

**Michael W. Toner**  
**Executive Vice President – Marine Systems**  
**General Dynamics Corporation**

---

Testimony before the  
House Armed Services Committee  
Seapower and Expeditionary Forces Subcommittee

Washington, D.C.  
March 20, 2007

**NOT FOR PUBLICATION UNTIL RELEASED BY  
HOUSE ARMED SERVICES COMMITTEE**

**Michael W. Toner**

**Executive Vice President – Marine Systems**

**General Dynamics**

Michael W. Toner became an executive vice president of General Dynamics in March 2003. He is responsible for the Marine Systems group, which includes Bath Iron Works, Electric Boat and NASSCO. He had been a vice president of General Dynamics since January 2000 and president of Electric Boat from January 2000 to October 2003.

Toner joined Electric Boat in 1965 as a test engineer and over the next 25 years had held several managerial positions, including manager of Reactor Services, manager of Trident ship's management, assistant general superintendent of the Pipe Shop, and director of facilities management. In 1990, Toner was appointed Electric Boat's director of operations and directed all production, planning and support activities from the start of a submarine's construction to its delivery. He was promoted to vice president of operations two years later. In 1994, he was appointed vice president of delivery and was responsible for all production, delivery and support activities at Electric Boat's five facilities in Connecticut, New Jersey, New York and Rhode Island. In 1995, he became vice president of innovation and was responsible for all engineering and design activity. In 1998, he became senior vice president of Electric Boat.

Toner was born in April 1943, in New Brunswick, New Jersey. He earned a bachelor's degree in nuclear science from the New York Maritime College in 1965, a master's degree in engineering from the University of Connecticut in 1970, and an executive-level master's degree in business administration from the University of New Haven in 1982.

**NOT FOR PUBLICATION UNTIL RELEASED BY  
HOUSE ARMED SERVICES COMMITTEE**

## Opening Remarks

Mr. Chairman and members of the committee, I am Mike Toner, Executive Vice President of General Dynamics Corporation Marine Systems. Thank you for convening this hearing. Two years ago I spoke in a similar forum to the Senate Armed Services Committee Seapower Subcommittee on the status of General Dynamics' shipyards and the future outlook for the shipbuilding industry. At that time I noted several critical steps that were essential to reducing the cost of ships. Paramount among these steps was ensuring a stable shipbuilding plan. As reflected in the Navy's FY08 Long Range Shipbuilding Plan, submitted to Congress last month, it appears that this goal has been partially achieved - there are no changes to the Navy's force structure requirements.

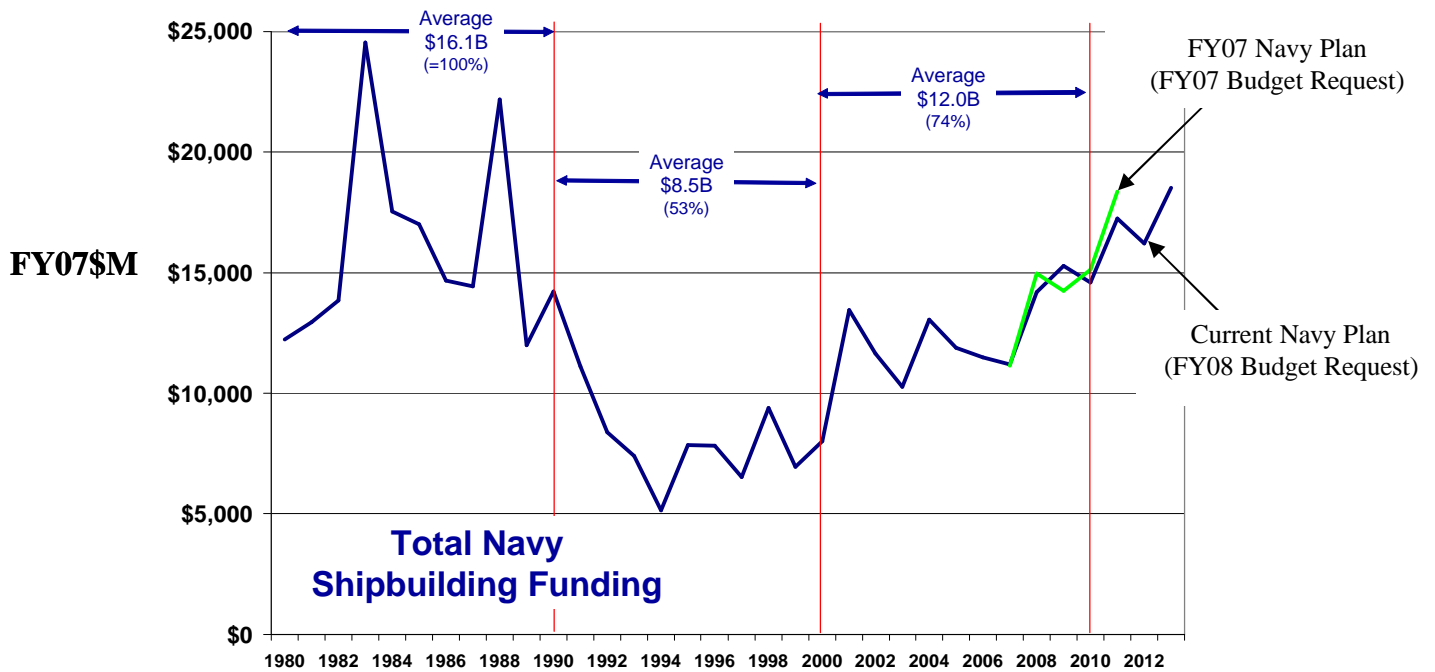
Unfortunately, what we are beginning to see in the Navy's FY08 funding plan is a downward trend in funding from the FY07 plan. Specifically, the FY08 plan shows a reduction in New Construction funding of nearly \$3.5B from the FY07 plan over the four year period FY08 – FY11, with a \$900M reduction in FY08. The risks in failing to meet the Navy's funding requirements are clear – the continued erosion of the shipbuilding industrial base and greater risk to achieving stated force level goals. This trend is particularly an issue in that the Navy's FY08 Long Range Plan also states that the “annual funding required to achieve and sustain the 313 ship force structure is about \$13.4B (FY05) per year or \$14.4B (FY07) per year.”

It is significant to note that although overall defense spending has returned to or surpassed Cold War levels, the shipbuilding component of the defense budget is only about three-quarters of what was funded over the 1980's. Compounding this issue is the recovery from the 1990's when shipbuilding funding declined to about 50 percent of Cold War levels. Across the industry, these dramatic market changes have had severe implications to employment, economic viability, and certainly in the ability to invest in facilities and process improvement.

A commitment to program and funding stability is absolutely essential to provide both shipbuilders and suppliers with the confidence to make the investments that will improve our efficiency, modernize the industrial infrastructure, and develop processes and technologies equal to world class standards.

Just as important as program and funding stability is increased volume. With increased volume, industry will achieve greater labor efficiency, reduced labor rates through increased overhead absorption, and reduced material costs through more economic quantity purchases. Most importantly, we will continue to deliver the highest quality warships to the Navy at a more affordable cost.

### Navy Shipbuilding Funding Trends



**The risks in failing to meet the Navy’s funding requirements are clear – the continued erosion of the shipbuilding industrial base and greater risk to achieving stated force level goals.**

## General Dynamics Marine

General Dynamics Marine is comprised of three major shipyards: Bath Iron Works in Bath, Maine; Electric Boat in Groton, Connecticut; and NASSCO in San Diego, California. These shipyards have a long and proud history of providing the Navy with ships and submarines used to project U.S. presence around the globe. The Marine Group offers a broad range of integration, design, engineering and production skills in naval shipbuilding. Today, the group continues to provide the Navy with the modern, sophisticated naval platforms and capabilities that will serve the U.S. well into the future, including: nuclear submarines, surface combatants, and auxiliary ships. We also manage ready-reserve and pre-positioning ships and build large-hulled vessels for select commercial customers.

