

# The Ten-Year Strategy of the United States Coast Guard Yard



Baltimore, Maryland

January 2019



This page was intentionally left blank

### Foreword

I am pleased to present the Ten-Year Strategy of the U.S. Coast Guard Yard. This document is intended to guide the Yard's efforts over the next decade to continue to provide valuable service in direct support of Coast Guard and partner agency front-line operations. This strategy is designed to inform the follow-on development of short-term (3-5 year) strategic plans, containing specific goals and objectives.

The Yard is the Department of Homeland Security's (DHS') only shipyard and largest industrial complex; it is also one of only five public shipyards remaining in the United States. The 113-acre Yard installation is home to more than 2,000 full-time employees, among the largest concentrations of DHS field unit personnel.

The Yard has designed, built, maintained and renovated Coast Guard, Navy, Army, National Oceanographic and Atmospheric Administration (NOAA), state and local government, and foreign military vessels and systems for nearly 120 years. Our workforce is incredibly proud of the fact that *nearly every Coast Guard cutter that has put to sea over the past century has been built, renovated and/or maintained by the Yard, and nearly all of the Coast Guard's cutter crews have benefitted in some way by the incredible work done by members of the Yard family. In addition to the Yard's role as a shipyard, at various points in history the Yard served as home to the Coast Guard Academy, a recruit training center, a technical training center, and the Coast Guard's research and development center. The Yard has assumed many roles, and continuously evolved with time to best suit the needs of our Coast Guard and our Nation.* 

As DHS' only shipyard and largest industrial complex, it is critical that the Yard anticipate changes in the external environment and emerging operational requirements to ensure continued relevancy, and of ultimate importance – continue to provide exceptional value to the operational fleet. Given the unique nature of the Yard, strategic planning is of utmost importance to sustaining this relevancy. The Ten-Year Strategy of the Coast Guard Yard is intended to guide the Yard along the best heading to prepare for our future.

Sincerely,

Matthew 2. pm, capt

Matthew W. Lake Captain, U. S. Coast Guard 42<sup>nd</sup> Commanding Officer, U.S. Coast Guard Yard

# Table of Contents

### Chapters:

- I. Executive Summary
- II. Background
- III. Shipyard Industry Outlook
- IV. Emerging Coast Guard Operations & Relevance to the Yard
- V. Future Yard Work
- VI. Strategic Priority: Workforce Management
- VII. Strategic Priority: Targeted Investment
- VIII. Strategic Priority: Innovation & Adaptation

### Appendices:

- I. List of Yard's Vessel Construction & Renovation Projects Since 1940
- II. References



A 270-foot Medium Endurance Cutter undergoing midlife maintenance at the Yard in 2009; several of these cutters are scheduled for a Service Life Extension Project (SLEP) at the Yard beginning in 2022.

## I. Executive Summary

Throughout the Yard's nearly 120-year history it has continuously adapted to best meet the needs of the Coast Guard and our Nation. At present, the Yard's unique mix of authorities, highly experienced and specialized workforce, and dedicated infrastructure have enabled the Yard to establish a niche renovating cutters and boats – *breathing new life into these assets so that they may be able to execute Coast Guard operations effectively for decades to come*.

Similar to the U.S. Navy, the steady decline of the U.S. shipyard industry has now begun to adversely impact the Coast Guard's ability to maintain its fleet and support operations. As a result of this phenomenon, coupled with growing demand for Coast Guard presence across the globe, and increasing complexity and breadth of the Coast Guard's surface fleet, the Yard has never been more relevant to the operational Coast Guard as it is today. To remain relevant, therefore, the Yard must continue to adapt to changes in Coast Guard operational focus, fill gaps left unfilled by commercial industry, and prepare now for the future. The Yard must prepare by pursuing the following strategies:

- <u>Workforce Management</u>: The Yard must continue to evolve its workforce recruiting, training and professional development programs to sustain its competitive advantage a highly experienced and stable workforce. The Yard must increase the mobility of its workforce, better supporting Coast Guard operations in areas of emerging geographic interest, and support post-disaster Coast Guard asset repair work where it fits within the Yard's business niche, complementing Director of Operational Logistics (DOL) capabilities. Finally, the Yard must evolve its workforce planning processes and Information Technology (IT) systems to better plan and allocate resources to improve efficiency and effectiveness.
- <u>Targeted Investment</u>: Much of the Yard's infrastructure is aging, optimized for legacy ship construction activities, and not fully capable of servicing the modernized cutter fleet. The Yard must make targeted investments over the next decade to service new Coast Guard operational assets, improve the shipyard layout, keep pace with changes in environmental standards and reduce vulnerability to flooding. The Yard must also make smart investments to bolster the effectiveness of "road shows", and transport Yard forces closer to the theater of operations when required to best support emerging changes in Coast Guard operational focus. The Yard must modernize and repair critical utilities, building structures, enhance physical security, and ensure base support equipment and facilities are sufficient to support all of the operations and mission support activities on the 113-acre installation. Finally, the Yard must develop scalable contingency plans in the event that the Yard suffers a catastrophic event that renders the Yard unusable.
- <u>Innovation and Adaptation</u>: The Yard must benchmark against U.S. and international shipyards, and seek out new technology that can benefit shipyard operations. This includes augmented robotics, new coating system technologies, networked industrial equipment, greater application of hand-held electronic devices, and additive manufacturing. Additionally, the Yard must examine whether the Yard's working capital fund authorities might be modified to engage in innovative lease agreements as a method of generating revenue to recapitalize existing facilities. The Yard must also examine the feasibility of modifying the Yard's working capital fund to accommodate long-term leases which might allow the Yard to establish a presence in areas of emerging Coast Guard operational interest, avoiding some of the risks associated with buying a new shipyard or other large industrial facility. Finally, the Yard should explore partnering with other agencies, and perhaps even other allied nations, to establish joint shipyard and/or industrial capability in remote locations where there are shared interests.

### II. Background

### A. Historical Context<sup>1</sup>



The Yard was the first large permanent operating base established by the Revenue Cutter Service (a forerunner of the modern Coast Guard), and the only shipyard ever built by the Coast Guard. From 1900-1910, the Yard also served as home to the Coast Guard Academy, before it was relocated to Connecticut. The Yard was established in Curtis Bay because of its geographic location – adjacent to a protected deep-water body of water with ready access to the Chesapeake Bay, and close to the locus of Coast Guard operations. At the time of the Yard's formation, the Commandant of the Revenue Cutter Service recognized the

*Revenue Cutter Service cadets at the Yard circa 1900* need to establish a government-operated shipyard because the commercial sector could not keep pace with the growing maintenance and construction requirements of the post-Civil War cutter fleet.

From 1899-1917 the Yard specialized in repair and renovation of wood and steel-hull ships, as well as design and construction of boats. Once the Coast Guard was formed in 1915 through a merger of the Revenue Cutter Service and Lifesaving Service, the Yard significantly increased its capacity and capability to design and build boats and cutters. As indicated in Appendix I, from the 1940s through the 1970s, the Yard designed and/or built a tremendous number of Coast Guard cutters and boats.

The Yard had three major growth points in its history – World War I, Prohibition, and World War II. In each of these cases the Yard adapted to significant changes in Coast Guard operations. During both World Wars the Yard received tasking from the Navy, building and repairing Coast Guard cutters, Navy ships and military vessels from allied nations. During the Prohibition-era the Yard built, repaired and overhauled large numbers of patrol boats and cutters that were used extensively to interdict "rumrunners" along the Atlantic Coast.

The majority of the Yard's present-day infrastructure was built from 1939-1945. During this time the Yard expanded from a 36-acre facility to 113-acres, acquired two drydocks, new machine and fabrication shops, warehouses, piers, wharves, and a shipway. The present-day Yard industrial area is built upon 10,400 wood piles topped with 6-feet of concrete, installed during World War II. At this same time, the Yard built up a workforce of 3,100 craftspeople, engineers and project managers that ran the shipyard with three shifts, 365-days per year to meet the needs of a Nation at war. The Yard's shipways and drydocks were serviced by an extensive train-rail network that connected the machine shops and fabrication buildings around the base. This shipyard lay-out and the Yard's composition supported workforce efficient ship

Since its formation, the Yard has had a broad impact on global Coast Guard operations. The Yard has built, renovated, and/or maintained Coast *Guard cutters and boats from Bahrain to Guam, and* everywhere in between. Furthermore, some of our Service's greatest leaders and heroes began their careers at the Yard. For example, below is a 1952 photo of CG-36500 after the heroic rescue of 32 survivors from the SS PENDLETON in a winter storm off the coast of Chatham, Massachusetts. The coxswain, Petty Officer Bernie Webber, and his crew performed the rescue at night in nearly 60-foot seas. The CG-36500 (used for the rescue) was a 36foot motor lifeboat designed and built at the Yard in 1946. the same vear Bernie Webber attended recruit training at the Yard.





