



Transitioning Advanced Manufacturing Technology to the Fleet



FY2025

Navy Manufacturing Technology Project Book

Contents

The FY2025 Navy ManTech Project Book: This edition of the Navy ManTech Project Book provides brief write-ups for Navy ManTech projects active in FY2025. The projects are organized by platforms and highlight Navy ManTech's cost-savings investment strategy, with its concentration on expanded throughput, enhanced capability manufacturing technology and affordability for the key platforms and to the fleet. Please contact the points of contact listed in the project summary for additional information on any Navy ManTech project.

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Navy ManTech Overview

The Navy Manufacturing Technology (ManTech) Program is an industrial preparedness program focused on manufacturing improvements for key naval platforms, responding to the needs of the Navy for the production and repair of platforms, systems and equipment. It helps reduce acquisition and total ownership costs by developing, maturing and transitioning key manufacturing technologies and processes. Investments are focused on those that have the most benefit to the warfighter.

The Navy ManTech Program is managed by Code 33, Sea Warfare and Weapons Department, of the Office of Naval Research (ONR), with direct oversight from the Chief of Naval Research. Navy ManTech operates synergistically with other industrial base programs, such as the Submarine Industrial Base (SIB) Program and National Shipbuilding Research Program (NSRP), and complies with USC Title 10, Section 4841 and DOW 4200.15.

Navy ManTech works with defense contractors, the Naval Research Enterprise, Navy acquisition Program Offices and academia to develop improved processes and equipment. ManTech promotes timely implementation to strengthen the defense industrial base. With their expertise in specific technology areas, the Navy ManTech Centers of Excellence (COEs) play a key role in the definition and execution of the program. Together with the Navy ManTech Program Office, representatives of our Navy customers and our industry partners, the COEs function as a team to define projects that address the needs of the Navy in time to make a difference. As an example, extensive interaction and cooperation among the Navy ManTech Program Office, COEs, General Dynamics Electric Boat, Huntington Ingalls Industries – Newport News Shipbuilding, Program Executive Office (PEO) Submarines and the PMS 450 Program Office have resulted in a focused ManTech initiative for the VIRGINIA Class submarine. To date, technology from 82 of the portfolio's projects have been implemented, or are in the process of being implemented, resulting in real acquisition cost savings of approximately \$54.7M per hull, verified by our industrial partners and PMS 450.

The directors of the ManTech programs of the Army, Navy, Air Force, Defense Logistics Agency, Missile Defense Agency and Office of the Secretary of War (OSW) coordinate their programs through the auspices of the congressionally chartered Joint Defense Manufacturing Technology Panel (JDMTP) with ex-officio representation from agencies such as the Department of Commerce and the Department of Energy. The JDMTP is organized to identify and integrate requirements, conduct joint program planning and develop joint strategies. Although the JDMTP has a shared strategic vision, technical projects and initiatives are selected, executed and managed separately through each service or agency ManTech program.

Navy ManTech Objectives

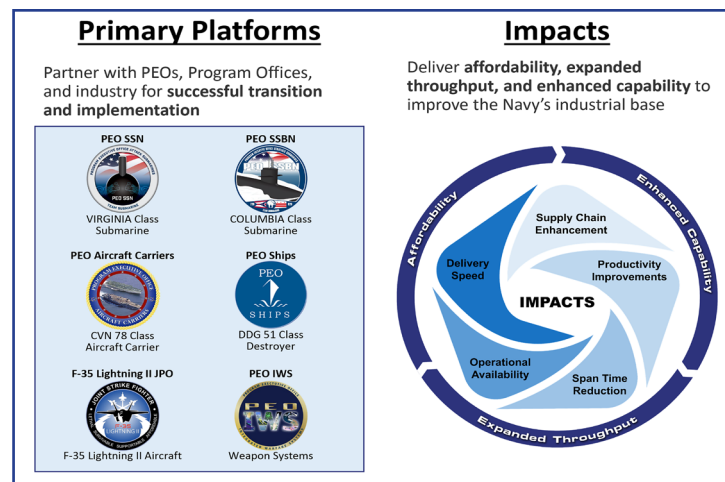
The overall objectives of the Navy ManTech Program are to improve the expanded throughput, enhanced capability of Department of the Navy systems and affordability by engaging in manufacturing initiatives that address the entire weapon system life-cycle and that enable the timely transition of technology to industry to support the fleet. More specifically, DOW Directive 4200.15 states that ManTech investments shall:

1. Aid in the economical and timely acquisition and sustainment of weapon systems and components.
2. Ensure that advanced manufacturing processes, techniques and equipment are available for reducing DOW materiel acquisition, maintenance and repair costs.
3. Advance the maturity of manufacturing processes to bridge the gap from research and development advances to full-scale production.
4. Promote capital investment and industrial innovation in new plants and equipment by reducing the cost and risk of advancing and applying new and improved manufacturing technology.
5. Ensure that manufacturing technologies used to produce DOW materiel are consistent with safety and environmental considerations and energy conservation objectives.
6. Provide for the dissemination of program results throughout the industrial base.
7. Sustain and enhance the skills and capabilities of the manufacturing workforce and promote high levels of worker education and training.
8. Meet other national defense needs with investments directed toward areas of greatest need and potential benefit.



Navy ManTech Investment Strategy

Focused on expanded throughput, enhanced capability and affordability, Navy ManTech supports industry's ability to expand production at scale throughout a weapon system's life-cycle. Ancillary impacts include supply chain enhancement, productivity improvements, span time reduction, operational availability and increased delivery speed. ManTech is focused on manufacturing improvements for key acquisition platforms: VIRGINIA Class submarine (VCS), COLUMBIA Class submarine (CLB), CVN 78 Class aircraft carrier, DDG 51 Class destroyer, F-35 Lightning II aircraft and select unmanned systems, as well as PEO Integrated Warfare Systems (IWS) weapon systems for the ship and aircraft classes.



