's west coast. Initial site visits were conducted to interview port officials and become familiar with the port and surrounding area. M&N then examined environmental conditions (winds, waves and currents) and LNG vessel characteristics/maneuvering during approach, while negotiating the harbor entrance, and berthing. For each site, M&N developed typical harbor/berth layout alternatives, LNG vessel maneuvering criteria/procedures, and expected annual berth downtime due to wind/wave climate exceeding operational limits. Alternatives indicated required turning basin, channel, and berth configurations and depths. Study findings were presented in a summary report.

**Rosarito LNG Marine Terminal, Baja, Mexico
El Paso Energy/Phillips**

M&N evaluated several potential sites in Baja California to establish the optimum location for an LNG marine terminal, and then prepared a Front End Engineering and Design (FEED) that included a comprehensive Design Basis, and arrangements and structural designs for an 800m long breakwater, a vessel berth (mooring dolphins, breasting dolphins and a loading platform), and a 2 km trestle to shore. The Design Basis vessel was a 138,000-cubic meter capacity LNG Carrier. To arrange and size the channels, M&N performed vessel maneuvering simulations (with and without tugboat assistance) using the program SHIPMA. M&N estimated the construction costs and schedule. Site visits were conducted to evaluate potential quarries for breakwater material, and to discuss/plan ship maneuvering issues with the local port pilots. M&N developed several conceptual layouts for the marine facilities including alternative designs for the breakwater, and an unprotected berth.

The scope also included evaluating a third-party Multi-Buoy Mooring (MBM) concept. M&N executed advanced dynamic analyses for the berthed LNG carrier behind the various breakwater alternatives to establish environmental limits, calculate the berth availability for each alternative arrangement, and determine the minimum length/cost for the breakwater. Berth availability calculations used an in-house stochastic program "ProbSIM" that simulates weather-dependent marine operations in response to a time-history of historical wind, wave and current. M&N's accurate transformations of deepwater Metocean time-histories to the shallow-water berth using "MIKE 21" were critical to these simulations.

**Altamira LNG Import Terminal, Altamira, Tamaupipas, Mexico
Shell/El Paso Energy**

As a subconsultant, M&N performed a detailed pre-FEED evaluation of Puerto Altamira on Mexico's Gulf Coast with respect to vessel maneuvering. This evaluation examined environmental conditions (winds, waves & currents) and LNG vessel characteristics/maneuvering during approach, negotiating the harbor entrance,

and berthing. This evaluation included a site visit and interview with port officials. M&N provided a report summarizing the study findings with typical harbor/berth layout alternatives, LNG vessel maneuvering criteria/procedures, and expected annual berth downtime due to wind/wave climate exceeding operational limits. Alternatives involved turning basin, channel, and berth configurations and depths. After this initial study, M&N completed a FEED for the Altamira site to develop the necessary marine facilities - unloading platform with shore-tie trestle and associated mooring/breasting dolphins.

After a change of ownership and at a later date, M&N completed a second FEED to optimize an LNG terminal design done by a second consultant. The optimization process began with a one-day Value Engineering session to identify potential savings for the marine facilities. For this second FEED, M&N completed structural analyses to determine pile loads/lengths for the waterfront structures including determining vessel berthing energies, wind loads, limit states for vessel berthing, and soil-structure interaction using non-linear analyses as well as design and opinions of probable construction costs for monopile mooring/breasting dolphins, unloading platform and trestle modifications, and facility shore protection.

Tangguh LNG Export Terminal, Papua, Indonesia British Petroleum

M&N provided marine engineering and design services for a proposed major “greenfield” liquefied natural gas (LNG) export facility to be built in a remote area of Indonesia. These services included:

- Evaluation of potential terminal sites,
- Navigation and ship maneuvering,
- Hydrodynamic and coastal modeling,
- Mooring and ship motion studies, and
- EPC tender documents.

Various marine facility configurations were studied to determine construction costs and schedule while meeting all specified design criteria including dynamic response and piping displacement criteria during an earthquake. The selected alternative was optimized to accommodate the range of proposed vessels while minimizing the structure requirements. This design utilized monopiles for the LNG trestle, together with long-span girders, resulting in a 75% reduction in the number of trestle piles typically used in more traditional approaches. In preparing the design basis and other documents for the EPC tender, M&N developed and evaluated a number of potential construction scenarios to establish the optimum timing for construction for each component of the marine facilities and the first delivery of LNG.