MENDOTA (255-foot High Endurance Cutter) under construction at the Yard in 1943

construction, while still retaining the capability to perform vessel renovation, maintenance and repairs. Concurrent with new construction, the Yard repaired everything from battle-damaged Navy submarines to Coast Guard cutters serving in the Battle of the Atlantic. The Yard was also home to an enlisted recruit training center (boot camp), a large supply depot, and technical training schools for Coast Guard enlisted members.

After World War II, the Yard workforce was reduced by nearly half, and while the Yard continued building new cutters and boats, it took on a steadily increasing role of vessel repair and renovation projects for the Coast Guard and other government agencies. By the 1990s most of the Yard's infrastructure designed to support ship construction had been abandoned or removed. During the decades that ensued, the Yard primarily focused on ship renovations, weapons and





ALERT undergoing renovation at the Yard in 2009; ALERT was built at the Yard in 1969

major construction and renovation projects is contained in Appendix I, illustrating the gradual transition from construction to renovation work. From the 1950s-2005, the Yard's shipyard workforce was steadily down-sized, to a low point of nearly 517 employees from 2005 to 2015. However, since 2015 there has been a significant resurgence in demand for Yard services, and with that a 20% increase in the shipyard workforce to match the demand.

#### B. The Yard as a "Business" within the Department of Homeland Security (DHS)

Unique within DHS, the Yard operates using an industrial working capital fund established by Title 14 U.S.C. § 939. Congress formally established the Yard's working capital fund authorities in 1949, at the same time similar authorities were provided to U.S. Navy shipyards. *Congress' intent was to improve public shipyard cost accounting, and encourage business-like behavior at these shipyards*<sup>2</sup>. With the exception of certain facility construction and maintenance, all shipyard capital, operating and maintenance costs are paid for from the proceeds of the Yard's working capital fund. In essence, the Yard operates as a non-profit "business" within the Coast Guard, generating revenue through the sale of services. This revenue is used to offset expenses, with the objective of "breaking even."

While the Yard provides support to the Coast Guard well beyond the Atlantic seaboard, the location of the Yard, as well as the need to diversify the industrial support base necessitates the use of commercial shipyards. To that end, approximately 85% of Coast Guard vessel shipyard maintenance occurs in commercial shipyards around the country, and 15% of this work occurs at the Yard. Nearly all of the contracts with commercial shipyards use a fixed-price contracting strategy, which means a contract is established for provision of services at a fixed price. If a contractor performs the work at a cost of less than the contract award price, the company makes a profit. However, if the project consumes more resources than anticipated, the company takes a loss. Consistent with the Yard's authorizing statute, the Yard operates on a cost reimbursement basis; this means the labor and material costs actually expended are charged to customers. Furthermore, unlike commercial shipyards, growth work and overtime are charged at nearly the same rate as regular work. *Consequently, the Yard is well suited to perform high-risk renovation work or other related activities in which the work scope is uncertain or carries high technical risk.* 

The Yard is now the last of the five remaining U.S. public shipyards to rely exclusively upon an industrial working capital fund – largely independent of direct Congressional appropriations. Over time, the four Navy-owned public shipyards transitioned to direct appropriations, with some working capital fund resources<sup>3</sup>. The principle advantages of the working capital fund are financial transparency, incentivized productivity, and cost control. While the Yard is not in direct competition with the commercial sector, the Yard's cost performance is frequently compared to private shipyards, and must remain competitive to provide continued value to the Coast Guard.

A disadvantage of the working capital fund is that the Yard cannot keep a "garrison force" of standby labor without driving up cost. In order to minimize cost, the Yard is incentivized to book work in a way that maximizes workforce utilization – which reduces some flexibility in terms of responding to large unexpected changes in work compared to the other public shipyards or industrial facilities that rely on direct appropriations. The Coast Guard has mitigated this risk by providing the Yard the ability to manage its own wage-grade workforce size, composition and skillsets. The Yard also has exclusive human resources policies and a separate union collective bargaining agreement that allows for increased flexibility compared to the rest of the Coast Guard. Nonetheless, the Yard must diligently plan future work and anticipate changes in requirements to avoid deleterious financial impacts, or loss in capability to serve the operational fleet. Moreover, the Coast Guard must guard against putting controls on the working capital fund or establishing policies that reduce the flexibility to respond to changes in demand for Yard services.

#### C. The Yard's Competitive Advantage & Focus

There are two general categories of U.S. shipyards: construction and repair shipyards. Construction shipyards are optimized for shipbuilding; most construction yards use block-modular construction techniques, with highly specialized capital equipment and facilities. Such shipyards tend to have a stable and specialized workforce. Some larger construction shipyards also have organic professional engineering ship design capabilities. On the opposite end, repair shipyards tend to be clustered in regions in which the workforce can migrate from shipyard to shipyard, since contracts tend to be short in duration. These shipyards keep costs low by using temporary labor, and minimize overhead by keeping capital investments to a minimum. Repair yards rarely have their own organic professional engineering staff, as they specialize in maintenance and repairs.

*The Yard is neither a construction nor a repair shipyard.* Although the Yard is highly capable of repairs, and historically performed new ship construction, over the past several decades the Yard carved out a valuable niche as a vessel renovation specialist. The Yard's expertise in this field provides a service not readily available in the commercial sector. The reason for this business focus is that the Yard has a stable, highly experienced workforce with infrastructure that is suited for renovation work. Importantly, the Yard has an integrated professional engineering staff that specializes in back-fit ship design and systems engineering, skillsets that are not readily available in the U.S. commercial market.

While the Yard is capable of a wide range of vessel maintenance and construction, the Yard performs at its best – and provides best value to the Coast Guard and partner government agencies - when it is tasked with work that fits within its competitive advantage. *The Yard's competitive advantage is its highly specialized, stable and professional workforce, coupled with its unique integration of engineering design and waterfront production.* This competitive advantage enables the Yard to excel at repeatable work, and also perform risky back-fit design and renovation projects on aging cutters and other vessels. These include projects such as midlife availabilities, service life extension projects, and repeatable repair availabilities, including Recurring Depot Availability Programs (RDAP). The Yard also performs back-fit engineering changes to newly delivered cutter and boat classes. To highlight these points, it is useful to look at some examples from recent Yard history.

The Yard conducted a Major Maintenance Availability (MMA) on fourteen of sixteen 210-foot medium endurance cutters (WMECs) from 1984-1998, extending the service life of these vessels. The Yard designed and replaced major systems and hull structure for less than one third the price of what a new cutter of similar size and capability would have cost the Coast Guard, and did so *for less than half* the labor hours required for the two commercially-performed 210-foot MMAs using the same work specifications<sup>4</sup>. The two cutters that

underwent commercial MMA were decommissioned in 2001 due to poor material condition. Each of the fourteen 210-foot WMECs serviced by the Yard in MMA are still sailing today – more than 50 years after construction. The 210-foot WMECs that underwent MMA at the Yard benefited from the strong integration of design engineers and expertise of Yard craftspeople, and experience working on 210-foot WMECs.



Yard electricians install the propulsion motor on STURGEON BAY as part of the 140-foot Icebreaking Tug SLEP



225-foot Seagoing Buoy Tenders undergoing MMA at the Yard

Today, the Coast Guard is leveraging the Yard's competitive advantage by tasking it with performance of the 140-foot Icebreaking Tug (WTGB) Service Life Extension Project (SLEP), CGC EAGLE SLEP, and 225foot Seagoing Buoy Tender MMAs, as well as Patrol Boat RDAP. The Yard completed the SLEP of six 140-foot WTGBs thus far, achieving 95.7% production "labor learning" – a substantial reduction of the labor hours required for each subsequent vessel undergoing renovation<sup>5</sup>. This statistic is unmatched in many new ship construction projects, where production labor learning on this project alone yielded more than \$7 million in taxpayer cost savings over five years, and shortened the overhaul schedule duration, resulting in delivery of nearly a half year of additional icebreaker availability to the Great Lakes and Northeast.

In 2014, the Yard began the 87-foot Coastal Patrol Boat RDAP program, a four-year continuous maintenance cycle for the Atlantic Area Coastal Patrol Boat fleet of 47 cutters. Through the use of innovative work sequencing, repeatable processes, and new material control methods, the Yard continues to deliver all 47 cutters with an average of less than 2 days of schedule growth – a statistic unrivaled in the recent history of commercial



87-foot Patrol Boat dry-docked as part of RDAP

or government shipyard Coast Guard cutter repair projects. The Yard has also substantially improved the material condition and readiness of the cutter class. While doing so, the Yard reduced the cost for base work by 28%, achieving more than \$3 million in taxpayer savings per year, and provided more than 120 days of additional patrol boat availability per year to Atlantic Area operational commanders.