Strategic planning for Navy ManTech is an ongoing effort. Navy ManTech annually analyzes acquisition scenarios and plans to determine major acquisition programs for potential investment. As the current platforms ManTech supports mature through their respective acquisition cycles, ManTech's investment targets change.

Although different in focus, scope and size, ManTech's strategic initiatives function similarly. For each, ManTech has established an integrated project team or IPT with representatives from Navy ManTech, the platform Program Office and representative industry. The IPT meets regularly to coordinate and review the portfolio and to ensure that projects are completed in time to meet the platform's window of opportunity for implementation.

Individual Navy ManTech projects are developed in conjunction with industry and the acquisition Program Manager (PM). With their expertise in specific manufacturing areas, the Navy ManTech COEs play a key role in project definition. Planning for transition prior to the initiation of projects is critical for the implementation of technology on the factory floor and eventually into the fleet.

To clarify communication between program participants, Navy ManTech has established definitions for "transition" and "implementation." For Navy ManTech purposes:

- **Transition** denotes that point at which the ManTech project is completed and the technology meets customer (Program Office / industry) criteria and goals for implementation and is available for use at industrial / naval organic facilities.
- **Implementation** denotes the actual use of the ManTech results on the factory floor. (The resources for imple-

Navy ManTech Investment Strategy

mentation are typically provided by entities other than ManTech including the Program Office and / or industry). Agreements are reached on the degree of participation of the PEO / PM in support of the projects.

The goal is for each PEO / PM to contribute resources to enable successful completion and implementation of ManTech projects. Resources supplied may include financial support or cost share for the ManTech project itself or funding of Navy laboratory personnel to provide test, evaluation, certification and / or other services. In addition, each PEO / PM is expected to provide personnel with technical expertise and / or management experience to assist the ManTech Program Office in project oversight. This support affords assurance that the weapon systems PM is truly committed to the successful outcome of the ManTech project. In addition, this close working relationship between the parties provides ManTech with a long-term view of implementation.

On a per-project basis, Technology Transition Plans (TTPs) document roles, responsibilities and required resources needed to achieve transition and implementation. TTPs highlight the path from the technology development that ManTech performs to implementation on the factory floor. TTPs are signed by Navy ManTech, the relevant COE Director, a management representative of the industrial facility where implementation will occur, the Program Office and, if appropriate, the Technical Warrant Holder. To assess progress, ManTech tracks the status of TTPs and conducts an annual assessment of transition and implementation.

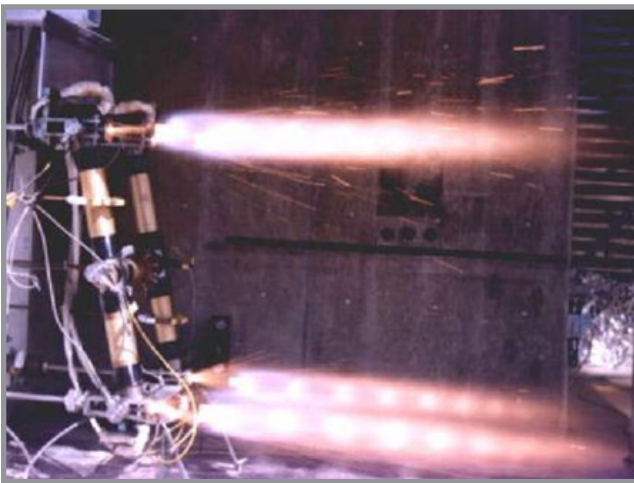
In FY2012, Navy ManTech formalized its focus on implementation and risks to implementation by instituting an implementation risk assessment management process to assess potential future projects (i.e., those in the planning stages) as well as ongoing projects. For ongoing projects, risks are discussed during scheduled program reviews to ensure ManTech is on the same page as acquisition and industry stakeholders. For projects in the planning phases, the goal is to recognize risks to implementation upfront and, by doing so, prioritize the funding of projects that have the greatest probability of implementing and have a real impact on affordability. Semi-annual affordability assessments identify projected cost reduction / avoidance per project. These assessments, which are verified by industry and the relevant Program Offices, provide critical information to ensure that ManTech can continue to meet both its goals as well as those of the platform and are essential to ManTech's success. While a large majority of annual ManTech Program resources are invested in accordance with the investment strategy, Navy ManTech does support smaller efforts in Energetics and Repair Technology (RepTech).

Energetics: ManTech projects that support energetics develop and transition process technologies for the synthesis of new or improved energetic materials, improved manufacture of propellants and explosives and improved handling and loading of energetic materials into systems and components. Projects develop solutions to ensure the availability of safe, affordable and quality energetics products in support of Program Executive Offices, such as Integrated Warfare Systems (PEO IWS / IWS3C) and Conventional Strike Weapons (PEO (W) / PMA-201). The Energetics Program is managed by the Energetics Manufacturing Technology Center (EMTC). More information on EMTC can be found on Page 11.

Navy ManTech Investment Strategy

RepTech: While the major emphasis of Navy ManTech is on support of new production, ManTech also addresses repair, overhaul and sustainment functions that emphasize remanufacturing processes and advancing technology.

The RepTech Program focuses on fielded weapon systems and provides the process and equipment technology needed for repair and sustainment. Requirements for RepTech projects are driven by Navy depots, shipyards, Naval Air Systems Command, Marine Corps Logistics Bases, intermediate maintenance activities and contractor facilities responsible for overhaul and maintenance of fleet assets. In general, RepTech projects are usually shorter in duration and are funded at lower levels than standard ManTech projects. The RepTech Program is managed by the Institute for Manufacturing and Sustainment Technologies (iMAST). More information on iMAST can be found on Page 11.