## Global Shipbuilding Industrial Base Benchmarking Survey

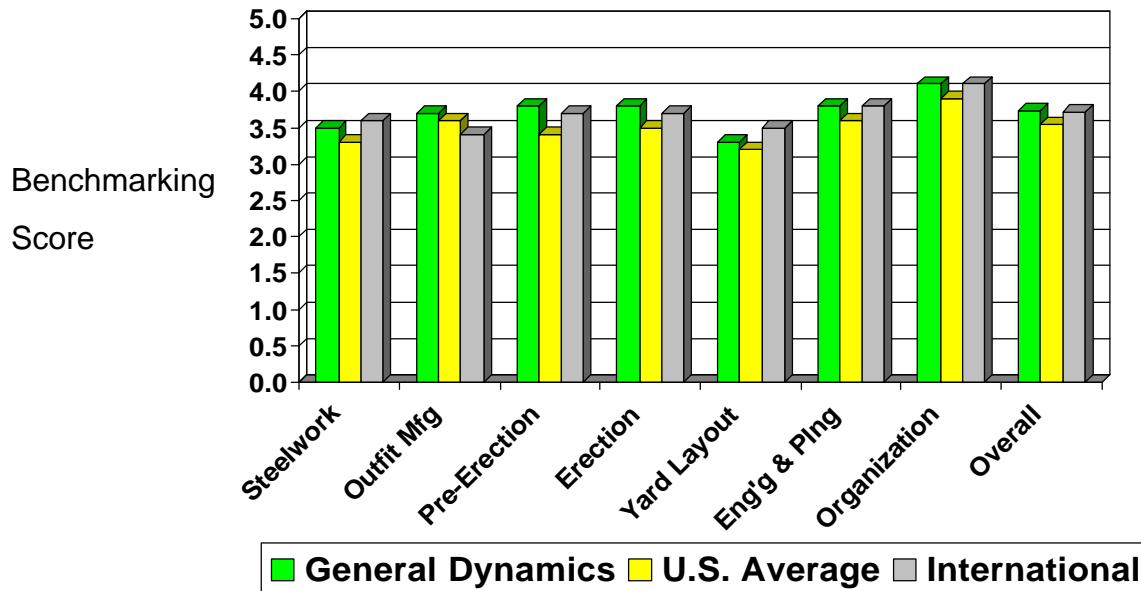
In late 2004, the Deputy Under Secretary of Defense for Industrial Policy (DUSD-IP) commissioned First Marine International (FMI) to conduct a *Global Shipbuilding Industrial Base Benchmarking Study* of the major U.S. and top-performing international shipyards. The resulting report, *First Marine International Findings for the Shipbuilding Industrial Base Benchmarking Study, Part 1: Major Shipyards*, was submitted to the House and Senate Armed Services Committees and the House and Senate Defense Appropriations Subcommittees on January 9, 2006, by the Under Secretary of Defense.

The FMI study examined seven major areas of shipyard technology and productivity:

- Steelwork production
- Outfit manufacturing and storage
- Pre-erection activities
- Ship construction and outfitting
- Yard layout and environment
- Design, engineering, and production engineering
- Organization and operating systems

In the three survey areas associated with General Dynamics' key capabilities, (Outfit Manufacturing, Pre-Erection Activities, and Ship Construction and Outfitting), the General Dynamics yards exceeded the international average.

### OSD Shipyard Benchmarking Survey



**General Dynamics' shipyards exceeded the U.S. average in all seven areas – in five of the seven areas General Dynamics met or exceeded the international average.**

#### GD Marine Shipyard Modernization

In the late 1990's, General Dynamics, in cooperation with the state of Maine and the city of Bath, invested over \$300M in a state-of-the-art Land Level Transfer Facility (LLTF) at Bath Iron Works (BIW) to radically improve surface combatant shipbuilding processes. The investment included a new blast and paint building, transporter roadway, modernization to existing buildings, new equipment and of course the LLTF. In 2006, to further leverage the proven benefits of the world-class LLTF, BIW began construction of a new \$40M Ultra Hall facility. When completed in 2008, this new building will enable significant increases in the size of erection units and consequent expansion of pre-erection unit completion levels; both improvements will enhance BIW's productivity and reduce costs on future surface combatants.

Since 2000, Electric Boat has invested almost \$200M in capital improvements to its Groton shipyard and Quonset Point manufacturing facility. Recently, Electric Boat invested \$70M to repair and modernize its Graving Dock #3, the supporting dock structure for the Groton Land Level Construction Facility. Currently, Graving Docks #1 and #2 are also being repaired and upgraded. The total project cost for these facilities is \$65M and is being partially funded by the State of Connecticut through property tax exemptions and low rate loan packages.

Since the purchase of NASSCO by General Dynamics in 1998, significant investments totaling more than \$160 M have been made to upgrade production facilities to world class levels.

The three General Dynamics shipyards have used the information provided by FMI to guide their capital expenditure and process improvement activities wherever possible. NASSCO is leveraging the results of internal studies as well as the FMI bench-marking report to identify opportunities for facility on process investments. Early investments were made in steel assembly and an automated profile fabrication line resulting in significant reductions to man hours and cycle time in ship construction. The FMI benchmarking survey scores influenced BIW's investment decisions and provided focus for process improvements. The FMI results were mapped to the production process and emphasis was given to improve stages of construction with high work content. Facilities modernization at Electric Boat has included areas the FMI study highlighted for improvement such as steel processing, warehousing and material flow.

#### People – Our Key Resource

As essential as facilities, tools and equipment are to building ships, it is the people that are the essential element. They are the key to building ships. This industry demands a tremendous range of specialized skills -- from the naval architects and engineers that design the ships to the tradesmen and women that form tons of steel into the ship's structure, that integrate the latest mechanical and electrical equipment into the ship systems, and that ultimately, with the Navy, take these ships to sea on their initial trials.

These specialized skills are not readily found in other industries and take years to develop. This is why new shipbuilding orders are critical to the health of the shipbuilding industrial base. In order to attract and retain the next generation of shipyard workers, we must demonstrate that America's shipbuilding industry is healthy and will be a robust environment for them to develop the tools and technologies needed to advance the shipbuilding enterprise.

General Dynamics Marine shipyards are also benefiting synergistically with former Electric Boat executives now in place as presidents of BIW and NASSCO. BIW has implemented the lessons learned from modular submarine construction by moving more work earlier into the construction process and facilitating for this way of doing business. NASSCO is capitalizing on the strong program management approach developed with the VIRGINIA submarine program.



## **ELECTRIC BOAT**

### **Business Overview**

Electric Boat Corporation, headquartered in Groton, Connecticut, has been designing and building submarines for the U.S. Navy since 1899. Starting with the first nuclear submarine, the USS NAUTILUS, Electric Boat has delivered 98 of the U.S. Navy's 195 nuclear submarines. Electric Boat has designed 15 and built the lead ship for 16 of the 19 classes of nuclear submarines, and has designed the propulsion plant for all but one class. Today, Electric Boat remains focused almost exclusively on the design, construction, and life cycle maintenance of nuclear submarines for the U.S. Navy and its allies.

### **Programs**

#### **VIRGINIA**

The VIRGINIA submarine program is the first U.S. Navy combatant designed from its inception for the post cold war threat environment, and, with a focus on affordability. It is the first fully electronic ship design and the first ship to be designed using a revolutionary design / build process, pioneered by Electric Boat. This unique approach brought shipbuilders, designers, engineers, suppliers, and the U.S. Navy together, throughout the design and construction period, to address the competing demands of performance, producibility, and affordability.

The Virginia submarine program is currently planned to be a 30 ship program. The ships are being constructed under a unique teaming arrangement with the two nuclear shipyards, Electric Boat and Northrop Grumman Newport News. The lead ship of the VIRGINIA Class, USS VIRGINIA, was delivered in October 2004, within four months of the original schedule established a decade earlier. The ship completed its first deployment in September 2005, and in the words of the commanding officer, “performed remarkably.” The second ship, USS TEXAS (SSN775) was delivered at NGNN on June 20, 2006. This was the first submarine delivered at NGNN after a ten year hiatus in submarine construction. The third ship in the program, USS HAWAII (SSN776), was delivered by Electric Boat on December 22, 2006, ahead of its original contract delivery schedule and built for two million manhours less than VIRGINIA. The fourth ship in the program, USS NORTH CAROLINA, is 80 percent complete and is scheduled to deliver toward the end of the year.

Six additional ships under contract in the Block II multi-year procurement are at various stages of construction at Electric Boat and Northrop Grumman Newport News. Electric Boat and the Navy are planning for the next seven ship multi-year procurement, which will include ramping up to a procurement rate of two ships per year in FY12, an essential step in lowering ship unit costs.