In addition to work performed in Baltimore, the Yard performs "road-shows" – projects executed at ports around the country and overseas at the "speed of need." Given the flexibility of the Yard's working capital fund operation, and the commitment of the Yard workforce, employees are poised to deploy world-wide on extremely short notice. For example, in 2018 the Yard performed 3,433 man-days of "road-show" support. These "road shows" included emergency repairs to propulsion systems of cutters deployed "in theater" conducting migrant

and drug interdiction; electronics and navigation system upgrades aboard patrol boats in Bahrain conducting security operations in the Middle East; and troubleshooting and repair of the buoy crane on a 225-foot seagoing buoy tender in Hawaii, enabling the cutter to maintain critical aids to navigation throughout the Hawaiian island chain. Such "road shows" entail a wide-range of cutter and boat hull, mechanical and electrical system casualty repairs, upgrades and replacements, as well as weapons and electronic systems replacements, and renovation work. Frequently the Yard is called upon to tackle the most challenging repairs – often for complex systems when the original equipment manufacturer or other organic Coast Guard entity is unable to identify a suitable technical solution to a problem. In these cases the Yard provides invaluable support to operational commanders, only made possible by the incredible depth of experience and commitment that exists among the Yard's project managers, engineers and craftspeople.

The Yard serves a valuable role implementing engineering changes after delivery of new cutters to the fleet – especially when the cutter acquisition contract is fixed price. In the case of a fixed price construction contract, it is often less expensive for the Coast Guard to retrofit engineering changes after a cutter has been delivered rather than negotiate such changes with the shipbuilder during construction. The Yard recently designed and/or installed a number of engineering changes to newly delivered Fast Response Cutters and National Security Cutters, and continues to do so as these cutters are delivered to the fleet. In the past, the Yard designed and installed major system upgrades immediately following delivery of the 175-foot Coastal Buoy Tenders and the 225-foot Seagoing Buoy Tenders in the late 1990s, as well as installation of the weapons and sensor systems on 270-foot Medium Endurance Cutters after they were delivered.



Yard craftspeople install a Yard-renovated 76mm gun weapon system aboard the Polish Navy Frigate General Kazimierz Pułaski in Gdansk, Poland

Not only does the Yard serve the Coast Guard, but it also has a long history of performing renovation projects and "road shows" for other government agencies (OGAs) and allied nations. At present, the Yard has long-term agreements to perform renovations of several NOAA ships, an agreement to perform a SLEP of the U.S. Naval Academy's Yard Patrol Craft fleet, and a contract with the Navy to overhaul MK38 gun weapons systems for a large number of their surface combatant vessels. The Yard also supports foreign military sales, including the reactivation and conversion of decommissioned Coast Guard cutters, and 76mm gun weapon systems overhauls. For example, over the past three years, the Yard reactivated and converted patrol boats for Ukraine, Pakistan, Costa Rica and the Republic of Georgia.

The Coast Guard and other government agency partners have a choice as to *how and to what extent* they use the Yard. Cutter crews and other Yard customers have to want to come to the Yard – or the Yard will become irrelevant. There have been several times over the past century the Coast Guard considered closing the Yard, and in several cases significantly down-sized the Yard's workforce. In most of these

instances the Yard arguably "lost its way," in that the Yard performed work that was not within its "competitive advantage" and therefore not able to provide best value to its customers.

To remain relevant, the Yard must forever remain well-attuned to the needs of the operational Coast Guard, and shift capabilities and capacity to best meet these needs – while keeping ever mindful of what sets the Yard apart from commercial industry and other government industrial facilities.

#### D. The Yard's Base Support Function

In addition to the Yard's primary shipyard function, the Yard has served as an operational base since its formation in 1899. As stated above, the Yard installation is currently home to more than 2,000 full-time employees, among the largest concentrations of DHS field unit personnel. The Yard facility is 113-acres spanning across Anne Arundel County and Baltimore City. The Yard has 95 buildings, and its own co-

generation power plant and utility grid, including electricity, gas, oil, steam, compressed air, welding gas and oxygen. The Yard also provides base support services for an average of 12 cutters at any time, including those that are undergoing renovation at the Yard, decommissioned cutters undergoing conversion in preparation for foreign military sale, and homeported cutters. The Yard currently serves as "landlord" for 14 tenant units, the largest of which are the Surface Forces Logistics Center and Sector Maryland National Capital Region. The Yard's base functions include fire and police services, civilian and military human resources services, morale welfare and recreational facilities, housing, dining facilities, public works, training facilities, environmental management services, armories, and a clinic. A primary focus of the Yard's base activities is to support the large military and civilian workforce, support and care for visiting cutter crews, and ultimately - facilitate Coast Guard operations. Visiting cutter crew stewardship is an exceptionally high priority for the Yard, given that more than 25 different cutter crews rotate through the Yard each year as their cutters are renovated and/or maintained by Yard employees. The vast majority of the Yard's base functions are carried out by military personnel, and are critical to efficient and effective operation of all the activities that occur on the Yard installation.

### **III. Shipyard Industry Outlook**



#### A. Historical Context

Source: "Decline of U.S. Shipbuilding," January 21, 2016. <u>www.shipbuildinghistory.com</u>; Large shipbuilders are defined as those capable of constructing ships greater than 400-ft in length.

The nature of the U.S. shipyard industry has changed dramatically over the past six decades. During World War II, the United States was the undisputed shipbuilding powerhouse. For example, between 1939 and 1943 the U.S. expanded shipbuilding production by 5,200%6! At the end of the war there was tremendous overcapacity in U.S. shipyards, as well as an overabundance of relatively new vessels. Thus, the demand for U.S. vessel construction and repair work diminished precipitously. From the 1950s-1980s the number of U.S. commercial shipyards continued to shrink and consolidate, owing to changes in the U.S. and global economies and policies. Concurrently, the Navy closed several of its public shipyards. By the 1990s, few commercial vessels were built in U.S.

shipyards, aside from those required to be built and flagged in the U.S. by the Jones Act.

#### **B.** Industry Current State and Future Outlook

At present, military ship construction drives the U.S. shipyard market. Specifically, 60% of industry revenue comes from military ship construction, 22% from commercial ship construction, and 18% from ship repair<sup>7</sup>. The industry is also highly concentrated, with the six largest U.S. shipyards accounting for two-thirds of industry revenue and nearly 90% of all military vessel construction<sup>8</sup>. While the U.S. shipyard industry was a sizeable segment of the U.S. economy in the mid-20<sup>th</sup> century, it now accounts for less than 0.15% of our Gross Domestic Product (GDP)<sup>9</sup>. In comparison, the auto industry contributes 3.0% - 3.5% of U.S. GDP<sup>10</sup>. From an international perspective, the U.S. ranks 19<sup>th</sup> in commercial shipbuilding, with only 0.35% of global new construction, despite having the largest economy in the world<sup>11</sup>.

Given the meager state of the industry, there is growing concern that U.S. shipyards are unable to recapitalize and maintain the U.S. military fleet<sup>12</sup>. In fact, a 2018 Government Accountability Office (GAO) report of Navy ship maintenance documented 18,851 lost days of surface warship availability from 2012-2018, and 8,472 lost days of submarine availability from 2008-2018 in large part due to insufficient capacity of Navy and commercial shipyards to perform scheduled maintenance on time<sup>13</sup>. For example, the attack submarine USS BOISE was removed from operational service for 852 days (from June 2016 - October 2018) awaiting available dry-dock space at a shipyard capable of overhauling the vessel<sup>14</sup>.

As stated previously, the Coast Guard performs approximately 85% of its shipyard depot-level maintenance at commercial shipyards, and approximately 15% at the Coast Guard Yard. This is a higher ratio of commercial work than the Navy, which is required by law to perform no less than 50% of its depot level maintenance in its own public shipyards<sup>15</sup>. Consequently, maintenance of Coast Guard cutters is impacted to a much greater extent than the Navy by changes in the commercial shipyard industry. Similar to the Navy, the Coast Guard Surface Forces Logistics Center has already observed a steady decline in commercial repair shipyard competition and availability in certain geographic regions in support of cutter maintenance in recent years. This has increasingly resulted in "no-bids," harmful delays to cutter operational schedules, and higher than expected costs for maintenance and repairs. Given the state of the industry, these trends are expected to continue for the foreseeable future.