Development of energetics manufacturing for primary explosives. *Courtesy of EMTC.*



Innovative cold spray repair technology for ships. *Courtesy of iMAST.*

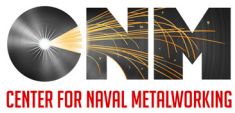
Navy ManTech projects are executed through the Navy ManTech Centers of Excellence (COEs). The COEs were established as focal points for the development and transition of new manufacturing processes and equipment in a cooperative environment with industry, academia and the Naval Research Enterprise.

The COEs:

- Execute projects and manage project teams
- Serve as a corporate expertise in technological areas
- Collaborate with acquisition Program Offices / industry to identify and resolve manufacturing issues
- Develop and demonstrate manufacturing technology solutions for identified Navy requirements
- Provide consulting services to naval industrial activities and industry
- Facilitate transfer of developed technologies

Descriptions of ManTech's seven COEs are presented on the following pages.

Navy ManTech Execution



Center for Naval Metalworking (CNM)

Established in 2016, CNM develops and deploys innovative metalworking and related manufacturing technologies to reduce the cost and time to build and repair key U.S. Navy ships and weapon platforms while also collaborating with other relevant manufacturing industries. CNM utilizes a proven approach that blends a virtual center model with in-house technical expertise to ensure that project teams are comprised of the best providers from industry to identify, develop, select and execute “metals-centric” projects that support the Navy ManTech Program objectives and transition to industry.

CNM is managed by Advanced Technology International (ATI) in Summerville, SC. CNM conducts projects that focus on metals and advanced metallic materials, metal-based composites, metal materials manufacturing processes (i.e., additive manufacturing) and joining techniques, coupled with process design control and advanced metrology and inspection technologies.

CNM website: cnm.ati.org



Composites Manufacturing Technology Center (CMTC)

Established in 2000, CMTC is a virtual center that develops improved manufacturing processes for composite-based components and facilitates technology transfer to resolve manufacturing and repair issues identified and prioritized by the Navy’s Program Executive Offices, Navy platform Program Offices, other DOW services and industry. Operated by Advanced Technology International (ATI) in Summerville, SC, CMTC forms teams of prime contractors, composites industry suppliers and universities to address Navy composites manufacturing technology needs and has strong in-depth knowledge and experience in composites manufacturing technology for all DOW weapon systems. As part of CMTC’s organizational structure, all laboratories, facilities and project labor resources are provided by project teams. This structure results in cost benefit to the Navy with maximum funding going to project execution.

CMTC’s current portfolio includes composites manufacturing projects active or in development for the VIRGINIA Class submarine (VCS), COLUMBIA Class submarine (CLB), DDG 51 Class destroyer, CVN 78 Class aircraft carrier, F-35 Lightning II aircraft, MQ-25 Stingray unmanned aircraft and the XLUUV unmanned undersea vehicle.

CMTC website: www.cmtc.ati.org

Navy ManTech Execution

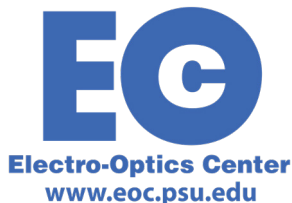


Electronics Manufacturing Center (EMC)

Established in 2021, EMC is the ONR electronics COE located within the Penn State Applied Research Laboratory (ARL) in Freeport, PA. The

core mission and function of EMC are to identify, develop and facilitate the transition of electronics manufacturing technologies to reduce the cost and time to deploy electrical and electronic, both digital and analog, systems as well as the supporting power storage and distribution infrastructure to naval ships, aircraft, submarines and unmanned systems. EMC personnel and technical contributors are experienced in most facets of electronics manufacturing and include experts from ARL, Pennsylvania State University and collaborators in the electronics manufacturing industry. The EMC facility has multiple laboratories dedicated to technology research and development, offices and meeting rooms and spaces to perform DOW-specified work.

EMC website: www.arl.psu.edu/emc/



Electro-Optics Center (EOC)

The Electro-Optics Center (EOC) operates within the Penn State Applied Research Laboratory (ARL) and has served as Navy ManTech's COE for electro-optics since 1999.

EOC's mission is to transition new electro-optics technologies and applications to Navy-selected focus platforms, through strong technical interactions with DOW and its industrial base, demonstrating acquisition cost and / or life-cycle cost savings and accelerating capabilities to the warfighter. EOC generally focuses its projects in one of three technical areas: manufacturing of electro-optics, manufacturing using electro-optics and electro-optics manufacturing systems.

EOC is comprised primarily of former industry and DOW personnel and maintains technical competencies in laser systems, imaging sensors and systems, fiber optics and photonics and electro-optics manufacturing technology. Located in Freeport, PA, EOC collaborates with electro-optics companies throughout the United States. EOC also supports important DOW technology thrusts and programs of national interest, such as the design, analysis and testing of advanced laser weapon systems. As a University Affiliated Research Center, Penn State's ARL maintains essential research, development and engineering core capabilities, maintains long-term strategic relationships with DOW sponsors, and operates in the public interest, free from real or perceived conflicts of interest.

EOC website: www.eoc.psu.edu

Navy ManTech Execution



Energetics Manufacturing Technology Center (EMTC)

Established in 1994, EMTC is Navy-operated and located at the Naval Sea Systems Command's Naval Surface Warfare Center, Indian Head Division (IHD), in Indian Head, MD. IHD serves as the focal point for EMTC and, as a renowned leader in energetics, provides a full spectrum of capabilities including energetics research, development, modeling and simulation, engineering, manufacturing technology, production, test and evaluation and fleet / operations support. EMTC develops solutions to manufacturing problems unique to military system / subsystem acquisition and production requirements and the energetics industry. EMTC has a full understanding of the inherent dangers of energetics and the need for special processes, equipment, facilities, environmental considerations and safety precautions required for manufacturing.