Pier 400 Dredging and Landfill Design, Los Angeles, California The Port of Los Angeles

M&N was selected by the Port of Los Angeles as part of a joint venture to provide engineering services in the conceptual and final design of the largest planned landfill project in the United States. The ultimate construction of Pier 400 includes 11 km of new navigation channels ranging between 14 and 25 meters below MLLW with two turning basins. The 50 million cubic yards of dredged material would be used to create approximately 235 hectares of landfill to support container and liquid bulk operations.

Unique elements contained in the design include nearly 9 km of retention structures on challenging geotechnical conditions, construction phasing to accommodate environmental and institutional requirements, and incorporation of other critical Port of Los Angeles projects either impacting or relying on the Pier 400 Project. In addition to the Port projects, the U.S. Army Corps of Engineers is involved as a funding partner and has a vested interest in the design and phasing of construction. The Port of Los Angeles proceeded from concept to construction within one and a half years. The ultimate products consisted of reports recommending two stages of construction. M&N developed plans and specifications for the Stage I construction for channel

deepening to 19 meters MLLW and creation of approximately 70 hectares of landfill. M&N also assisted the U.S. Army Corps of Engineers in the preparation of plans and specifications for Stage 2 construction. A special feature of the project included creation of a Permanent Shallow Water Habitat for least tern feeding that also served as a Contained Aquatic Disposal (CAD) site for chemically challenged sediments.

Doha Port Master Plan, Doha, Qatar
Bechtel Limited/Government of Qatar

M&N was retained by Bechtel to provide port master planning consulting services for a new commercial port in Doha, Qatar. The 220-hectare port, scheduled for operation in 2010, will be located on reclaimed land offshore of the new Doha International Airport and will be accessed by an 8-km trestle. The port will feature state of the art container and general cargo handling facilities.

A separate port basin area will be dedicated to berthing for visiting guest navies and the Qatari Coast Guard.

The first stage of the master planning process was to produce a preliminary Master Plan which defined site attributes and constraints, the cargo traffic forecast and the preferred port site location and concept.

The second stage of the project focused on producing a final master plan which defined the configuration of the various port systems and presented a procurement strategy for phased development and the cost and schedule of the opening day development.

Through a series of workshops held in Doha, M&N and Bechtel worked directly with the Stakeholders and various Qatari Ministries to define a set of key objectives and policies for the new port. Subsequent workshops focused on presenting important findings and alternative port concepts.

The final Master Plan defined the following:

- Commercial and Navy Port Configuration
- Port Marine Operations
- Utilities
- Ground Access
- Terminal Layouts
- Breakwater, Dredging and Reclamation Requirements
- Procurement Strategy and Implementation

Dredged Material Management Plan, New York Harbor, New York
U.S. Army Corps of Engineers, New York District

M&N provided specialized dredging analyses and design services for the development of a Dredged Material Management Plan (DMMP) for maintaining Federal navigational channels within New York Harbor. The main emphasis of the DMMP is to assess sedimentation patterns and future dredging projections for various Federal and non-Federal dredged areas of the harbor. Additionally, M&N is involved in the identification and development of sedimentation reduction methods to limit the short- and long-term dredging requirements throughout the harbor. Work included documentation of past sedimentation minimization efforts, the identification of suitable locations and methods for implementing sedimentation reduction/minimization procedures and the development of the conceptual designs and cost estimates using such methods for those locations. Specific alternatives included artificial island construction (in Lower New York Harbor and offshore) as well as placement of dredged material in excavated pits in the Upper and Lower Harbor and Jamaica Bay.

Poplar Island Restoration, Baltimore, Maryland Maryland Port Administration

Poplar Island is a landmark project for the beneficial use of dredged material and serves as an example of solutions to dredged material placement issues. In total, the restoration project will provide a dredged material placement capacity of approximately 38 million cubic yards of clean sand and silt to be taken from Chesapeake Bay shipping channels that serve the Port of Baltimore. In 1847, Poplar Island provided approximately 1,000 acres of wildlife habitat, but years of steady erosion have reduced it to 4 islets totaling less than 5 acres. When complete, island restoration will create more than 1,100 acres of wetland (including intertidal and perched) and upland habitats. These habitats will provide vital nesting and nursery areas for many of Chesapeake Bay's fish, shellfish, wildfowl, and other birds.