There are a number of significant challenges that deter significant U.S. commercial shipyard growth over the next decade. These include:

- <u>Lack of domestic demand</u>: A lack of domestic demand for *commercial* ship construction and repair work significantly dampens the financial incentive for industry to build more shipyards. Military construction alone is insufficient to drive industry to invest large amounts of capital and other resources to open new shipyards, particularly given the high barriers to entry. Importantly, in the long run, demand for military ship construction is unpredictable compared to other industries because it relies on U.S. policy which often changes in response to the geo-political climate and other exogenous factors. Additionally, the Jones Act requires that only U.S.-built and flagged vessels may be employed for the carriage of goods and passengers between U.S. ports. Thus, the Jones Act guarantees a certain amount of commercial sector work for U.S. shipyards. Albeit unlikely, if the Jones Act requirements were modified, this would undoubtedly result in an even further reduction of domestic demand for U.S. shipyard capacity.
- <u>High barriers to entry</u>: Opening new shipyards in the U.S. is challenging, requiring investment of very large amounts of capital, acquisition of properly zoned waterfront property along a navigable waterway with ready access to the sea, an absence of encroachment from commercial and residential development, complex environmental management and regulatory considerations, and the need for quick access to airports, roads and rail for logistics support. Given that most small and medium sized shipyards have low profitability (compared with many other capital-intensive industries), this makes opening new U.S. shipyards quite unattractive from a business perspective<sup>16</sup>. Furthermore, entry into the U.S. shipyard industry is further complicated by the fact that the industry is now dominated by just a few large companies that are able to set prices for the market.
- <u>Workforce constraints</u>: Lack of a readily available trained workforce, and an aging population of U.S. shipyard craftspeople are major concerns for U.S. shipyards<sup>17</sup>. When shipbuilding was still a major sector of the U.S. economy, there was an abundance of trained and skilled workers in the market. Moreover, schools invested in training programs responsive to the need for shipyard labor. This is no longer the case. For example, it is rare that a high school guidance counselor today would advise a student to become a ship-fitter or boat joiner, or that a high school would



Bethlehem Steel Sparrows Point Shipyard & Steel Mill in Baltimore, MD employed more than <u>45,000</u> people in the 1950s. When it finally closed in 2003, many of the skilled employees came to work at the Yard. Source: Baltimore Sun

have training programs for these trades. Forty years ago there were *tens of thousands of such jobs at several commercial shipyards just in Baltimore*, and many schools taught students the basics of these trades. U.S. shipyards are now forced to invest large amounts of money and time recruiting and training their own workforces, making these shipyards even less responsive to changes in market demand.

This problem is not limited to craftspeople; professional engineers with ship design experience are also in short supply. For example, within the Coast Guard, many cutters and boats were "in-house" designs 40-70 years ago. This acquisition strategy sustained high levels of technical expertise within the Service, and provided tremendous benefit as these vessels were renovated and upgraded through their service lives. Today there are only a handful of Coast Guard personnel that have actual first-hand experience performing detailed design work and building ships and ship systems. Nearly all of that organizational experience resides at the Yard.

• <u>Diminished complementary industry</u>: In addition to diminished shipyard capacity, the production of U.S.designed and manufactured materials and equipment used to build ships have diminished. This includes base materials such as steel, and finished components such as engines, reduction gear, navigation and control systems. Strong complementary industry is critical for shipyards in order to sustain a healthy supply chain, keep costs competitive, and sustain innovation in the production and design of ships and ship systems.

In summary, United States commercial shipyard capacity and capabilities will remain a significant challenge for the Coast Guard in the foreseeable future. As a result, the Yard must position itself to fill in where the commercial market is unable to meet the Coast Guard's needs, and adjust its capacity and capabilities as necessary to fill gaps.

### C. Coast Guard Fleet Recapitalization - A Shift to Larger Shipyards

The Coast Guard is in the midst of recapitalizing its surface fleet. In general, the Coast Guard is replacing smaller vessels with larger, more complex assets. In many instances, these changes will require the Coast Guard to shift maintenance traditionally performed in small shipyards to larger shipyards that specialize in larger, more complex vessel repair. One challenge with this trend is that the Coast Guard will likely begin to compete directly with the Navy for shipyard capacity within the decade. Furthermore, the cost of doing work in shipyards that specialize in military vessel and larger ship repair tend to be higher than those that specialize in repair of small commercial vessels (which have lower overhead costs and tighter profit margins). While one might argue that an increase in demand for more shipyard capacity will elicit a market response to open more U.S. shipyards that are capable of servicing these larger vessels, the industry economic factors outlined previously make such a market response highly unlikely.



The new 360-foot Offshore Patrol Cutters (OPC) will replace the CG's fleet of 210-foot and 270-foot Medium Endurance Cutters (WMECs) over the next decade. Many of the shipyards that currently dry-dock WMECs do not have adequate facilities to dry-dock OPCs.

The trend of increasing size and complexity of Coast Guard cutters is likely to displace the Coast Guard from a more competitive segment of the U.S. shipyard industry (small shipyards) to a less competitive segment (larger shipyards). Furthermore, the Coast Guard is likely to face increasing constraints with regard to commercial shipyard capacity as it begins to compete with the Navy for space and time in larger shipyards.

These trends will make it increasingly important to sustain organic Coast Guard shipyard capacity to

avoid shipyard "bottlenecks." This will also require the Yard to make smart investments to ensure it remains capable of dry-docking and serving the new cutter fleet, including Offshore Patrol Cutters and Fast Response Cutters.

# IV. Emerging Coast Guard Operations & Relevance to the Yard

### A. Emerging Coast Guard Operational Focus

The Coast Guard maintains several operational strategies that provide insight into areas of emerging focus over the next decade or more. These operational strategies point to where the Yard must focus its efforts over the next ten years.

- <u>Contingency Response</u>: All of the recent Coast Guard Evergreen studies assessed that the U.S. is likely to experience an increase in the frequency and severity of natural disasters which impact the coastal and near-coastal zones<sup>18</sup>. As outlined in the 2018-2022 Coast Guard Strategic Plan, this will require the Coast Guard to continue to place emphasis on robust disaster response, improve the resiliency of its own infrastructure, and ensure the mobility and interagency operability of its assets and personnel<sup>19</sup>.
- <u>Western Hemisphere</u>: Consistent with the Coast Guard's Western Hemisphere Strategy, the Coast Guard will continue to focus operations in the Western Hemisphere Transit Zone to stem the influence of transnational criminal organizations and the flow of drugs, migrants, and other illegal activity through Central America and across our southern borders<sup>20</sup>. A large portion of interdiction operations are performed by the Coast Guard's major cutter fleet. Furthermore, increasing pressure on fisheries stocks and other natural resources in the U.S. Exclusive Economic Zones will continue to send a strong demand signal for offshore-capable major cutters<sup>21</sup>. The cutters in these regions tend to operate at the far reaches of the Coast Guard support and commercial industrial networks.
- <u>Arctic</u>: The Coast Guard's Arctic Strategy highlights the increasing commercial maritime activity in the Arctic domain, and projects increased presence of Coast Guard assets. Given the large volume of untapped natural resources including petroleum and mineral wealth, this is an area of emerging strategic focus<sup>22</sup>. Of particular note, other competitor nations have built up icebreaker capacity and support infrastructure, and have increasingly asserted their presence in the region. Given the nature of this region, U.S. and allied infrastructure and bases are almost non-existent. Consequently, assets that operate in the Arctic must have high mobility and endurance, and possess very high operational reliability.
- <u>Cybersecurity</u>: Cybersecurity has become increasingly important to the Coast Guard and our Nation with the rapid advance of technology. The Coast Guard is responsible for helping to protect critical maritime infrastructure, as well as ensuring the resiliency of its own systems against cyber-attack<sup>23</sup>. Modern ship systems and industrial equipment have become increasingly automated and networked, and thus cybersecurity will continue to have increasing importance in design and maintenance of the Coast Guard's cutter fleet, and to shipyard operations.
- <u>Navigation Technological Advances</u>: The Coast Guard recognized as far back as 35 years ago that advances in navigation and maritime technology have the potential to reduce the reliance on certain visual aids to navigation (ATON) including floating buoys and other visual "traffic signals" in certain navigable waters.<sup>24</sup> Advances in automatic identification systems (AIS), satellite navigation, electronic charting, advanced collision avoidance systems and other new technology may further reduce the need for visual aids. This is particularly important as the Coast Guard is responsible for maintaining ATON using its fleet of buoy tenders and ATON boats.

#### **B.** Relevance to the Yard

The emerging areas of operational focus above indicate the following trends that are of great strategic interest to the Yard:

• Increased need to provide agile and mobile support forces, particularly those that are able to support assets in inhospitable climates such as the Arctic, and in disaster-impacted regions.