EMTC does not own or operate any facilities or equipment but is essentially a virtual enterprise that involves government, industry and academia in identifying requirements and executing projects. EMTC identifies weapon system and manufacturing-based needs, develops and demonstrates the required manufacturing process technology solutions and transitions successful results that ultimately benefit the warfighter.

EMTC website: go.usa.gov/xMBqg

IMAST

INSTITUTE FOR MANUFACTURING
AND SUSTAINMENT TECHNOLOGIES

Institute for Manufacturing and Sustainment Technologies (iMAST)

Established in 1995, iMAST executes and oversees the Navy ManTech mission at the Pennsylvania State University's Applied Research Laboratory, one of seven U.S. Navy University Affiliated Research Centers. Located in State College, PA, iMAST addresses challenges related to Navy and Marine Corps weapon system platforms in the following technical areas: materials processing, laser processing, metals and polymer additive manufacturing, advanced composites, digital manufacturing, coatings removal and surface preparation, complex systems monitoring and in advanced manufacturing and sustainment.

iMAST also manages the Repair Technology (RepTech) program and applies new and emerging technologies to improve the capabilities of Navy depots, shipyards, Naval Air Systems Command, Marine Corps Logistics Bases and lower-level maintenance activities throughout the fleet. RepTech cooperates and communicates with Navy COEs, the joint depot community, DOW industrial activities, industry, PEOs and university laboratories to improve sustainability, reliability and system availability.

iMAST website: <https://www.arl.psu.edu/imast>

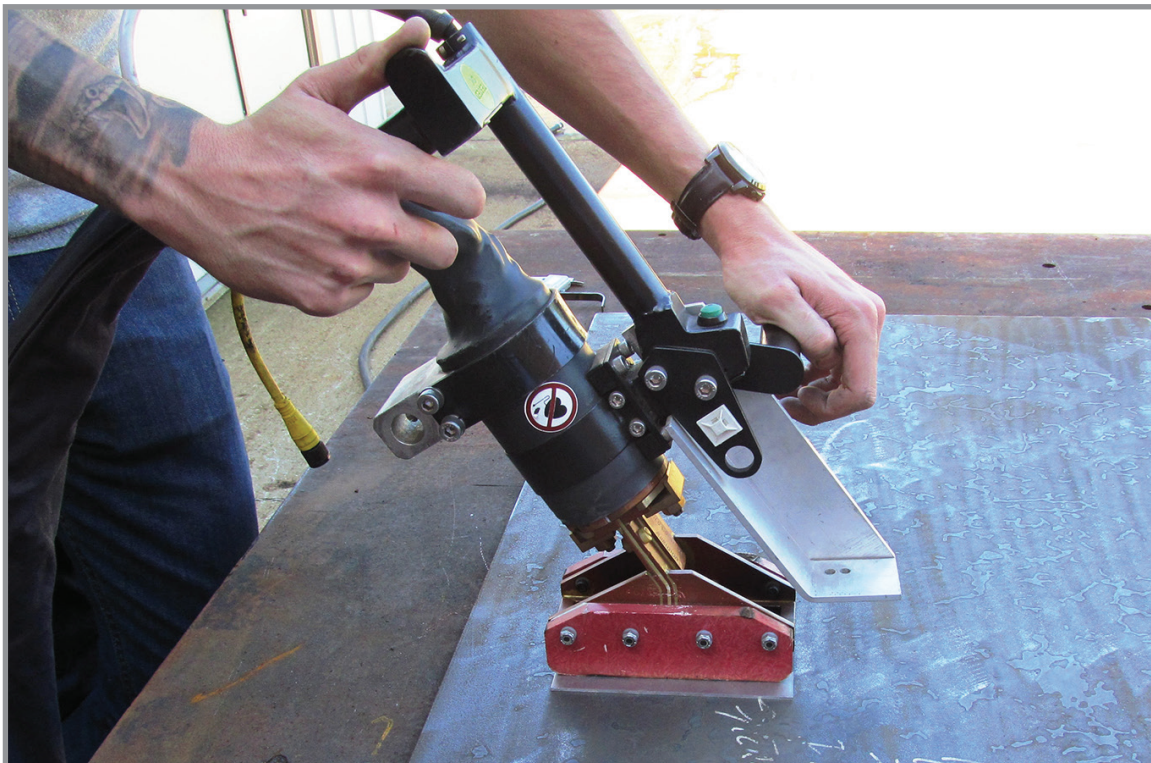
Navy ManTech Execution



Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

Established in 2003, the NSAM Center and its predecessor, the Center for Naval Shipbuilding Technology, have been operated by Advanced Technology International (ATI) in Summerville, SC. The NSAM Center develops advanced manufacturing technologies and deploys them in U.S. industrial facilities to improve manufacturing processes and ultimately reduce the cost and time required to build and repair Navy weapon platforms. The NSAM Center works closely with the Navy's acquisition and sustainment community and the defense industry to address manufacturing technology issues that negatively impact efficiency with respect to both cost and cycle time. Projects improve construction and repair processes, such as optimizing production practices, increasing the use of robotic manufacturing methods, investigating modular / packaged units, improving accuracy control, eliminating inefficiencies in material usage and using advanced manufacturing tools and technologies.

The NSAM Center focuses on technologies that improve the affordability of current Navy acquisition programs. New projects will investigate using modern planning systems, automated fabrication technologies, supply chain improvements, streamlined unit / module flow to and within storage and construction areas, wireless data management applications, 3D models to support production and improved scheduling systems for new, aggressive build strategies. NSAM website: <https://nsam.ati.org>



Induction heating and straightening for ship panels will reduce rework.
Courtesy of NSAM.



CVN 79 underwater hull in dry dock.
Courtesy of Huntington Ingalls Industries – Newport News Shipbuilding.



CVN 79 lower bow positioned in dry dock.
Courtesy of Huntington Ingalls Industries – Newport News Shipbuilding.