M&N and its joint-venture partner completed engineering design services and relevant components of the Environmental Impact Statement. These services included dredged material placement and coastal engineering design. The project design included an assessment of island construction impacts on tidal hydrodynamics, constituent transport, and sedimentation. To accomplish this assessment, M&N developed 3 numerical models of the central portion of Chesapeake Bay and modeled existing, past (1847), and future "with-project" conditions. RMA-2 was used to model tidal hydrodynamics; RMA-4 was used to model constituent transport; and STUDH was used to model sedimentation. Modeling also included wave-induced erosion around the island perimeter and a water quality analysis to determine which island alignment had the least impact on water quality, and therefore sensitive shallow water habitat nearby.

M&N examined three design alternatives and compared those to existing and historic conditions. Hydrodynamic results indicated that post-construction conditions would be similar to the historic conditions that existed in 1847. Constituent transport modeling indicated that island restoration would create little difference in overall water quality relative to existing conditions for the project site. Sedimentation modeling was used to predict erosion and accretion patterns for the design alternatives.

Jeddah Marine Terminal Upgrade, Saudi Arabia Aramco

M&N provided a study to upgrade existing oil terminal berths and supporting facilities at the Jeddah Marine Terminal to accommodate 160,000 DWT tankers. Initially, M&N provided a site visit to gather & review available data including wind, wave, current & bathymetry and to inspect the facilities. Subsequently, M&N evaluated the facilities condition and required upgrades and developed a Basis of Design for their rehabilitation/upgrade. M&N then developed conceptual design alternatives for berths, shipping channels & turning basins, aids-to-navigation, breakwaters, & dredging. Coastal engineering analysis included a sedimentation evaluation of the harbor. In addition to structural and coastal engineering, conceptual design included all mechanical and electrical engineering for oil terminal loading systems. M&N presented data, evaluation, conceptual design alternatives and supporting information in a final report.

Tanker Terminals, Caribbean ESSO

M&N evaluated existing oil terminals and determined needed repairs as well as upgrades required to berth various sized tankers for locations in the Caribbean (Nicaragua, Guatemala, Belize, and Grand Cayman). Services provided included:

- Acquisition & review of data on berth configuration / construction,
- Static mooring analyses to determine required upgrades to allow tanker mooring,
- Determination and specification of additional inspections / data required,

- Evaluation of proposed PLEM (Pipe Line End Manifold) as designed by others, evaluation of alternatives and recommendations for modifications,
- Preparation of material list, drawings and specifications for installation of new upgraded mooring hardware, repair of existing moorings, and load tests,
- Coordination with Contractor performing installation / repair work and load tests and review of equipment proposed for use, and
- Dynamic analyses of upgraded mooring to establish berth operational limits.

Tanker Terminal, Bahamas ESSO

M&N evaluated an offloading platform and breasting and mooring dolphins for a fixed terminal. Services included:

- Underwater and topside inspection of structures to document pile and concrete structure condition, with written report on findings
- Preparation of construction documents for repairs
- Evaluation of the existing structure in current condition to withstand mooring and berthing loads,
- Establishment of limiting operational criteria, and
- Provided recommendations for structural upgrades to increase capacity of berth.

Tanker Terminal Rehabilitation, Bermuda ESSO

M&N provided a field investigation and condition assessment reports on the fuel offloading trestle and its two accompanying mooring/breasting dolphins as well as four associated mooring buoys. Subsequent to the inspection, M&N prepared construction documents for trestle/dolphin rehabilitation as well as for improvements to/relocation of the associated mooring buoys. Structure rehabilitation involved shotcrete of mooring/breasting dolphins and loading platform as well as surface preparation/painting of new pipe racks and existing steel framing. Mooring buoy improvements involved new anchors and new chain. As part of the improvements, the mooring buoys were relocated to satisfy new operational criteria. M&N provided construction services during bidding and successfully negotiated with the contractor to keep the project within the construction budget without reducing the project scope. During construction, M&N provided construction support services in the form of 6 site visits to review repairs, shop drawing review, “as-built” drawing preparation, and assistance in selection of a full-time construction inspector.