- A significant focus on ensuring operational reliability of major cutters deployed far from the continental United States, away from traditional bases of support and commercial shipyards.
- A continued and sustained focus on cutter operations in the Western Hemisphere Transit Zone, far reaching Exclusive Economic Zones and increasing presence in the Arctic.
- Demand for improved resiliency of Yard infrastructure and mobility of the Yard workforce, so that these forces are able to support operations effectively in the wake of disasters.
- Improved cyber resiliency of industrial infrastructure supporting homeland and national security activities will be an area of increasing focus. This includes improved back-fit design and maintenance of cyber-resilient ship systems (platform information technology), and ensuring workforce proficiency in this new space.
- The Yard is heavily invested in maintaining the Coast Guard's large fleet of seagoing and coastal buoy tenders. Advances in technology that change buoy tender fleet requirements have direct relevance to future work performed by the Yard.

# V. Future Yard Work

### A. Future Yard Work

As outlined above, the Yard's current primary work focus is on vessel renovation projects and the Recurring Depot Availability Program (RDAP) for East Coast 87-foot Coastal Patrol Boats. The Yard also performs "road-shows," new cutter acquisition post-delivery engineering changes, a modest amount of depot-level dry-dock maintenance and repair work, as well as certain overhauls of ship systems, including gun weapons, engines and other equipment.

In order to best meet the needs of the Service over the next decade, it is expected that Coast Guard and other government agency vessel renovation projects will continue to be the "bedrock" of Yard work, comprising approximately 40-50% of annual workload. The Yard will plan for an increase in the proportion of RDAP projects, a slight increase in "road-show" work as a total percentage of Yard work, and a slight reduction in routine depot-level cutter dry-dock maintenance work as a portion of the total portfolio. The Yard also anticipates a slight increase in demand for post-delivery engineering changes as the Offshore Patrol Cutters begin to be delivered to the fleet over the next decade.

At present, 87-foot RDAP constitutes 12% of annual work at the Yard. By 2023 the Yard anticipates standing up a new Fast Response Cutter (FRC) RDAP line of business modeled after 87' CPB RDAP, which will increase total RDAP work to 25-30% of annual Yard work. At present, "road-show" projects constitute approximately 10% of annual work; the Yard anticipates an increase to nearly 15% of total work over the next decade. The balance of remaining work (up to 15%) will focus on post-construction cutter engineering changes, ship systems overhauls, and dry-dock maintenance and repair of vessels – to include Offshore Patrol Cutters, CGC EAGLE, ATON cutters, domestic icebreakers, and other government agency ships.

### VI. Strategic Priority: Workforce Management

#### A. Evolve Recruiting, Professional and Career Development Programs

To best serve the fleet, the Yard must sustain a well-trained workforce with a stratification of experience, and a well-defined career pyramid with ample opportunity for upward mobility. To retain the Yard's existing competitive advantage in vessel renovation, the Yard must also attract and retain skilled craftspeople, professional engineers, project management professionals, and financial managers. The Yard should work with Surface Forces Logistics Center and Headquarters to ensure project management, fiscal, and engineering staffs are able to flow in and out of the Yard to gain experience at other units, bringing back new perspectives and ideas to the Yard. The Yard should also look for opportunities to partner with other shipyards to develop recruiting and training programs.

• <u>Recruiting</u>: The Yard will target its wage grade workforce recruiting efforts in Baltimore and Anne Arundel County, Maryland. Recruiting will continue to focus on entry-level positions for most trades, recognizing that there is a virtually non-existent "market supply" of experienced shipyard craftspeople in the United States given the state of the industry.

Critical to the future of the Yard is continued integration of the local community into the activities that occur on the installation. One of the most effective ways to do this is to hire civilian personnel from "right outside the gate." The Yard must expand its partnerships with workforce development



Interns undergo welding training using the Yard's weld training stations

agencies tied to local government and trade schools. Part of this effort is to expand and mature the Yard's high school and college internship programs. Based on historic attrition rates, the Yard must ensure 3%-5% of the workforce at any given time is comprised of student interns – who will ideally become full-time Yard employees. The Yard will also recruit entry-level engineers and financial professionals from 4-year colleges around the country, using internship programs.

Attracting the best military personnel to the Yard is also of paramount importance. To do so, the Yard must be viewed as a great place to work, and that Officers and Enlisted members are perceived as having successful careers when they leave the Yard. The Yard must also groom Naval Engineers for future assignment to Yard leadership positions. Ideally, future Yard military leaders will have experience in industrial operations, and formal education focused around business and engineering. The ideal future candidates for top Yard leadership positions are career engineers with prior Yard experience, who have attended business school or other training/education programs that provide insight into operating a businesslike organization.

Professional & Career Development: Since the Yard is the only shipyard in the Coast Guard, and the last major Maryland shipyard, it must develop its own organic training programs to sustain workforce proficiency. Strong training programs are also critical to sustaining the Yard's competitive advantage – its experienced, well trained workforce. This training must be accompanied by professional certification programs, in order to ensure shipyard craftspeople are keeping pace with global industry standards. Much effort has been spent over the past several years developing technical training and certification programs for Yard craftsmen, and certainly more work remains. However, the greatest need is the provision of supervisory, project management, financial, human resources and administrative training for mid-level managers. These areas have often been overlooked at the Yard – but are critical to sustaining an effective workforce and a positive workplace climate. In the past, the lack of focus on developing supervisory skills resulted in a multitude of management shortcomings that, when left unaddressed, caused adverse impacts to serving the fleet.

In terms of military personnel professional development, many of the base support functions at the Yard, including police, fire services, the clinic, and morale, welfare and recreational programs require specialized training. While much of this training is provided centrally by the Coast Guard, there are many skills – particularly those that are unique to supporting the shipyard - that must be developed organically and through other non-Coast Guard training sources.

Career guidance and development is critical to ensuring employees understand how to progress within the Yard and the Coast Guard by gaining the skills, education and training they need to advance. The Yard must further develop mentorship programs, and continue to evolve its career development programs.

### B. Embrace an "Expeditionary" Workforce

Given the anticipated evolution of Coast Guard operations and the nature of the shipyard industry, the Yard should anticipate an increase in demand for "road show" work – delivered at the "speed of need." Importantly, certain geographic locations such as the Arctic have minimal transportation and commercial or industrial infrastructure. The Yard must be prepared to expand its capacity to conduct some renovation, emergency repairs and maintenance in these inhospitable, unaccommodating regions. Furthermore, as the Yard improves its "road show" capabilities, it should give thought to utilization of these capabilities to support Coast Guard assets after a natural disaster. Such dual-role mobile industrial capability would likely provide value to the DOL in repairing Coast Guard assets in the wake of a disaster. To that end, the Yard must:

- Increase focus on the development of mobile, self-contained shipyard "force packages" that can effectively support Coast Guard assets "down range" in emerging regions such as the Arctic. The Yard should coordinate development with other Coast Guard mission support organizations such as Surface Forces Logistics Center Industrial Operations Division and DOL, to avoid creating overlapping capability, and make use of existing supply chains where possible.
- Establish partnerships with other government agencies, and perhaps even other allied nations, to identify and potentially make use of existing industrial infrastructure in forward operating areas.

### C. Evolve Workforce Planning

For the past two decades the Yard's shipyard workforce was largely static, and therefore the Coast Guard allocated work with the goal of filling the capacity of the Yard, which was generally limited by the number and skillsets of its craftspeople. Recently, the Yard was relieved of this workforce "cap," and the Yard now shapes its workforce to match the demands for its services – very similar to a business, and better aligned to Congress' intent behind the Yard's authorizing legislation. Moving forward, the Yard must take a more sophisticated approach to analyzing and predicting out-year work, and adjust the size and composition of the workforce to meet the demands associated with that work. The Yard must also develop a workforce structure that is more flexible and better able to scale up or down to changes in demand.

The Yard's workforce planning efforts must also leverage new project planning information system technology to better allocate personnel resources across Yard projects. These efforts must also include the ability to better conduct "real-time" analyses that enable the Yard to provide better information to operational commanders and other decision makers to make well-informed risk-based decisions on growth work or changes in work priorities.