### **SSGN**

The SSGN Program is converting four former strategic missile submarines of the Ohio Class to a configuration that provide key capabilities for covert strike and clandestine Special Operations Force (SOF) missions. SSGN provides up to 154 Vertical Launch Weapons from missile tubes previously housing ballistic missiles, an enhanced Virginia Class communications suite and a dedicated command and control space for mission planning, and two Special Operating Forces lockout chambers to host dual Dry Deck Shelters and/or Advanced SEAL Delivery Vehicles. The reconfigured ship will be able to house 66 SOF personnel and provide a dedicated SOF command and control planning center.

Electric Boat was responsible for the SSGN conversion design, manufacturing of components and assemblies, and installation and test of the conversion elements at Puget Sound and Norfolk Naval Shipyards. The first SSGN, USS OHIO, was delivered back to the Navy in December, 2005 following its conversion at Puget Sound Naval Shipyard. Since that time, two additional SSGNs have been delivered to the Navy, the most recent on November 22, 2006, two weeks ahead of schedule. The last ship of the program, USS GEORGIA, is completing its conversion at Norfolk Naval Shipyard and is expected to deliver in September 2007.

### **Workforce**

The design, construction, and maintenance of a nuclear submarine, the most complex system in the world today, is extremely labor-intensive. There are over 10,000 engineers, designers, and craftsmen at Electric Boat. Their expertise encompasses a myriad of fields, and is the product of decades of experience. Among the many areas where submarine design and construction calls for unique skills and abilities are: acoustics and silencing; arrangement density; atmosphere control; design for depth and submergence; submarine hydrodynamics, nuclear propulsion; pressure hull design; ship control systems; shock; submarine combat system and weapons handling systems; SUBSAFE; and weight engineering.

Electric Boat's workforce is concentrated at the Groton, Connecticut site, home to most engineering and design activity and where ship final assembly, test, and trials occurs. There are also about 2,000 employees at the Quonset Point, Rhode Island manufacturing and modular construction facility. In addition, Electric Boat detachments and road crews support Navy submarine maintenance and modernization at the two ballistic missile submarine bases; Bangor, Washington, and Kings Bay, Georgia; at the four naval shipyards; at the land-based prototype site in upstate New York; and at engineering field offices in Newport, Rhode Island and Washington, DC.

## **Facilities**

Electric Boat Corporation facilities encompass some of the finest submarine research, engineering, design and construction capabilities in the world. Our engineering and construction facilities, dedicated to submarines, have a replacement value of more than \$1.7 billion. Since the start of the Ohio submarine program, Electric Boat has modernized and upgraded our facilities at the Groton shipyard and at a our manufacturing center in Quonset Point. These investments provide the Navy with in-place, modern, and proven facilities and trained people.

Electric Boat's Groton shipyard occupies 118 acres along the Thames River in Groton, Connecticut supporting both new construction and maintenance activities. Our Land Level Ship Construction Facility (LLSCF) at Groton, which was the forerunner of domestic and United Kingdom land level submarine construction facilities, has operated since 1974. Built in the early 1970's to support the Trident ballistic missile submarine program, and designed for handling, movement, and assembly of heavy outfitted submarine hull sections into complete submarines, it has enabled Electric Boat to continually improve labor-savings, time savings, and modular submarine construction techniques. On the teamed VIRGINIA program, the LLSCF receives hull sections and modules from Quonset Point and Northrop Grumman Newport News, assembles them into completed submarines, and then positions the ships for float-off using electric/hydraulic transfer cars and a pontoon in the associated graving dock.

Two additional dry docks as well as various piers and shops also support overhaul and repair activities for active submarines, primarily those assigned to the Naval Submarine Base, New London.

At Quonset Point, we have a controlled assembly shop facility for hull section modular outfitting and construction. Our Automated Frame and Cylinder Facility at Quonset Point produces hull sections with unparalleled quality and efficiency. It represents an industrial process breakthrough in submarine hull construction. Quonset Point delivers sections of the submarine to the Groton final assembly site which are upwards of 95 percent complete, incorporating not only components and assemblies, but increasingly systems or sub-systems pre-tested prior to shipment. Electric Boat's Quonset Point facility is located on the site of the now closed Naval Air Rework Facility in Rhode Island. It was established during the 1970's when Electric Boat required additional space to support Ohio and Los Angeles Class submarine production.

## **Capital Investment**

Since 2000, Electric Boat has invested almost \$200M for capital improvements to its Groton shipyard and Quonset Point manufacturing facility. Recently, Electric Boat invested \$70M to repair and modernize its Graving Dock #3, the supporting dock structure for the Groton Land Level Construction Facility. Currently, Graving Docks #1 and #2 are also being repaired and upgraded. The total project cost for these graving dock repairs is \$65M and is being partially funded by the State of Connecticut through property tax exemptions and low rate loan packages.

At Quonset Point, the facility investments to improve the VIRGINIA Class submarine construction process include a new \$12.4M steel processing facility, which was dedicated December 17, 2001, only 13 months after groundbreaking. This 45,000 square foot, state-of-the-industry facility has reduced the time required to process a batch of steel from 5.6 days to 1.3 days. The machinery includes: automated blast machine; laser marker with second side capabilities and plate flipper; water jet, which cuts plate up to eight inches thick; high definition plasma cutter for double-bevels to 1.5" thick; and laser cutter for plates to ¾" thick.

## **Virginia CAPEX Program**

The overarching vision for the VIRGINIA Class Improvement Initiative is to provide greater value to the Navy by reducing the cost of VIRGINIA Class construction. In order to achieve this vision, it is our intent to establish a more affordable and sustainable VIRGINIA Class co-production build plan by leveraging the strengths of respective facilities to realize greater production efficiency; achieve a reduction in total shipyard labor hours for construction; achieve a reduction in cycle time for final outfit, test, and delivery; and improve the combined learning curve efficiency. This initiative is facilitated through the Virginia Class CAPEX Program.

The Block II VIRGINIA submarine construction contract ties \$231M of profit to five specific incentives: labor cost control; material cost control on 35 major components that drive CFE material cost; schedule performance on key construction events; total cost performance; and CAPEX. CAPEX provides profit incentives of up to \$91M to the shipbuilders to invest in facilities and process improvement projects that provide cost savings to the program. The contractors prepare a business case analysis for potential projects which is then presented to the Navy for review and approval. Approval is at the sole discretion of the Government and based upon the Government's determination that the proposed project is in the best interests of the VIRGINIA program. Within thirty days after approval by the Government and commencement of a project, a Special Incentive not to exceed 50 percent of the estimated investment cost is paid to the shipbuilder. Upon successful implementation of the project, an additional Special Incentive not to exceed 50 percent of the original estimated investment cost is then paid to the shipbuilder.

To date, \$36M of the potential \$91M CAPEX incentive payments have been earned by Electric Boat and Northrop Grumman Newport News. Three infrastructure improvement projects at EB have been completed with CAPEX funding



**Light Metal Fabrication Facility**  
**\$10M Investment--\$31M Program Savings**



**Module Transportation & Facilitization Project**  
**\$13.1M Investment--\$99M Program Savings**



**Coatings Facility**  
**\$9.4M Investment--\$139M Program Savings**

**The Light Metal Fabrication Facility, the Coatings Facility, and improvement to the Modular Transportation System are three projects completed under the CAPEX Program. These three projects provide over 3 M manhours of savings for ships in the Virginia submarine program.**

The Light Metal Fabrication Facility project is designed to achieve a step change in cost, accuracy, expanded capabilities, and performance of light metal fabrication and structural assembly of VIRGINIA Class components. The savings will be accomplished by the reduction in labor hours performed during the manufacturing and assembly process for light metal assemblies. The scope of light metal fabrication and assemblies work includes ventilation assemblies, joiner type work, stowage & lockers, consoles and special fittings. Ground breaking for the facility took place in November 2004. The facility achieved full on-line capability in November 2005. The state of the art technology and machinery, with its sorting, cutting, punching, bending and shaping capability, is considered the most advanced facility of its kind in the United States. The forecasted gross total Virginia Class cost saving for the \$10M investment are \$31M. In addition to the cost benefits, the new machines and process flow will help to enhance worker safety while improving the quality of the piece parts, and ultimately the final product, through improved accuracy and precision.