Side-by-Side Floating Storage and Re-Gasification Unit (FSRU) Mooring and Downtime Analyses Various Clients

M&N performed relative motion analyses for side-by-side FSRU / LNG tanker offloading in conjunction with operational downtime studies for several clients. Adding complexity to the modeling was the fact that the moorings were located in shallow (25m to 50m) water depths, requiring use of the full quadratic transfer function (QTF) matrix to calculate motions and mooring forces. Characteristic relative motions between manifolds were calculated using state-of-the-art mooring analysis programs for several environmental conditions and relative headings, and served as input along with a proprietary software program developed to determine operational downtime for a given hindcast of varying lengths and intervals (i.e. 20 years of wind, wave and current data at 1 hour intervals).

Transit Analysis and Marine Traffic Study, Maine
Confidential Client

M&N carried out a study to evaluate the impact of LNG carrier traffic on the existing vessel traffic in the area. A simulation model was developed and various scenarios were run to estimate the vessel delays in the system, both before and after the introduction of the new LNG traffic. The computed delays were compared to assess the repercussion of the additional traffic on existing ship traffic.

Tank Size / Shipping Logistics Study, Jamaica
Confidential Client

M&N carried out FEED work for the marine facilities. The study evaluated the logistics associated with shipping LNG from an export terminal to the proposed import terminal in Jamaica.

Marine Facilities Assessment, Pakistan
Confidential Client

M&N assessed the suitability of three potential LNG terminal sites to accommodate LNG vessels of the size required by this project, providing a basis from which the project team could proceed with the pre-qualification and bid phases of the project.

Shipping and Storage Study, and Traffic Study, Oregon
Confidential Client

M&N conducted a shipping simulation was carried out to evaluate the logistics associated with shipping LNG from three feed terminals to a proposed LNG import terminal, and to determine the adequacy of the proposed storage. A closed-loop, discrete event simulation modeled the operations at the import terminal, including onshore storage tanks, the re-gasification process, and send-out to the customer, and transport of LNG from three export terminals.

The number of LNG carriers required in each of the three fleets was determined based on the send-out requirement, the desired mix, and the volume of gas resulting from each cubic meter of LNG from the three sources.

Another study was carried out to assess the effect of the increased LNG traffic on the existing vessel traffic on the waterway. A probabilistic shipping traffic simulation model was developed to simulate the vessel movements within the ship channel. Various navigation regulations and traffic rules were applied in the model.

Shipping Study, Equatorial Guinea
Confidential Client

M&N carried out a simulation study to evaluate the need for a third storage tank as a result of the increased production at an LNG export terminal. M&N also conducted a simulation study to evaluate the shipping and storage requirements, and a simulation study to evaluate the potential downtime associated with local weather conditions and night restrictions at the terminal.

Ship Traffic Study, Lake Charles, Louisiana
Confidential Client

M&N determined the impact of proposed expansion of LNG import terminal operations on existing vessel traffic. Determined what configuration of the port facilities would optimize the envisioned expansion.

Relative Motions Study
Confidential Client

M&N assisted with the development of a turret-moored FSRU. The purpose of this study was to: select the minimum water depth for siting the FSRU; calculate the time history of motions and side-by-side mooring response corresponding to the metocean hindcast; calculate metocean environmental combinations and responses that limit the FSRU – LNG carrier side-by-side mooring / fender system for the mooring and relative motion responses of interest for the selected water depth; and calculate the relative motion demands on the loading arms.

Maintenance Dredging Plan, Texas
Confidential Client

M&N developed a maintenance dredging plan for a proposed LNG import terminal. The plan outlined the required maintenance dredging volumes, frequency, and proposed placement and/or beneficial re-use associated with the 30 year design life of the terminal facility.

Pre-FEED Motions and Mooring Analysis, Gulf of Mexico
Confidential Client

M&N calculated the motions and mooring loads for ships berthed at an offshore LNG terminal, and prepared pre-FEED berth arrangements. The terminal's arrangements were centered on a gravity base structure.