### **VII. Strategic Priority: Targeted Investment**

### A. Background: Yard Infrastructure and Equipment

The Coast Guard's 2015 report to Congress entitled "*Coast Guard Yard Dry-dock Facilities and Industrial Equipment*"<sup>25</sup> noted the average age of Yard dry-dock facilities, wharves and piers is over 70 years old, with the exception of the ship-lift, built in 1996. Some of the Yard's major capital equipment, such as cranes, lathes and milling machines are aged and beyond design service life, with an average age of 24 years old. By comparison, the average age of capital equipment at the Navy's four shipyards was reported in 2017 as 22 years old<sup>26</sup>. In 2018 the Navy announced it will invest \$21 billion into its four shipyards over the next two decades, in recognition of the impact the deteriorating infrastructure and equipment will continue to have on fleet readiness if not addressed today<sup>27</sup>. Interestingly, the Navy's "worklist" is very similar to the Yard – including dry-dock

and crane repairs, upgrades to equipment, and modifying shipyard layouts to improve efficiency and capacity. While the Yard has focused on replacing capital equipment assets needed to keep pace with technology and to maintain effective operations, 85% of the 476 Yard capital assets are past their design service life, representing millions of dollars of potential investment to replace older equipment. The Yard fell behind in its recapitalization efforts during the 1970s – 2000s as the Yard downsized and shifted its focus from vessel construction to renovation.

#### **B.** Focused Investment

Unlike other government activities that rely exclusively on appropriated funds, the Yard uses its authorities to allocate revenue from Yard operations to acquire and maintain capital equipment<sup>28</sup>. This presents an advantage, in that the Yard is able to depreciate the acquisition cost over the useful service life of the asset. This provides flexibility by spreading the investment expense over an extended period, and allows the Yard to take a strategic approach to recapitalization rather than being constrained by annual appropriations. The downside is that such investments must be paid for with future revenue, which is highly dependent on the demand for Yard services. When the Yard's services are in high demand it has more flexibility to make investments; when demand wanes there is less flexibility. On the other hand, the Yard must use appropriated funds for facilities recapitalization and investment. Shore facility investment requires careful planning and preparation years in advance - thus the need for the Yard to focus on strategic requirements out past ten years, and create a risk-based investment plan. The Yard's future investments must meet the following goals:

- <u>Improve shipyard layout</u>: The Yard's waterfront infrastructure was designed during the decades-long period of ship construction, and was not optimized for today's vessel renovation work. There is also some industrial infrastructure that has been abandoned, but consumes valuable space in the shipyard. To improve efficiency and effectiveness, the Yard must broaden the Yard's strategic planning and budgeting focus to ensure that out-year industrial schedules are accompanied by a risk-based strategic plan for capital facilities and equipment. Moreover, the Yard must update its Area Use Plan to identify facility modifications required to improve the flow and efficiency of renovation work. This may ultimately result in demolition of inefficient facilities and consolidation of industrial processes and infrastructure closer to the waterfront.
- Service new Coast Guard operational assets: For decades the Yard had all the requisite infrastructure to service and maintain the Coast Guard's entire surface fleet. With the delivery of larger and more complex assets the Yard must keep pace and modify its infrastructure to ensure it is able to service cutters and boats delivered today - and over the next decade. A failure to do so will significantly reduce the relevance of the Yard, to the long term detriment of fleet readiness. Quite simply, the Yard must make these investments in order for it to provide value to the operational Coast Guard, as it has done for the past 120 years. At present, the Yard lacks the capabilities to drydock the new Offshore Patrol Cutters, and cannot effectively service Fast Response Cutters without infrastructure upgrades. The priorities over the next



The Yard is the only Navy-certified overhaul facility for nearly all of the heavy weapons installed in the CG fleet. The Navy recently invested funds to upgrade the Yard's capability to service next-generation weapons systems getting fielded in the Navy & CG fleets.

decade therefore include completion of the ship-lift expansion project funded in 2016, construction of Offshore Patrol Cutter capable dry-dock facilities, and installation of a travel lift and related infrastructure to support new Fast Response Cutters. Construction of Offshore Patrol Cutter capable dry-dock facilities should ideally occur within the next 5-6 years so that the Yard is able to best support the installation of post-delivery engineering changes that are inevitable in this very large fixed-price acquisition project. The Yard must also continue to make incremental investments in its weapons and engine overhaul facilities to support the modernized Coast Guard fleet. A failure to make these investments will relegate the Yard to supporting

legacy assets including ATON cutters, domestic icebreakers and coastal patrol boats. Given the tenuous state of the overall U.S. shipyard industry and the lack of commercial capacity to support large-scale renovation work, a failure to make the marginal investments at the Yard required to service new assets would result in a reduction in fleet readiness. Such a loss of readiness would not manifest immediately, but rather occur over a long period of time and become extremely difficult to reverse once today's new cutters are well along in their respective service lives.

Keep pace with changes in environmental regulations and standards: Shipyard operations by their nature are risky from an environmental perspective - involving application and use of hazardous materials in close proximity to water and often in the open atmosphere. Recent changes in environmental requirements have obligated the Yard to re-evaluate how it performs some of its work. The greatest risk at the Yard is storm-water pollution, and to a lesser extent air pollution (primarily from paint removal and painting operations). Within the next decade, the area of greatest focus must be on reducing the risk of storm-



Landfill gas wells that supply the Yard's co-generation power plant; the Yard produces nearly 85% of its electricity through its own power generation equipment, in part from landfill waste gas.

water and air pollution. This will require adaptation of new technology, expanded use of encapsulation for painting and blasting operations, changes in application methods, and modified business practices.

- <u>Reduce vulnerability</u>: The Yard must conduct targeted recapitalization of aging and unreliable infrastructure where it makes sense to do so. This effort must be guided by a strategically-focused Area Use Plan informed by future Coast Guard operational requirements. The highest priority is repair and recapitalization of the Yard's major wharves and piers, to include portal crane foundations. Concurrent with recapitalization of aging infrastructure, the Yard must improve the resilience of critical facilities, including relocating certain critical infrastructure and equipment outside of the 100-year flood plain.
- <u>Match expeditionary Coast Guard operations requirements</u>: By the end of the next decade the Yard must plan to make equipment investments and potentially pre-position equipment to best support Coast Guard assets "down range" in emerging areas of operational focus, such as the Arctic. This may also include development of pre-packaged modular industrial equipment designed to be transported by shipping container. Longer term, the Yard should also explore mobile dry-dock capability, to include modular floating dry-docks that can be shipped in pieces by cargo vessel and assembled in place, or towed floating dry-docks. This capability could enable the Yard to perform work "in theater" or other locations in the United States to support Coast Guard operations in areas where there is insufficient commercial shipyard capability.
- <u>Improve base support functions</u>: Over the next decade the Yard must make targeted investment in the most critical base functions across the installation. The greatest focus is on building structure repair and utilities. There may also be opportunity for divestiture of Coast Guard leased space in the Baltimore area that could enable employees to re-locate to the Yard, potentially reducing overall cost to the Coast Guard, while simultaneously providing an opportunity to recapitalize some buildings. The Yard must also continue to improve physical security, fire services equipment and morale, welfare and recreational support facilities to provide effective support to Coast Guard operations and Coast Guard crews.

• <u>Contingency planning</u>: As part of the Yard's Area Use Plan, the Yard must evaluate whether there are other shipyard locations in the Baltimore area outside Curtis Bay that might be better suited to support the Coast Guard's modernized cutter fleet. While it is unreasonable to assume the Yard will simply re-build in another location absent some catastrophic event, it is prudent to have contingency plans in the event a "black swan" event renders the Curtis Bay facility unusable. It is also unreasonable to assume that the Coast Guard could simply relocate the entire workforce to a geographic location outside Baltimore without losing the highly experienced civilian employees that form the basis of the Yard's competitive advantage. *Ideally any future Coast Guard Yard location in Baltimore would have the ability to service all of the cutters currently in operation, and those contemplated for the foreseeable future – overcoming the limitations of the current facilities. The Yard should have contingency plans available for a "clean sheet" shipyard construction project following a major catastrophic event, rather than simply being forced to rebuild the existing facilities due to lack of alternative plans.* 

### **VIII. Strategic Priority: Innovation & Adaptation**

### A. Integration of Emerging Technology

Given the state of the industry, with high capital costs and relatively low production volume, U.S. shipyards are generally risk averse when it comes to adopting new technology. Benchmarking larger U.S. shipyards engaged in military construction provides some insight into areas of emerging technology, particularly with regard to environmental controls, welding processes and coating systems. However, even greater insight is to be gained by examining new technology at high-volume overseas commercial shipyards. Areas of emerging technology that have direct applicability to the Yard include:



- Augmented robotics at Daewoo Shipyard, South Korea; Source: www.newscientist.com
- <u>Robotics</u>: Several South Korean shipyards and a few large U.S. shipyards have begun use of robots and augmented robotics in support of welding, painting and certain other shipyard processes.<sup>29</sup> Robots are best used in ship construction where the same processes are repeated over and over

again, as ships are built in series. Augmented robotics is a technology that allows a skilled craftsperson to don an assistive technology (e.g. robotic arm or skeleton) to improve production output at higher quality. Augmented robotics can be used for welding, rigging, painting and paint removal processes (that are not necessarily repeatable). Augmented robotics have great potential applicability at the Yard as the technology proliferates to the U.S.