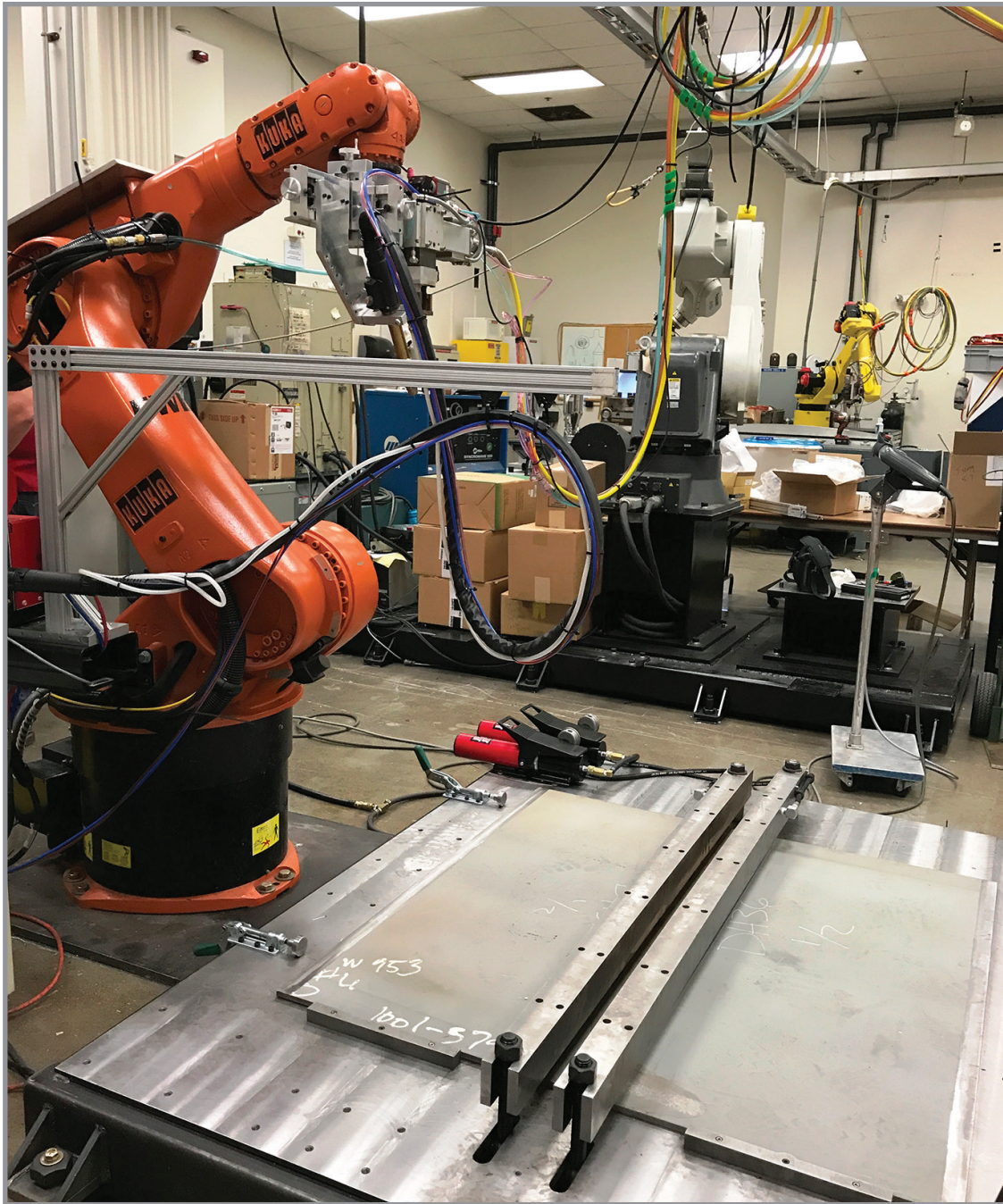
Navy ManTech Technology Transfer

As previously indicated, the emphasis of the Navy ManTech Program is on transition of manufacturing technology that will result in tangible benefits for the fleet. To achieve transition, it is imperative that the manufacturing advances be widely disseminated to the industrial base for implementation. To foster that dissemination, Navy ManTech provides the following:

Program Website	The Navy ManTech Program website can be accessed at https://www.onr.navy.mil/work-with-us/navy-mantech . The website is a central source to access general information about program activities and participation, developments and key points of contact. The site also offers links to the annual Navy ManTech Project Book and program success stories, as well as other publications.
Defense Manufacturing Conference	The annual Defense Manufacturing Conference (DMC) is a forum to present and discuss initiatives that address DOW manufacturing technology and related sustainment and readiness needs. The conference includes briefings on current and planned programs, funding, DOW initiatives and seminars related to the various technology thrusts currently being pursued.
ShipTech	The biennial ShipTech event is a forum to exchange information on the manufacturing technology developments generated by Navy ManTech through its COEs, as well as the related initiatives conducted by the National Shipbuilding Research Program (NRSP), industry and academia. The objectives are to reduce acquisition and total ownership costs of naval ships, accelerate the delivery of capabilities to the warfighter and enhance the competitiveness of the U.S. shipbuilding industry.
Project Book	The Navy ManTech Project Book is published annually and provides a snapshot of Navy ManTech projects active during the previous fiscal year. Points of contact for each project are provided to facilitate technology transfer and engagement.
Centers of Excellence	The Navy ManTech COEs are focal points for specific manufacturing technology areas. The charter for each COE requires it to act as a consultant to both the Navy and industry and to facilitate the transfer of technology throughout the industrial base.

Navy ManTech Technology Transfer

The Navy urges government activities, industry and academia to participate in its ManTech Program as participants, advisors, consultants and, most importantly, as beneficiaries. Development and implementation of new and improved technologies is achieved only through a concerted effort by everyone connected with the design, manufacture and repair and sustainment of naval weapon systems.