The submarine Coatings Facility is a self-contained, environmentally controlled building with requisite systems and equipment to support cost-effective application of coatings associated with submarine construction in both axis-horizontal and axis-vertical orientations. These coatings include tile and mold-in-place (MIP) special hull treatment (SHT), high solids and traditional epoxy paints, sound-damping, anti-sweat, and various other coatings. The Coatings Facility includes equipment for complete surface preparation of internal ship structures and tanks, main ballast tanks, hull cylinders and ship sections, and a mechanized blasting system for exterior hull surfaces. The Coatings Facility will accommodate improved construction sequence and shorten final assembly time. The Coatings Facility Project will enable a total savings of approximately \$139M for the VIRGINIA Class through the investment of ~\$9.4M of CAPEX funding.



The Module Transportation & Facilitization Project will increase the level of submarine modular construction efficiency by developing a transport system and infrastructure that supports modules up to 2,000 tons, versus the previous 1,580-ton system. This project will reduce VIRGINIA Class construction cost by enabling maximum submarine modular construction prior to module transport to the final assembly and test facility. Implementation of this project permits the creation of four essentially complete modules that are shipped to the final assembly facility. The completion of this additional work in a shop environment enables a reduction in construction risk by enabling earlier testing and alignment of critical systems and components. Increased module outfitting increases module weight from 1,580 tons (the heaviest module currently shipped) to ~2,000 tons. Overall module lengths will also increase to a maximum of 120 feet. To accommodate the heavier, longer modules, capital improvements were required to the existing support and transfer / transport system. This increase in efficiency results in approximately \$12M cost savings for Block II and approximately \$99M over the Virginia Class for an investment of \$13.1M.

### **Reengineering Savings**

With the abrupt rescission of the Seawolf program in 1991, Electric Boat was confronted with the challenge of remaining a viable enterprise in the face of a business future where its sole production program had been canceled. Electric Boat responded to this challenge with an immediate and complete reengineering of its business. This was an aggressive plan to ensure successful completion of its backlog of work while positioning the company to remain viable in what was expected to be a dramatically reduced submarine production market. Key objectives were: to be properly sized to meet demand; to utilize “best practices” for all processes and procedures; and to incorporate a culture of world class performance. As a result, Electric Boat has led the industry in shedding excess production capacity, reducing overhead and infrastructure costs, and developing tools and methods to preserve critical skills and capabilities during low rate production.

One of the most critical steps in the reengineering process was changing the historical relationship between overhead costs and direct labor costs. In 1992, at the outset of Electric Boat's reengineering effort, an aggressive, long range, overhead cost reduction target was established for 1998. A plan was laid out that included significant reductions in overhead cost each year. Electric Boat's realization of its goals necessitated identifying key cost areas, breaking each one down into discrete elements, and, most importantly, taking aggressive management actions to minimize these costs. These actions have resulted in actual and projected cost savings of over \$2.7B over 1993 through 2010; \$1.7B from 1993 – 2004, and \$1.0B from 2005 – 2010. Over 95 percent of those savings have or will accrue to the Government.

### **Labor Efficiencies, Learning Achieved, LEAN**

Electric Boat is proud of our culture to continuously improve our products and processes. We are in our fifth year of applying Lean Six Sigma tools to the entire submarine design, construction, test, and repair process. To date, we have trained over 500 Electric Boat employees in Lean Six Sigma. Lean Six Sigma at Electric Boat is deployed enterprise wide with a strong focus on leadership development, process management and, most importantly, employee engagement.

In 2006, Electric Boat completed 131 Lean Six Sigma projects producing a net hard savings of \$16.2M. We also have 223 more projects in process. This resulted in a program return on investment of over 6:1.

Electric Boat has trained over 150 employees in Lean Six Sigma black belt or green belt skills and over 380 management personnel in the tools for Process Management. This investment is now paying off in just about every facet of Electric Boat, from reducing the cost of new construction to improving performance on overhaul and repair activities.

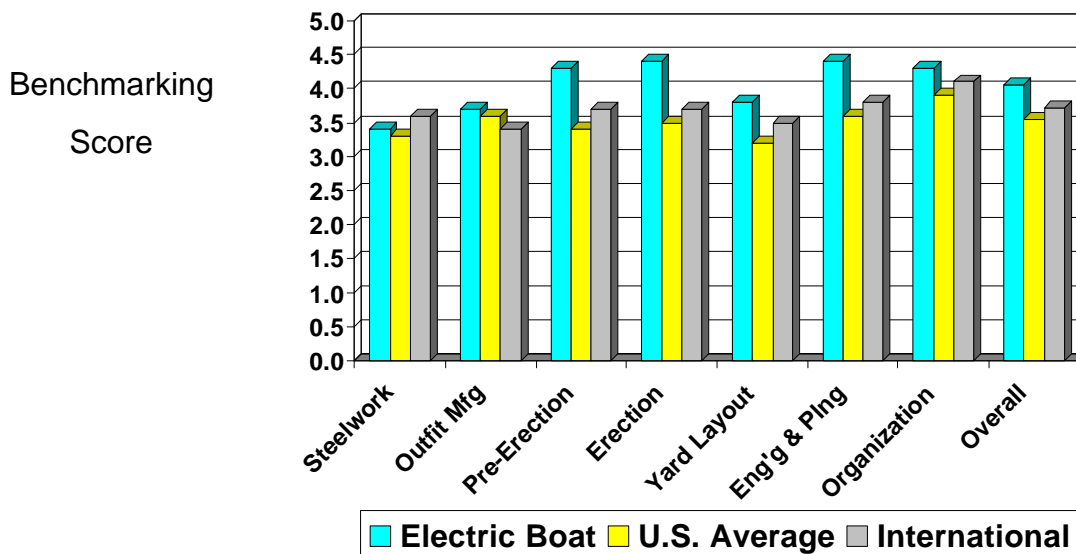
Electric Boat is working closely with industry partners, the Government and our suppliers to make submarine design, procurement and repair more affordable.

## Global Shipbuilding Industrial Base Benchmarking Survey

Similar to the performance already discussed for the three General Dynamics shipyards as a group, the results of the *First Marine International Findings for the Shipbuilding Industrial Base Benchmarking Study, Part 1: Major Shipyards* found Electric Boat to be a world-class performer.

In all seven areas of shipyard technology and productivity, Electric Boat exceeded the U.S. average, and in six of the seven areas Electric Boat exceeded the international average. In fact, in two of the areas Electric Boat scored higher than any international yard, and equaled the top international performance in four others. The one area where Electric Boat did not excel, steelwork production, was the result of having older, less automated technology in the plate and shape storage and handling categories, an area FMI explicitly stated was at the correct level of technology given the limited value of steelwork in a submarine as compared to a commercial vessel. FMI noted that “to achieve the lowest cost, a shipyard needs to have an appropriate level of technology for its cost base, its product mix and throughput. The extent to which the use of best practice influences productivity in a particular area is related to the proportion of man-hours spent in the area.”

**OSD Shipyard Benchmarking Survey**



**In all seven areas of shipyard technology and productivity, Electric Boat exceeded the U.S. average, and in six of the seven areas Electric Boat exceeded the international average.**

## **Looking to the Future**

The VIRGINIA Class Program is well on its way to becoming a benchmark DoD acquisition program in terms of cost, schedule and performance. With three ships delivered and construction progressing smoothly on the remaining ships currently under contract, VIRGINIA is a mature program with demonstrated success. As a mature program, it is not subject to the risks inherent in new development programs and it is incumbent on the shipbuilders to focus their efforts on program execution and unit cost reduction. To this end, Electric Boat and Northrup Grumman Newport News are is sharply focused on achieving the VIRGINIA cost challenge. Our effort is focused around four key initiatives:

- Reducing the construction schedule from 84 months to 60 months, facilitated by improved construction and material planning systems, with enhanced manufacturing, modular assembly, and final assembly and test;
- Achieving learning efficiencies in a low rate production environment, by maximizing workforce stability of the shipbuilders and across the submarine supplier base, and applying Lean Six Sigma and lessons learned across all processes a the yards and suppliers;
- Improving the design to remove inherent costs and enhance mission capability, with limited ship redesign aimed at reducing material cost and improving production efficiencies;
- Implementing an acquisition strategy that supports efficient material procurement and construction, utilizing Advance Procurement (AP) and Economic Order Quantity (EOQ) funding to reduce material costs and achieve construction schedule reduction. Also, maximizing the savings afforded by multi-year procurement.