- <u>Coating system and hazardous material management technologies</u>: The Yard must seek out technology that enables the Yard to readily adapt to evolving environmental requirements. Fundamental to this goal is adopting new coating systems and application methods that eliminate air and water pollution. Use of total ship enclosures to fully capture pollutants is generally expensive and inefficient, with the exception of repeatable projects like patrol boat RDAP where a large capital investment in a purpose-designed enclosure system makes sense. The Yard should therefore identify and adopt technology that facilitates paint removal and application using self-contained systems that do not rely upon total encapsulation, and minimize waste streams.
- <u>Network technology & cybersecurity</u>: The Yard must embrace the "internet of things." New networked industrial systems should be linked to the Yard's project management IT systems to improve visibility and better manage materials, labor and equipment such as forklifts, cranes, and industrial machines. As part of this effort, the Yard should also pursue greater use of portable electronic devices for use by employees in the shipyard for project administration. The future Yard should be able to better monitor equipment, labor and material utilization, and use this information to optimize resource allocation across the shipyard. This

networked technology must be built from the ground up to be resilient, operate on the Department of Defense Non-classified Internet Protocol Router network, and hardened against cyberattack.

• <u>Additive Manufacturing</u>: Additive manufacturing (3-D printing) has strong applicability to the Yard's niche of renovating obsolete and aged vessels and systems. While this technology has not yet matured to the point where it is cost effective for widespread use in most shipyards, it is increasingly used in other manufacturing industries. As the technology further matures, it will undoubtedly become increasingly useful - particularly in support of renovation and repair work. The Yard should seek out additive manufacturing technology that enables the Yard to perform back-fit design and fabricate replacement parts. This technology would also be particularly useful to an increasingly "expeditionary" Yard workforce operating in geographic regions that are at the furthest extents of the Coast Guard's supply chain.

#### B. Innovation and Adaptation in Partnerships and Authorities

In addition to leveraging new technology, the Yard must pursue non-material solutions to improving the capability and capacity of the Yard to support future operations. Some of these non-material solutions include:

- Expanded real property authorities: The Department of Defense and several other agencies have broad real property authorities such as Enhanced Use Leasing (EUL) that enable them to make use of under-utilized property to generate revenue. Some agencies even have the ability to execute real property transactions using a working capital fund<sup>30</sup>. EUL enables a federal agency to lease land or buildings to a private firm for an in-kind lease at another location, or to generate revenue that may be re-invested at another facility. This is particularly relevant to the Yard, which could lease certain portions of its facility in exchange for revenue to improve Yard infrastructure, or to develop a Yard presence in geographic areas where there is insufficient commercial shipyard capability. The Yard might also pursue modifications to the existing working capital fund authorities that would enable the Yard to enter directly into capital leases. This could conceivably allow the Yard to enter into a long-term lease with a commercial shipyard, and pay for the costs of the lease as a depreciable expense in the working capital fund (exactly like a business). Such capital lease authority could enable the Yard to overcome draft restrictions and dry-dock capacity limitations with the existing Curtis Bay facility by leasing out a larger shipyard in the Baltimore region. This would enable the Coast Guard to perform service life extensions or mid-life maintenance availabilities on large cutters like the Polar Icebreakers or National Security Cutters without costly upgrades to the Curtis Bay facility, and without being forced to use commercial shipvards to do this high-risk renovation work. Such lease authority might also allow the Yard to establish a presence on the West Coast or Alaska without the cost and risk of acquiring a new shipyard.
- <u>Partnerships</u>: In the near term, the Yard should evaluate opportunities where the Yard might leverage its industrial working capital fund authorities to engage in a strategic partnership with one or more of the Coast Guard Base industrial facilities located on the West Coast, or other areas of geographic interest. Longer term, the Yard may also consider partnerships with other federal, state and local agencies, or perhaps even other allied nations, to establish shipyard capability or industrial staging points in remote geographic regions to support future operations. Given the high cost and risk of building and maintaining permanent infrastructure in the Arctic and certain other remote regions, it is prudent to partner with other agencies and governments that have shared interests in maintaining a presence in these regions.

# Appendices

## I. List of Yard's Vessel Construction & Renovation Projects Since 1940

The following table provides an overview of vessel classes and major maritime equipment built by the Yard from 1940-2019. While the Yard built many small vessels as early as World War I (documented in photo evidence), there are insufficient written records identifying the specific vessel classes built during that time.

| Year Built | Major Construction Project   | Number Built |
|------------|--|--------------|
| 1940-1962  | Numerous boat classes including 26-foot motor lifeboats & motor surf boats,    | > 2,000      |
|            | 31-foot port security boats, 36-foot motor lifeboats, 40-foot motor lifeboats, |              |
|            | 42-utility boats, 52-foot buoy boats & other small craft                       |              |
| 1942       | 110-foot Harbor Cutters KAW & MANITOU  | 2            |
| 1943       | 180-foot Buoy Tender CGC IRONWOOD  | 1            |
| 1944       | 255-foot High Endurance Cutters MENDOTA & PONCHARTRAIN                         | 2            |
| 1944       | 100-foot Ocean Going Tugs SATAGO, SONNICANT, SECOTA,                           | 6            |
|            | TACONNET, TENSHAW & TOPOWA   |              |
| 1948-1988  | Lighted Aids to Navigation Buoys   | > 5,000      |
| 1950-1966  | 40-foot Utility Boats  | 241          |
| 1950-1952  | 128-foot Lightships SAN FRANCISCO & AMBROSE                                    | 2            |
| 1950-1960  | Mobile Antarctic Research Facilities for Camp Byrd, McMurdo Station &          | 4            |
|            | U.S. Army nuclear-powered mobile facility at Camp Century, Greenland           |              |
| 1953-1962  | 95-foot Patrol Boats (22 built for U.S. Navy & 36 built for CG)                | 58           |
| 1956-1962  | 52-foot Motor Lifeboats (Special Purpose Craft – Heavy Weather)                | 4            |
| 1957-1962  | 45-foot Stern Loading Buoy Boats   | 32           |
| 1958       | 100-foot Buoy Tender AZALEA  | 1            |
| 1960-1963; | 82-foot Patrol Boats (including 26 built for the Vietnam-based CG Squadron     | 53           |
| 1970       | One, outfitted specifically for combat service)                                |              |
| 1962-1972  | 44-foot Motor Lifeboats  | 110          |
| 1964-1971  | 157-foot Coastal Buoy Tenders RED WOOD, RED BEECH, RED BIRCH,                  | 5            |
|            | RED CEDAR & RED OAK  |              |
| 1965-1967  | 210-foot Medium Endurance Cutters CONFIDENCE, RESOLUTE,                        | 5            |
|            | DURABLE, DECISIVE & ALERT  |              |
| 1969       | 46-foot Stern Loading Buoy Tenders   | 3            |
| 1969       | 80-foot Construction Tender TERN   | 1            |
| 1969-1983  | 25-foot Surf Rescue Boats  | 206          |
| 1971-1982  | 41-foot Utility Boats  | 207          |
| 1972       | 88-foot Small Water-plane Area Twin Hull (SWATH) KAIMALINO                     | 1            |
|            | experimental high-speed craft  |              |
| 1974-1976  | 160-foot Inland Construction Tenders PAMLICO, HUDSON, KENNEBEC                 | 4            |
|            | & SAGINAW  |              |
| 1977-1981  | Air-launched oil spill recovery craft  | 28           |
| 1980-1988  | 55-foot Aids to Navigation Boats   | 10           |
| 1982       | 46-foot Catamaran Zero Relative Velocity (ZRV) Oil Skimmer Boat                | 1            |
| 1987-1990  | 130-foot River Tender Barges   | 6            |
| 1991       | 120-foot "Heritage" Class Patrol Boat Prototype                                | 1            |
| 1997-2001  | 49-foot Stern Loading Buoy Tenders   | 26           |

The following table provides an overview of major vessel classes and gun weapons systems that underwent conversion or renovation at the Yard from 1940-2019. The majority of the vessel conversion projects entailed modifying former U.S. Navy vessels for Coast Guard use. This work generally included major modifications to equipment, sensors and weapons systems, as well as hull structure modifications to meet CG mission requirements. Renovation projects include vessel reactivations, Major Maintenance Availabilities (MMAs) and Mission Effectiveness Projects (MEPs) – which are intended to sustain a cutter or boat class at or beyond midlife by replacing obsolete systems, and Service Life Extension Projects (SLEPs). SLEPs are intended to significantly extend the service life of a cutter or boat class after it has reached the end of its design service life. Generally, SLEPs entail more extensive work than MMAs and MEPs. While the Yard performed cutter and boat renovation work in the early part of the 20<sup>th</sup> century (documented in photo evidence and news articles), there are insufficient written records identifying the specific classes of vessels that underwent renovation during that time.