Increasing productivity and reducing distortion by employing hybrid laser arc welding.
Courtesy of Huntington Ingalls Industries – Ingalls Shipbuilding / NSAM.

Navy ManTech Releases New Investment Strategy

The Navy ManTech Program is committed to improving the cost and performance of the U.S. Navy's key weapon systems by developing and applying advanced manufacturing technologies that reduce the time and cost to produce those systems. The program focuses on the development, maturation and demonstration of manufacturing technologies in the Manufacturing Readiness Level (MRL) 4-6 range that can be successfully implemented by the weapon system manufacturer.

For FY2027, the Navy ManTech Program has made a pivot to its long-standing investment strategy to address the new Administration's focus on maritime dominance and the Chief of Naval Operations' strategic vision for the Navy.

The Navy ManTech Program's FY2027 strategy is focused on reducing acquisition and total ownership costs for key platforms by developing and transitioning advanced manufacturing technologies and processes. The strategy will prioritize projects with a measurable impact, including increased throughput, speed of delivery and enhanced capability, to support broader Navy goals of improving fleet readiness and modernizing industrial capacity. The FY2027 strategy is defined around undersea, surface, weapons and aviation systems platforms.

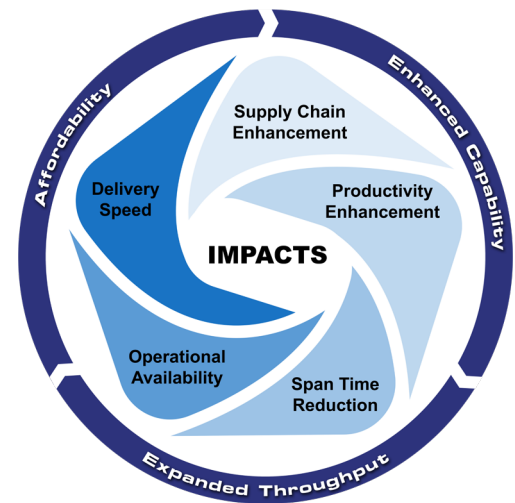


Key Focus Areas

- **Targeted acquisition platforms:** Supporting major new, current and future acquisition programs by developing the necessary manufacturing technologies to improve performance and reduce manufacturing costs.
- **Shipbuilding (Golden Fleet):** Supporting administration objectives to enhance U.S. Maritime Industrial Base by investing in critical technologies and strategic partnerships that increase shipbuilding capacity, enhance ship availability and support national maritime objectives.
- **Shipyard of the future:** Modernizing naval shipyards through technology integrations in advanced automation, robotics and digital thread technologies to enable fully connected and highly-efficient shipbuilding and repair ecosystems.
- **Advanced manufacturing and digital technologies:** Investing in advanced manufacturing methods and digital tools to improve efficiency and capability across various programs.
- **Platform sustainment:** Developing technologies to improve the repair and maintenance of ships, submarines and aircraft to meet fleet readiness goals.
- **Autonomous and unmanned systems:** Scaling robotic and autonomous systems and creating manufacturing processes for the production of these platforms.

Strategic Priorities and Execution

- **Speed and throughput:** Accelerating production and sustainment timelines through technology development and implementation that reduce manufacturing cycle times, increase process efficiency and enhance throughput of naval platforms.
- **Industry partnerships:** Collaborating closely with industry partners is crucial for identifying and solving manufacturing challenges and ensuring the successful transition of new technologies.
- **Measurable impact:** Measuring success through tangible benefits like reduced cycle times, increased process yields and a favorable return on investment for implemented projects.



Key Objectives to Meet the Strategy:

- Developing enabling manufacturing technologies for implementation on weapon systems.
- Partnering with PEOs, Program Offices and industry for successful transition and implementation.
- Analyzing continuously acquisition scenarios to identify where Navy ManTech's investments will have the most significant impact, refining the strategy as platforms mature through their acquisition cycles.
- Delivering highest impact manufacturing technologies for implementation to benefit the fleet.





Navy ManTech – expanded throughput, enhanced capability and affordability improvements for key naval platforms: VIRGINIA Class submarine (VCS), F-35 Lightning II aircraft, COLUMBIA Class submarine (CLB), CVN 78 Class aircraft carrier, DDG 51 Class destroyer and advanced weapon systems. *Courtesy of PEO (Subs), PEO (JSF), PEO (Columbia), PEO (Aircraft Carriers), PEO (Ships)*

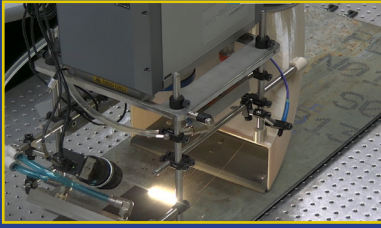
CVN 78 Class Aircraft Carriers Projects

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CVN 78 Class Aircraft Carrier *U.S. Navy image.*

Laser Ablation to Improve NNS Pre-construction Primer Removal Operations



PERIOD OF PERFORMANCE:
February 2019 to September 2024

PLATFORM:
CVN 78 Class Aircraft Carrier

CENTER OF EXCELLENCE:
Institute for Manufacturing
and Sustainment Technologies
(iMAST)

POINT OF CONTACT:
Chris Ligetti
(814) 865-6531
iMAST@arl.psu.edu

STAKEHOLDER:
PMS 378

S2823 — Laser Ablation of PCP from HSLA Steel

Objective

In CVN 78 Class aircraft carrier construction, preconstruction primer (PCP) must be removed prior to welding. Needle guns, handheld or walk-behind grinders and abrasive blast equipment typically are used. These are dangerous, laborious processes that can be detrimental to the substrates and produce excessive waste materials. A substantial percentage of CVN 78 Class aircraft carrier steel fabrication labor is consumed in PCP removal at Huntington Ingalls Industries – Newport News Shipbuilding (NNS) in the Steel Production Facility (SPF). An unacceptable number of personnel injuries are experienced each year, surface erosion of the steel substrate is prevalent and cleanup and disposal costs for blast media are rising. Laser ablation can reduce these concerns. Supporting studies have already led many defense and commercial industries to implement the technology. For shipyards, implementation challenges (e.g., technical, procedural, training, safety, environmental and financial) may be overcome by appropriately identifying and carefully addressing application needs individually.