Achieving this goal requires establishing a more affordable and sustainable VIRGINIA Class co-production build plan by leveraging the strengths of respective facilities to realize greater production efficiency; achieve a reduction in total shipyard labor hours for construction; achieve a reduction in cycle time for final outfit, test, and delivery; and improve the combined learning curve efficiency by the end of Block II construction.

## **BATH IRON WORKS**

### **Business Overview**

Bath Iron Works, located on the west bank of the Kennebec River in Bath, Maine, delivered its first ship to the United States Navy in 1893 and has continued that proud tradition to this day. Since that date, BIW has delivered over 400 ships, including 245 military ships and more than 160 commercial vessels and private yachts. Most recently, BIW received its first commercial contract in twenty years and is working jointly with another company on an offshore supply vessel conversion.

### **Major Construction Programs**

At present, BIW is participating in three design and construction programs that constitute the Navy's premier surface combatant construction programs for the next decade. Given the planned low procurement rates for these warships, BIW is pursuing other ship construction opportunities beyond the traditional Navy customer.

### **DDG 51**

BIW is the lead designer and builder for the DDG 51, Arleigh Burke Class of destroyers that have been BIW's mainstay construction work since 1987. To date, BIW has delivered 27 of these ships and will build a total of 34 of the 62-ship class. DDG 112, the last ship of the Class, will begin fabrication in July 2007 and BIW will deliver the ship in the first quarter of 2011. BIW not only builds the DDG 51 Class ships, but also works closely with Northrop Grumman Ship Systems (NGSS) of Pascagoula, MS, the follow yard builder, and the Navy as the class design agent. In addition, BIW provides support for the ships currently operating in the U.S. Navy fleet under the Planning Yard contract for the Class. BIW provides "cradle to grave" support to the Navy for the Arleigh Burke Class of destroyers.

## **DDG 1000**

BIW is actively involved in all engineering and design aspects of the DDG 1000 along with NGSS and other government and industry team members. BIW and NGSS were each awarded contracts in August 2006 to each perform approximately half of the detail design. The industry team is leveraging state-of-the-art technology and industry best practices, specifically the collaborative design/build approach developed by Electric Boat on the Virginia program, to deliver a superior surface combatant design ready for construction. BIW anticipates starting fabrication for its first ship in mid-2008.

## **LCS**

BIW leads the GD LCS team providing program management, planning, technical management, contract administration, design and construction support. Construction of the first GD LCS began in November 2005 and the keel was laid on 19 January 2006 at teammate Austal USA's facility in Mobile, Alabama. In addition to the work being performed in Bath, BIW currently has approximately one hundred craftspeople, engineers and managers located in Mobile supporting the program. The team is focused on the challenges of lead ship construction and getting the first ship to sea. When delivered in mid-2008, the GD LCS, an innovative trimaran design, will provide a new, revolutionary capability to the naval surface fleet.

## **Workforce**

BIW produces the world's most sophisticated surface combatants, which require a wide array of specialized skills from the naval architects performing concept design to shipyard mechanics bringing the ship to life. While appropriate facilities are an important component of successful ship production, maintaining the capacity for innovation and skills of the workforce is paramount to the health and viability of the shipbuilding industrial base. BIW's skilled workforce has an average of twenty years experience in the engineering, design and manufacturing ranks. Care must be taken as the surface combatant construction programs enter low-rate production that these perishable, highly-experienced core shipbuilding skills are maintained in the face of retirements and reductions-in-force due to decreased workload.

BIW is one of Maine's largest private employers and plays a significant role in the state's economy. Driven by decreasing shipbuilding volume and efficiency gains within the shipyard, BIW's employment has fallen from approximately 7,900 employees in 2000 to about 5,600 through the beginning of 2007 – a decrease of almost 30 percent.

### **Facilities**

BIW is located on 73 acres in the city of Bath and is supported by offsite fabrication and warehousing facilities. Beginning in the late 1980s, BIW made numerous capital investments to support the start of the DDG 51 program including construction of an outfit fabrication facility, a building hall for large unit construction and a climate-controlled warehouse. Additionally, a 300-ton crane and a 450-ton transporter to move large units around the shipyard were also purchased. The next major recapitalization began in the late 1990's after General Dynamics' acquisition of BIW. General Dynamics, in partnership with the state of Maine and the city of Bath, invested over \$300M in a state-of-the-art Land Level Transfer Facility (LLTF) at Bath Iron Works to dramatically improve the shipbuilding process. The investment included the LLTF, a flat, 15-acre facility to support the assembly and launch of ships; a floating dry dock to launch the ships; the Manufacturing Support Center which co-locates manufacturing management and support personnel, as well as warehousing and support services on the LLTF in close proximity to the ships under construction; a new blast and paint building; and modernization to other existing infrastructure. The size and throughput capacity of this flexible, world-class facility was established in cooperation with the Navy based on the FY99 projected surface combatant plan that was significantly higher than today's lower-rates of production.

Fundamentally, the LLTF allows work to be moved to earlier, more efficient stages of construction where access to equipment is less congested and support services are more readily available. The LLTF eliminates weight and size restrictions formally imposed by the inclined ways method of construction. Shipyard workers build and outfit increasingly larger combinations of hull “units”— sections of ship complete with piping, cabling, and equipment—inside climate-controlled building halls that are then joined into complete ships on the LLTF. Outfit Support Towers on the LLTF provide workers with multi-level access to the ship and contain offices, work shops, tool rooms, lockers and food service areas to keep services required by the shipbuilders convenient to the job site. The LLTF investment allows the ship to be built more efficiently with more final construction work and outfitting completed while the ship is still out of the water. When the planned level of pre-launch work is completed, the ship is translated from the LLTF onto a floating dry dock and becomes waterborne for the first time. The following figure shows the physical arrangement of the main shipyard.



- Off-site Support Facilities:**
1. Hardings Structural Fabrication Facility
  2. East Brunswick Manufacturing Facility (Pipe Shop & Sheet Metal Shop)
  3. Consolidated Warehouse Facility
  4. Surface Ship Support Center
  5. Church Road Office Facility (Technical)

- |                            |                                  |  |
|----------------------------|----------------------------------|--|
| 6. Production Shops        | 13. Pre-Outfit II Building       | 20. Dry Dock Landing Grid #2               |
| 7. Erection Plattens       | 14. Land Level Transfer Facility | 21. Dry Dock Landing Grid #3               |
| 8. Blast & Paint Facility  | 15. Ship Way #1                  | 22.-25. Outfitting Piers                   |
| 9. Small Assembly Building | 16. Ship Way #2                  | 26. Manufacturing Support Center           |
| 10. Panel Line             | 17. Ship Way #3                  | 27. Engineering Building                   |
| 11. Aluminum Shop          | 18. Floating Dry Dock            | 28. Main Office & Administration Buildings |
| 12. Main Assembly Building | 19. Dry Dock Landing Grid #1     |  |

- Key:**
- Fabrication
  - Pre-Outfit
  - LLTF
  - Ships Completion
  - Other

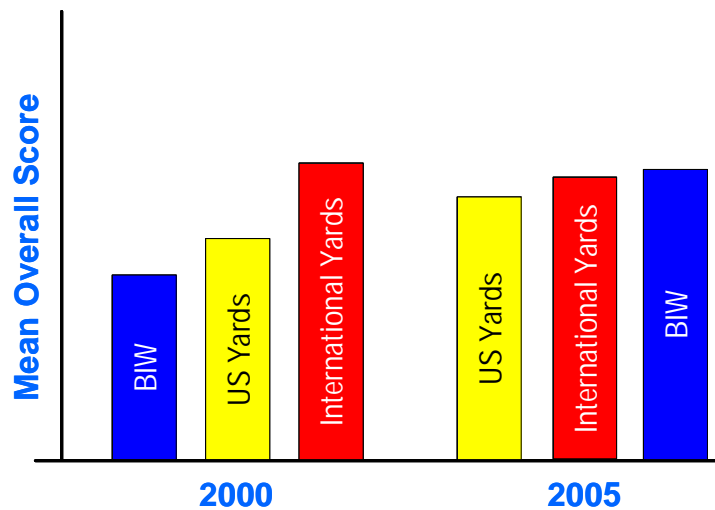
**General Dynamics, in cooperation with the state of Maine and the city of Bath, invested over \$300M in a state-of-the-art Land Level Transfer Facility to radically improve the shipbuilding process.**



In addition to the macro shipbuilding process changes associated with the activation of the new facility in May 2001, myriad lower-level improvements associated with lean manufacturing principles have been continuously introduced due to the innovative spirit of BIW’s skilled mechanics and managers. Some of BIW’s surface combatant “firsts” include “lighting-off” the ship’s generators before launch; aligning the main propulsion power train before it is water-borne; using photogrammetry, a technology principally developed for surveyors and cartographers, to aid in equipment and structural alignment; and reducing the number and length of sea trials.