| Year         | Major Renovation / Conversion Project                                 | Number |
|--------------|---|--------|
| 1950s        | 125-foot "Active" Class Patrol Cutter reactivation & SLEP             | 32     |
| 1950s        | 165-foot "Thetis" and "Algonquin" Class Medium Endurance Cutter SLEP  | 29     |
| 1956         | Conversion of ex-USS CHILULA & ex-USS AVOYEL to Medium                | 2      |
|              | Endurance Cutters CHILULA & AVOYEL                                    |        |
| 1958         | Conversion of ex-USS BISCAYNE and ex-USS WAMPANOAG to Patrol          | 2      |
|              | Cutters DEXTER & COMANCHE   |        |
| 1971-1975    | 269-foot Heavy Polar Icebreaker WESTWIND MMA                          | 1      |
| 1973-1980    | 180-foot Seagoing Buoy Tender Major Renovation Project                | 14     |
| 1975-1990    | Renovation of 5-inch/30-caliber gun weapons systems (gun installed on | 28     |
|              | High Endurance Cutters & several Navy combatants)                     |        |
| 1977-1983    | 95-foot Patrol Boat SLEP  | 16     |
| 1979-1983    | 295-foot Barque EAGLE SLEP  | 1      |
| 1980-1981    | Conversion of ex-USS UTE & ex-USS LIPAN to Medium Endurance           | 2      |
|              | Cutters UTE & LIPAN   |        |
| 1984-1995    | 180-foot Seagoing Buoy Tender SLEP                                    | 9      |
| 1984-1991    | 270-foot Medium Endurance Cutter Post Delivery Retrofit & Upgrades    | 13     |
| 1985         | Conversion of Washington State Ferry KULSHAN to CG Governor's         | 1      |
|              | Island Ferry GOVERNOR   |        |
| 1988         | 180-foot CG Governor's Island Ferry COURSEN SLEP                      | 1      |
| 1988-1999    | Modernization of CG and U.S. Customs Sea-Based Aerostat Platforms     | 5      |
| 1987-1998    | 210-foot Medium Endurance Cutter MMA                                  | 14     |
| 1990-Present | Renovation of 76mm & 38mm gun weapons & MK53 fire control systems     | >150   |
|              | for CG, U.S. Navy, Saudi Navy and Polish Navy                         |        |
| 1994         | Conversion of ex-USNS VINDICATOR to Medium Endurance Cutter           | 1      |
|              | VINDICATOR  |        |
| 1998-1999    | Reactivation & conversion of CGC GENTIAN from 180-foot seagoing       | 1      |
|              | buoy tender to CG Caribbean Support Tender                            |        |
| 1999         | Conversion of ex-USS ENDENSHAW to Medium Endurance Cutter ALEX        | 1      |
|              | HALEY   |        |
| 2005-2012    | 110-foot Patrol Boat MEP  | 20     |
| 2005-2014    | 210-foot and 270-foot Medium Endurance Cutter MEP                     | 27     |
| 2014-2015    | 199-foot ex-USS CONSTELLATION Sloop of War Renovation Project         | 1      |
| 2014-2020    | 140-foot Icebreaking Tug SLEP   | 9      |
| 2014-2018    | 295-foot Barque EAGLE SLEP  | 1      |
| 2015-2018    | Modernization & renovation of NOAA Ships FERDINAND HASSLER &          | 2      |
|              | THOMAS JEFFERSON  |        |
| 2015-2024    | 225-foot Seagoing Buoy Tender MMA                                     | 16     |

### **II. References**

<sup>1</sup> "U.S. Coast Guard Yard, a History of Service to the Fleet," National Public Policy Research Institute Archives, 15 July 1985.

<sup>2</sup> In 2018 Title 14 U.S.C § 939 replaced 14 U.S.C. § 648, the Yard's original authorizing statute, which was enacted into law in 1949: http://uscode.house.gov/download/annualhistoricalarchives/pdf/2012/2012usc14.pdf.

<sup>3</sup> "Comparing Working-Capital Funding and Mission Funding for Naval Shipyards," Congress of the United States Congressional Budget Office (CBO), April 2007.

<sup>4</sup> Congressional Record, 103<sup>rd</sup> Congress of the United States, U.S. Coast Guard Response to Question for the Record from Congressman Carr, House Appropriations Committee, Subcommittee on Transportation, 21 April 1993.

<sup>5</sup> 95.7% production labor learning means that the per cutter cost of the 140-foot WTGB SLEP was reduced by an average of 4.3% each time the total number of cutters was doubled (after completion of hull #2, hull #4, etc.) as a result of the efficiency and workforce "learning" that comes with repetition.

<sup>6</sup> Brown, Robert. "*The United States Shipbuilding and Repair Industry: Adequate for Prolonged Global Conflict?*" U.S. Army Command and General Staff College, 1978.

<sup>7</sup> IBIS World, "*Staying Afloat: Despite a Decline in Commercial Orders, Military Shipbuilding Will Thrive.*" Industry Report 33661a, July 2012.

<sup>8</sup> Badiola, Francisco, et. al., "Spring 2016 Shipbuilding Report," National Defense University, 2016.

<sup>9</sup> Bachri, Saymsul, et. al., "Spring 2015 Shipbuilding Report," National Defense University, 2015.

<sup>10</sup> Nash, Timothy, et. al., "Automotive Industry Report, Cars and the Economy: A Michigan and National Perspective," Northwood University, 2016.

<sup>11</sup> U.S. Department of Transportation, Maritime Trade and Transportation, 2007, Table 7-2

 $http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/maritime\_trade\_and\_transportation/2007/html/table\_07\_02.$  html

<sup>12</sup> O'Rourke, Ron, "*Options and Consideration for Achieving a 355-Ship Navy*," Congressional Research Service Statement before Senate Committee on Armed Services, Subcommittee on Seapower, July 25, 2017.

<sup>13</sup> GAO-19-225T, *Rebuilding Ship, Submarine, and Aviation Readiness Will Require Time and Sustained Management Attention*, 12 December 2018.

<sup>14</sup> GAO-19-229, Actions Needed to Address Costly Maintenance Delays Facing the Attack Submarine Fleet, November 2018.
<sup>15</sup> Title 10 U.S. Code § 2464 – Department of Defense (DoD) Core Logistics Capabilities; this law requires DoD to perform a minimum of 50% of depot level maintenance in organic DoD facilities in order to safeguard long-term national security.

<sup>16</sup> Bachri, Saymsul, et. al., "Spring 2015 Shipbuilding Report," National Defense University, 2015.

<sup>17</sup> Riposo, Jessie, et. al., "U.S. Navy Shipyards: an Evaluation of Workload and Workforce Management Practices," Rand Corporation, 2008.

<sup>18</sup> "Evergreen IV: Strategic Needs," United States Coast Guard, September 2015.

<sup>19</sup> "2018-2022 Coast Guard Strategy," United States Coast Guard, November 2018.

<sup>20</sup> "2014 Western Hemisphere Strategy," United States Coast Guard, September 2014.

<sup>21</sup> "Evergreen IV: Strategic Needs," United States Coast Guard, September 2015.

<sup>22</sup> "2013 Arctic Strategy," United States Coast Guard, May 2013,

<sup>23</sup> "2015 Cyber Strategy," United States Coast Guard, June 2015.

<sup>24</sup> Schlegelmilch, Reuben, "*Futuristic Look at the U.S. Coast Guard in 2020*," U.S. Coast Guard Office of Research and Development, October 1984.

<sup>25</sup> U.S. Coast Guard Report to Congress, Coast Guard Yard Dry-dock Facilities and Industrial Equipment, 2015.

<sup>26</sup> GAO-17-548, Naval Shipyards – Actions Needed to Improve Poor Conditions that Affect Operations, September 2017.

<sup>27</sup> Eckstein, Megan. "NAVSEA Looking for Early Wins as it Kicks Off 20-Year Yard Modernization," U.S. Naval Institute News, September 12, 2018.

<sup>28</sup> Capital equipment is defined as having an acquisition cost greater than \$50,000; COMDTINST M7100.4 (series), Financial Resource Management Manual.

<sup>29</sup> Savvides, Nick, "*Outlook 2018: Asian Shipyards to Embrace Innovation in 2018*," Fairplay – OJS Markit Maritime Portal, December 2018; https://fairplay.ihs.com/commerce/article/4295546/outlook-2018-asian-shipyards-to-embrace-innovation-in-2018.

<sup>30</sup> GAO-09-283R, Real Property Disposal, February 2009.