This Institute for Manufacturing and Sustainment Technologies (iMAST) project develops and tests a laser ablation removal process that reduces the time to strip PCP, limit impact to the steel substrate and reduce labor and consumable costs. iMAST, working with NNS, developed, tested and optimized a 1 kW, pulsed fiber laser by IPG Photonics to remove PCP in various conditions (weathered and unweathered). Testing, per the Technical Warrant Holder guidance, was completed to assist NNS with laser ablation qualification and implementation for semi- or fully-automated SPF applications in order to help support the CVN 78 Class aircraft carrier construction schedule. Testing showed that laser ablation could be used to successfully remove PCP.

Payoff

The final project business case, based on expected process improvements per NNS, shows substantial labor reductions per CVN 78 upon implementing laser ablation. This translates into a five-year cost savings of \$16.0M – \$19.0M and associated return on investment (ROI) of approximately 2.1:1, primarily attributable to an anticipated 60% reduction in labor hours for primer removal upon the implementation of multiple SPF laser systems. These figures also include a roughly 60% decrease in consumable material costs for primer removal (e.g., abrasive wheels) and cost avoidances related to injuries experienced using current PCP removal methods.

Implementation

NNS anticipates the need for three to four laser ablation systems in the SPF. This includes capital equipment procurement; standard operating procedure and safety protocols / training development; and equipment installation, debugging and training. Implementation has begun: NNS submitted a letter to Naval Sea Systems Command 05V (aircraft carriers) for notification of implementation, and NNS concept designs have been discussed with integrators for multiple installation areas. System procurement is anticipated in FY2026. The strategy for implementation has a timeline beginning in mid-FY2025.



Streamlining Aircraft Carrier Construction with Modular Hatch Assembly

S2894 — Advanced Weapons Elevator (AWE) Modular Hatch Assembly

Objective

The Advanced Weapons Elevator (AWE) Modular Hatch Assembly project addresses alignment issues and schedule delays associated with the traditional shipboard construction of AWE doors and hatches. These components are critical for maintaining integrity of the system that supports transporting munitions and mission-critical items from the carrier's lower decks to the upper decks. The traditional process requires extensive labor and various build practices that tends to be prone to misalignments due to environmental factors and spatial constraints.

This Center for Naval Metalworking (CNM) project developed a modular approach to manufacturing AWE doors and hatches in a shop environment rather than onboard the ship. The modular approach reduces labor costs, improves alignment accuracy and accelerates construction schedules by building the hatches in a controlled shop environment. Key deliverables included improved fixturing and jigs, a new manufacturing cell concept, updated build plans and modular assemblies.

Payoff

The AWE Modular Hatch Assembly project delivered significant benefits, including:

- **Labor Efficiency:** Reducing labor costs significantly by shifting manufacturing to a shop environment.
- **Improved Alignment:** Enhancing accuracy in hatch assembly, reducing rework and inspection costs.
- **Accelerated Construction:** Streamlining the build process, reducing schedule delays and improving throughput.

Savings

- Savings per CVN 78 Hull: \$2.6M

Implementation

The project results are expected to be implemented at Huntington Ingalls Industries – Newport News Shipbuilding (NNS). Full implementation is expected in FY2029, with the modular manufacturing process integrated into the construction of CVN 78 Class aircraft carriers.



PERIOD OF PERFORMANCE:
September 2022 to December 2025

PLATFORM:
CVN 78 Class Aircraft Carrier

CENTER OF EXCELLENCE:
Center for Naval Metalworking (CNM)

POINT OF CONTACT:
Daniel Reed
(843) 760-3361
daniel.reed@ati.org

STAKEHOLDER:
PMS 378



Advanced Thermal Insulating Coatings for Anti-Sweat and Thermal Applications



PERIOD OF PERFORMANCE:
October 2021 to April 2025

PLATFORM:
CVN 78 Class Aircraft Carrier

CENTER OF EXCELLENCE:
Composites Manufacturing
Technology Center (CMTC)

POINT OF CONTACT:
Ryan Frankart
(864) 646-4529
ryan.frankart@ati.org

STAKEHOLDER:
PMS 378

S2944 — Thermal Insulating Coatings (TIC)

Objective

The installation of traditionally-formed insulation is labor-intensive, requiring manual application of adhesives and fitting each insulation piece individually. Approximately 210,000 linear feet of insulation are required for CVN 78 Class aircraft carrier non-nuclear piping systems alone, consuming over 1.5M labor-hours for hand-fitting pipe and ventilation insulation. Hand labor accounts for 95% of the cost to install insulation.

This Composites Manufacturing Technology Center (CMTC) project tested and validated the service properties of novel Thermal Insulating Coatings (TICs) for shipboard applications. The project also explored new implementation requirements, including facility and equipment specifications, build strategies and in-service testing plans. TICs are intended to replace traditional insulation systems, offering improved affordability, efficiency and performance.

Payoff

- **Labor Cost Savings:** Replacing 50% of formed insulation is projected to save approximately \$25M per CVN 78 Class aircraft carrier.
- **Improved Efficiency:** Simplifying the insulation process, reduces labor hours and enables faster installation.
- **Enhanced Performance:** Providing comparable thermal conductivity to legacy insulation materials while offering long-term maintenance improvements.
- **Scalability:** Applying to high-volume insulation applications, targeting CVN systems and other naval platforms.