**Global Benchmarking**

As previously described, in early 2005 the Deputy Under Secretary of Defense – Industrial Policy (DUSD-IP) conducted a global shipbuilding industrial base benchmarking study as a follow-up effort to a similar study conducted in 2000. In the 2000 study, BIW was ranked below the U.S. average and international yards were well ahead of BIW and other U.S. yards. The LLTF under construction was not reflected in the scores since it was not yet operational. When the study was repeated in 2005, it showed that BIW had risen above the U.S. average in the use of best practices and was slightly above the international average as seen below.



**BIW’s use of shipbuilding best practices has increased to world-class levels during the past five years.**

BIW has used the benchmarking survey scores throughout the shipyard to provide focus for additional process improvements as well as to influence future investment decisions. The benchmarking category scores were mapped to BIW's production process and greater emphasis was given to further improve those stages of construction with high work content to maximize productivity improvements. Similarly, investment decisions have been made to increase the use of best practice in areas which will have the greatest effect.

### **Mega Units**

Subsequent to the Global Benchmarking study, additional productivity and process improvements were identified as the new LLTF production processes matured. Consistent with BIW's construction strategy of moving work to earlier, more efficient stages of construction, the next logical step was to build and outfit larger units, referred to as Mega Units. Mega Units are created by joining smaller units together inside a building, enabling the installation of a majority of the equipment before being transported to the LLTF for erection. These Mega Units weigh as much as 1,400 tons, versus the 450-ton units on earlier LLTF ships. By moving work that was once performed outside on the LLTF into a climate-controlled facility where shipbuilders have better access to the individual units, BIW was able to achieve greater construction efficiencies in a safer work environment. The first two mega units were completed in 2006 and produced significant productivity improvements on the first hull. This strategic improvement to ship production at BIW was the result of innovative mechanics, supervisors and planners continuing to exploit the value of the LLTF investment and leveraging the collective assets of GD Marine. Mega Units required little capital investment because EB had purchased large transporters under the previously-described Virginia CAPEX program to move similarly large submarine units. The transporters are easily moved over-the-road between Maine and Connecticut and are shared by BIW and EB, avoiding the need for additional equipment investment.



**Mega Units enable more efficient use of the of the LLTF by moving work to earlier, more efficient stages of construction**

### **Performance Improvements**

The LLTF investment, combined with the innovation and skill of BIW's workforce, has dramatically decreased the number of hours required to construct a destroyer. Today, it takes 1 M fewer labor hours to build a DDG at BIW today than it did just four ships ago. This is a significant accomplishment given the late stage of the DDG 51 program with 27 ships, or 80 percent of BIW's total number of ships, delivered and at the point when learning curves traditionally predict minimal ship-to-ship savings. It is important to note that even though the cost savings have been dramatic, quality has been maintained. In fact, the Navy inspector aboard the most recent sea trials for DDG 101, USS GRIDLEY stated, "Overall performance could not have been better." The net result is an affordable, quality ship for the U.S. Navy.

### **Ultra Hall Investment**

Building on the Mega Unit concept, BIW identified further process changes that will continue to improve shipyard efficiency and reduce costs. The next big step is to construct even larger ship sections, known as Ultra Units. However, units of this size exceed the size and weight restrictions of BIW's current facility and, given the business environment changes since BIW's last major capital investment, industry's ability to invest independently is much more limited. With the prospect of a decade of low-rate procurement plans for major warships, this business environment does not support near-term investments for the potential of a longer-term return - a difficult and uncertain prospect for shareholders, given historical instabilities of procurement plans. Despite these unfavorable market conditions, BIW, in cooperation

with the Navy, was able to develop the business case to justify General Dynamics' investment in the \$40M Ultra Hall facility with capacity to build Ultra Units up to 5,000 tons each. This decision was based on the strength of BIW's demonstrated performance improvements and the prospect of continued, sustained improvements on the remaining DDG 51 Class ships. Given that this substantial capital investment will result in lower total costs to the Navy, BIW and the Navy agreed to change contract terms to allow BIW to reinvest the resultant savings in the construction of the Ultra Hall facility.

The Navy will see reduced costs on the final ships of the DDG 51 Class —DDGs 111 and 112—and BIW expects to save approximately \$340M in total future surface combatant construction costs using the Ultra Unit concept. The timing of the investment is important to BIW. Not only will the new facility benefit the DDG 51 Program, but it will also allow BIW to refine the techniques necessary to construct and integrate even larger ultra units required for the DDG 1000 Class. The following figure shows the taller, new Ultra Hall facility next to the existing pre-outfit building.



**The \$40M Ultra Hall Facility will further enhance BIW's productivity and reduce costs on future surface combatants.**

### **Design Best-Practices**

In addition to construction process changes and facility modernization, BIW is committed to developing an efficient, producible DDG 1000 design. The key to achieving this goal is leveraging design-build and best-practice approaches to outfit modularization and integrated engineering methodologies pioneered on the Virginia Program. In addition, we are applying standard engineering best-practices, such as Lean Six Sigma. Essential ship production knowledge and skills are concentrated in the manufacturing division and must be captured early in the design process to ensure that the design not only meets technical requirements but also is efficiently produced. The challenge was to define a new design strategy and supporting organization that would enable integration of this knowledge into the pre-production areas with specific emphasis on embedding the production processes in the production design information. This has been accomplished using design-build teams with membership drawn from the engineering, design, planning and production disciplines so best-practices are embedded into the design product from the outset and rework minimized. This process is being used across the DDG 1000 Design-Build Team by key participants from NGSS, EB, and the Navy and employs a common, comprehensive design-build strategy and established written production guidelines to ensure the final design can be built efficiently in both shipyards.

### **Re-Engineering**

BIW has continuously re-engineered all aspects of its business since being acquired by General Dynamics in 1995. When the DDG 1000 procurement rate dropped to one ship a year in 2005, BIW took aggressive actions to become more competitive and affordable in preparation for lower rates of ship construction. These actions included right-sizing the workforce across all functions within the company, reducing paid holidays and lost time, eliminating salaried severance and reducing overhead. Re-engineering actions are continuously revisited to ensure maximum cost savings are being achieved and industry best practices are in place without compromising product quality.

## **Looking to the Future**

When construction completes in 2008, the Ultra Hall facility will further leverage the proven benefits of the world-class LLTF and enhance BIW's productivity. In general, investment incentives create allow investment risk, along with the resultant savings, to be shared between industry and the government. The Ultra Hall project is an example of how government and industry cooperation, to the mutual benefit of each party, can result in successful facility modernization despite a procurement environment that is not conducive to large, independent capital investments.

The capacity for innovation of the BIW workforce, combined with the collective resources of GD Marine and external efforts like the Global Benchmarking study will continue to refine existing processes and identify new areas for focus and investment. The result will be a modernized shipyard providing affordable, quality ships to the U.S. Navy. BIW has a strategic facilities plan for future investment should additional means become available to upgrade existing equipment and facilities or construct new ones. Some examples of future potential investments are:

- § Build new modernized fabrication facilities located within the main shipyard to incorporate new, more efficient steel cutting and forming technologies and eliminate over-the-road transportation and size restrictions imposed by the current offsite facility.
- § Construct a larger blast and paint facility to accommodate larger units prior to being joined in the Ultra Hall facility. This new facility would also enable more effective application of high-solids paint, an increasing requirement in naval construction, in a climate-controlled environment.
- § Upgrade welding equipment to state-of-the-industry machines to significantly improve existing processes to gain additional savings.

BIW is committed to improving overall shipyard productivity. Through investments in people, processes and facilities, the shipyard is focused on being a capable, nimble, affordable provider of quality surface combatants.

## **NASSCO**

### **Business Overview**

National Steel and Shipbuilding Company, NASSCO, in San Diego has been designing and building ships for almost 50 years and is the only remaining private shipyard on the west coast capable of building large, ocean-going vessels. NASSCO, with its 4500 engineers, designers, and skilled shipbuilding craftsmen is the largest industrial manufacturer in the San Diego area and is a strategic resource to both the Navy and Southern California.

NASSCO specializes in a product mix of Jones Act commercial wet and dry cargo ships and Navy auxiliary/underway replenishment ships. Fifty-eight commercial vessels and fifty-five large naval auxiliaries have been designed and constructed at NASSCO since 1961. The commercial ships include large crude carriers, product tankers, break bulk ships, container ships, trailer ships and others. The naval auxiliaries include ships for the Combat Logistics Force (CLF), amphibious ships, destroyer tenders, hospital ships, and a variety of strategic sealift and other support ships. In addition, one quarter of NASSCO's business activity is devoted to maintenance and repair of the Navy's fleet home ported in San Diego. NASSCO, working together with the Navy has developed the most effective mode of Navy maintenance in the country, the Multi Ship, Multi Option (MSMO) contract, which ensures the ships stationed in San Diego get the good quality maintenance at the right time and at the right price.

Importantly, NASSCO, with its well-developed new construction capability, is the only private shipyard on the west coast that can perform major battle damage repair or major structural modifications to Navy ships.

### **Programs**

#### **T-AKE**

The T-AKE 1 LEWIS & CLARK Class dry cargo / ammunition ship is the latest in NASSCO's long line of Navy auxiliary ships. It is the first new underway replenishment ship design in more than twenty years. Using computer modeling and simulation design tools and proven off-the-shelf state-of-the-art

commercial marine systems, NASSCO's T-AKE design incorporates a highly efficient cargo handling system and a low life-cycle-cost electric drive propulsion system. NASSCO delivered the first ship, USNS LEWIS & CLARK in June of 2006. T-AKE 1 has been undergoing extensive operational evaluation with US Navy off of the east coast. The results to date have been extremely positive. Cargo transfer rates achieved for Connected Replenishment (CONREP), Vertical Replenishment (VERTREP) and Fueling at Sea (FAS) all exceeded ORD requirements, in some cases by more than 50 percent. The Military Sealift Command (MSC) has asked for delivery of follow on ships as quickly as possible. NASSCO delivered the second ship, USNS SACAGAWEA, just last week on 27 Feb 2007 and has plans to deliver two more T-AKEs to MSC in 2007. Five additional T-AKEs are currently under contract at various stages of construction. Options for five more ships are expected to be awarded in the near future, bringing the total potential for the class to fourteen ships.



**Figure 1 – USNS Lewis and Clark (T-AKE 1) underway replenishment of USS Theodore Roosevelt (CVN-71) and USNS Mount Baker (T-AE 34) simultaneously**

### **Underway Replenishment and Strategic Sealift**

NASSCO is a leading builder of underway replenishment and strategic sealift ships. From the AFS combat stores ships to the AOE gas-turbine-powered carrier strike group combat support ships, from the Large Medium Speed Roll-on/roll-off (LMSR) sealift ships to the most current T-AKE, NASSCO-built



ships are an essential element of the Navy's ability to operate throughout all regions of the world, independent of shore-based support. The considerable experience gained in each of the Navy's past combat logistic ship and sealift ship program in the areas of design and production ideally positions NASSCO to be a principal contributor on the Navy's forthcoming Sea Basing program. The last three T-AKEs will be built to support the Maritime Pre-positioning Force, Future (MPF(F)). Three new LMSRs are planned based on the original design but with significant added capabilities including an enhanced flight deck and more habitability spaces. Three, large heavy-lift ships, designated the Mobile Landing Platform (MLP), are envisaged as staging areas for the transfer of vehicles, cargo, ammunition and operators from logistics ships to combat craft prior to debarking from the Sea Base and proceeding to the landing beaches. NASSCO stands ready to support the needs of the MPF(F) or any other US Navy auxiliary program foreseen to meet future requirements.

#### **Commercial – PC-1**

NASSCO has built more of the country's commercial oil tankers than any other shipyard today. Currently, NASSCO is working through the final design stages of a series of nine double hulled, Handy-max sized product carriers for US Shipping. These ships will haul refined petroleum products or chemicals in the Gulf of Mexico. NASSCO has teamed with the second largest shipbuilder in the world, Daewoo Shipbuilding and Marine Engineering (DSME) of Korea, to offer our domestic customers a proven quality design, built in the United States, without paying first of class prices. The design is based on two existing classes of product carrier currently in service overseas but tailored to take advantage of the build strategy that best fit the facility at NASSCO in San Diego. Construction will begin in the summer of 2007 with keel laying for the first ship in December, 2007.

NASSCO continues to look for additional opportunities for replacement tonnage or new markets in the commercial Jones Act fleet including additional product carriers, container ships, trailer ships, shuttle tankers, and others. Commercial shipbuilding brings tremendous benefits to the Navy and the nation including:

- Allows shipbuilding and ship design technology benchmarking against the best in the world; not just the best in the U.S.
- Ensures access to the best of international marine technology and competitive prices for commercial marine systems that are found aboard many Navy ships
- Creates a steady order book when combined with Navy programs to mitigate cyclical nature of business thus preserving and enhancing the employment skill level necessary to build ships
- Commercial volume allows for the continuous process improvement in construction technique
- Helps attract a necessary new generation of engineers into shipbuilding
- Spreads yard overhead costs across a wider base making Navy ships less expensive

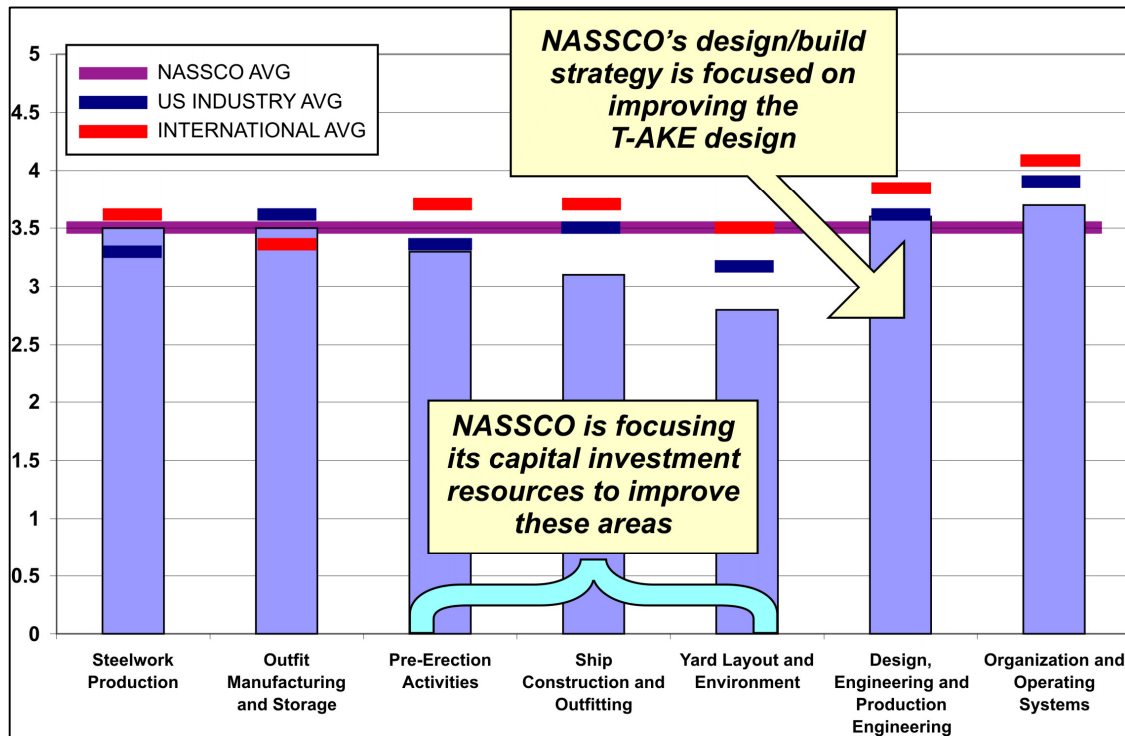
Any assistance, such as, Title XI loan guarantees, that can be brought to bear to increase the number of commercial ships built in this country will pay great dividends in the future. Some of our commercial customers have been forced to secure financing at exorbitant interest rates to fund replacement tonnage. Title XI would allow stable operators in proven markets to replace existing Jones Act tonnage at reasonable rates with relatively small outlays from the government.

### **Facilities**

Since the purchase of NASSCO by General Dynamics in 1998, significant investments totaling more than \$160M have been made to upgrade production facilities to world class levels. Although some benefits from these new facilities were realized on the TOTE and BP ships delivered earlier this decade, the true beneficiary is the Navy's new, T-AKE dry cargo/ammunition ships, future auxiliary ships and future commercial contracts.

NASSCO is leveraging the results of internal General Dynamics and international bench-marking studies (First Marine International (FMI) 1999 and 2004) to identify opportunities for strategic investment. Early investments were made in steel assembly and in an automated profile fabrication line resulting in significant reductions to required man hours and cycle time in early stages of construction. Two additional cranes were added enabling larger lifts (~300 tons individually) to facilitate an increase in the

size and outfit completion percentage of erectable blocks. In the most recent 2004 FMI study (see Figure 2), NASSCO leads the US shipbuilding industry and is approaching the international average in steel production, a significant improvement since the 1999 study.

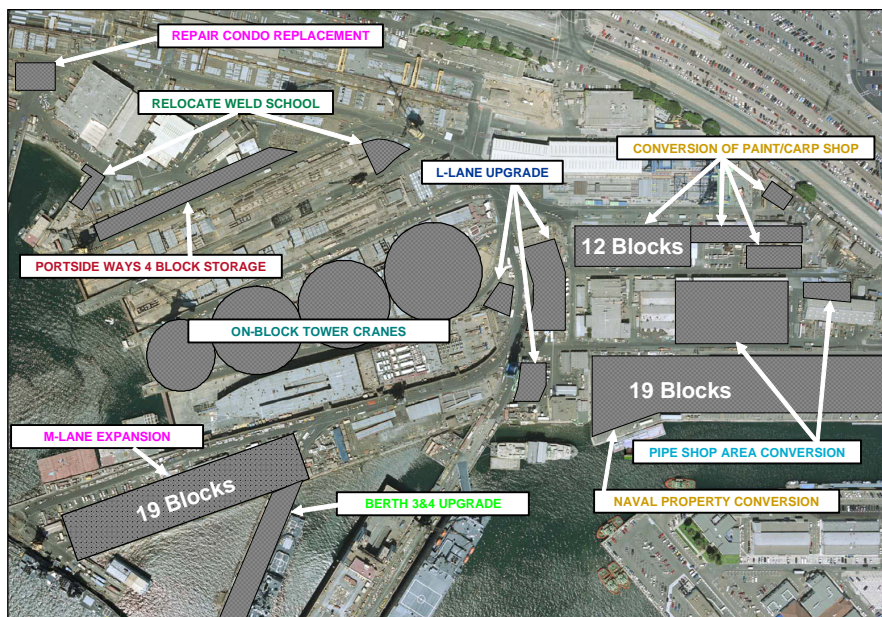


**Figure 2 – 2004 NASSCO FMI Study Results**

As depicted in Figure 2, recent capital infrastructure improvements have been focused on weaknesses pointed out in the 2004 FMI study: pre-erection activities, ship construction and outfitting and yard layout and shipbuilding environment. These initiatives will result in an increase in the percentage of outfitting achieved prior to erection and improved process flow in the shipyard. Improvements to yard layout have increased the number of on-ground outfitting positions by more than 50 percent, greatly supplementing NASSCO's ability to build grand blocks.

NASSCO will continue to conduct self-evaluation and benchmarking within the GD Marine Group and participate in DoD sponsored benchmarking studies. In addition, our partnership with a world class

shipbuilder, DSME, has enabled us to spend a considerable amount of time discussing best practices and challenging existing processes. NASSCO will continue to maximize the on-ground outfitting footprint through internal rearrangement and, potentially, the lease of the Navy property contiguous to the southern boundary of the shipyard. This property would enable the development of a new inverted block outfitting lane and a dedicated blast and paint facility, greatly reducing cycle times for painting onboard. We will continue to eliminate current shipyard bottlenecks, maximize work performed off ship and focus on transitioning from a vertically integrated manufacturing facility to a lean shipbuilding assembly facility in the future facilities plan, Figure 3.



**Figure 3 - Strategic Facilities Plan**

Capital investment to improve efficiency and reduce cycle times is not the only way NASSCO is reducing the cost of ships. NASSCO continues to focus on Design for Producibility and improvements in our Build Strategy for both the T-AKE and the PC-1 programs. This effort has been demonstrating excellent return on investment and the overall learning curve for the T-AKE program, represents one of the best NASSCO, or any other domestic shipyard, has ever achieved.

### **T-AKE Learning Curve**

The establishment of business relationships that bring international shipbuilding best practices to NASSCO has provided fertile ground for more efficient practices and ship design. Improvements in structural design, yard layout, and outfitting suggested by our international partners are bearing fruit on a daily basis resulting in cycle time and cost reductions. Additional Navy funding is being sought to maximize potential savings on the T-AKE design and to sustain an experienced design/build team until the next large design effort for the US Navy.

## Summary

### **Shipyard Modernization**

It is critical that America's shipbuilding infrastructure continue to modernize and advance the construction process in order to provide the nation with technically superior and affordable naval platforms. Towards that end, there are several initiatives that Congress, the Navy and industry can explore:

- Capital investment incentives – whether contractual or legislative. Industry investment in its shipyards must measure the return on this investment against a range other investment options. Low rate procurement does not support large capital investments for the potential of a longer-term return. Investment incentives, similar to the VIRGINIA CAPEX program, can be a key enabler to encourage future investment in America's shipyards.
- Program and funding stability in the Navy's Plan - Key business decisions related to facility modernizations must be made years in advance of when they are required. These decisions must be predicated on reliable workload forecasts to justify expenditures. Absent a predictable plan, the industrial base can not fully leverage its capabilities and competencies that provide the Navy with the most affordable ships possible. Stability is a critical factor in a business that, for all intents, has but one buyer.
- Alternative financing approaches may give the Navy enough budgetary flexibility to sustain their procurement strategy and support their national defense obligations. The appropriate financing approach will likely vary from program to program, but advance appropriations, multi-year procurements, incremental procurement, split funding and lead ship R&D procurements all potentially offer budget flexibility to the Navy, thereby creating the opportunity for industry to reliably predict volume, and thus provide more cost fidelity for future work.

- Integrating Research and Development with the Design/Build approach. This is the next step to advance naval ship design and construction technology. Revolutionary manufacturing technologies often reach the prototype stage, but rarely cross over from prototype to full scale deployment into major manufacturing programs where they would have the most significant impact on cost. We believe there is significant benefit to increased funding and better alignment of Navy R&D for mature as well as developmental shipbuilding programs. Towards that end, the Virginia Design for Affordability effort could be expanded to include these technologies. Furthermore, as Design for Affordability experience is gained, the effort could provide a model to apply the same technologies and interactive, cost-sharing approach to the design development and construction programs for all other major naval new construction programs.
- Volume – While stability and predictability are key, volume in the form of increased new construction orders is critical to the health and well-being of the nation’s shipyards. The surface combatant outlook is very similar now to what the submarine outlook was in the 1990’s, it is facing prolonged low rate procurement.
- An Enterprise Solution - We need to look closely at our policies and plans for accomplishing maintenance and modernization work. In a low rate production environment this work can play a much more important role in preserving our production capabilities. By performing more of this work at the ship construction yards, we will strengthen these yards by sustaining critical shipbuilding skills and capabilities. In addition, we will reduce the cost of new construction by utilizing existing capacity and facilities and spreading overhead costs over a greater volume of work.
- Revitalize commercial shipbuilding in the U.S. - The establishment of business relationships with DSME of Korea is bringing international shipbuilding best practices to NASSCO and has provided fertile ground for more efficient practices and ship design. Improvements in structural design, yard layout, and outfitting suggested by our international partners are bearing fruit on a daily basis resulting in cycle time and cost reductions.

The goal of General Dynamics Marine Systems is to be the best at what we do, whether that is submarines, surface combatants, naval auxiliaries or commercial ships. Toward this end, the General Dynamics Marine management team remains committed to driving costs from our products, whether through basic process improvements or through major capital investment, when warranted. We will continue to work with the Navy and the Congress to identify potential funding and / or program management alternatives that offer mutual benefits to all parties. Most importantly, we remain dedicated to delivering the highest quality, affordable products to all of our customers.