Savings

- **Estimated Total Cost Savings:** \$45.6M.
- **Estimated Return on Investment (ROI):**
 - 9.3:1 with 50% replacement.
 - 21.9:1 with 100% replacement.

Implementation

The primary challenge for successful implementation is meeting stringent Navy fire, smoke and toxicity requirements and reallocating labor resources from hand-applying insulation to applying coatings. This will require collaboration between manufacturers and the Naval Sea Systems Command (NAVSEA) fire protection team to define new product testing criteria, new designated facilities, equipment, defined process lanes and associated procedures governing the applications. Implementation is targeted for CVN 82 / 83 platforms in FY2027 with partial opportunities for CVN 82 depending on TIC approval timelines.



Revolutionizing Abrasive Collection with Autonomous Technology

S3005 — Autonomous Abrasive Collection

Objective

The Autonomous Abrasive Collection project is addressing the labor-intensive, hazardous and inefficient process of recovering abrasive blast media during shipbuilding and maintenance operations. Current methods require significant human labor, expose workers to health and safety risks and result in high operational costs.

This Center for Naval Metalworking (CNM) project is developing and delivering a prototype capable of autonomously collecting, transporting and dumping abrasive material. The system will reduce labor costs, improve worker safety and enhance operational efficiency. Key features will include autonomous navigation within a user-defined area, battery power and advanced mobility for navigation and operation in shipyard environments.

Payoff

The Autonomous Abrasive Collection project will deliver significant benefits, including:

- **Labor Savings:** Reducing human labor expended in abrasive collection activities.
- **Improved Safety:** Minimizing worker exposure to hazardous conditions, reducing risk of muscle strains or sprains and incidents of respiratory illness and dermatitis.
- **Cost Savings:** Reducing operational costs associated with abrasive media recovery and recycling processes.
- **Enhanced Efficiency:** Improving throughput and reduced abrasive waste during shipbuilding and maintenance operations.

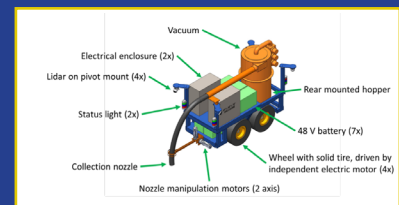
By automating abrasive collection, this project will improve safety, reduce costs and enhance operational efficiency in shipyard environments.

Savings

- Savings per CVN 78 Class Aircraft Carrier Hull: \$5.7M
- Savings per VIRGINIA Class Submarine Hull: \$800K
- Savings per DDG 51 Class Destroyer Hull: \$436K

Implementation

The project results will be implemented in FY2027 at Huntington Ingalls Industries – Newport News Shipbuilding (NNS) and Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) facilities. The transition event will occur after the successful completion of the pilot demonstration.



PERIOD OF PERFORMANCE:
October 2023 to October 2026

PLATFORMS:
CVN 78 Class Aircraft Carrier
COLUMBIA Class Submarine (CLB)
DDG 51 Class Destroyer
VIRGINIA Class Submarine (VCS)

CENTER OF EXCELLENCE:
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(CNM)

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STAKEHOLDERS:
PMS 378
PMS 397
PMS 450
PMS 400D



Predictive Analytics to Minimize Impacts of Stack-Up Tolerances During Ship Erection



PERIOD OF PERFORMANCE:
June 2025 to December 2026

PLATFORMS:
CVN 78 Class Aircraft Carrier
COLUMBIA Class Submarine (CLB)
DDG 51 Class Destroyer
VIRGINIA Class Submarine (VCS)

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced
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S3010-A — Enterprise-Wide Accuracy Control for the Digital Environment

Objective

The Enterprise-Wide Accuracy Control for the Digital Environment project seeks to expand the capabilities of the Digital Accuracy Control Management System (DACMS) and the NSRP RA23-01 Digital Environment for an Enterprise-Wide Accuracy Control system. This Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project is creating a centralized accuracy control system that collects and assimilates measurement data from various stages of ship construction and associates it globally with design data. The primary goals are to reduce rework and schedule disruptions caused by misaligned ship components, such as stacking tolerances, weld distortion and material distortion during storage. By implementing advanced data analytics and predictive models, the project will ensure the most accurate and affordable end-product while enabling real-time analysis and decision-making.

Payoff

The project is expected to deliver significant benefits, including:

- Reduction of Fit-Up Hours: Reducing the time required for fit-up processes.
- Reduction of Welding Hours: Improving alignment and accuracy will reduce the number of welding hours needed during unit erection.
- Reduction of Process Support Labor Hours: Requiring fewer hours to fit and weld units.

The integration of predictive analytics and real-time decision-making will significantly reduce unforeseen events impacting fit-up processes, thereby reducing rework and corrections at late stages of construction.

Savings

- Five-Year CVN Savings: \$13.0M
- Five-Year Total Savings: \$18.3M
- Five-Year Return on Investment (ROI): 3.1:1

Implementation

The project will be implemented across multiple shipyards, including Huntington Ingalls Industries – Newport News Shipbuilding (NNS), General Dynamics Bath Iron Works (BIW) and Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls). Implementation is planned to occur at each shipyard in the fourth quarter of FY2026. The implemented system will be accessible via various mediums, such as computers and mobile devices, ensuring usability across different user groups. Full-scale implementation is expected to deliver substantial benefits to shipbuilding operations, with opportunities for further expansion to additional use cases and platforms.

Transforming Surface Preparation with Automated Panel Blast and Coat Technology

S3012 — Automated Panel Blast and Coat

Objective

The Automated Panel Blast and Coat project leverages the universal primer concept to automate surface preparation and priming for the majority of a ship's surfaces. The ability to retain the universal primer allows the coating of ship panels much earlier in the build process, thereby creating the opportunity to use automation. Currently, painting is labor-intensive and time-consuming and exposes workers to hazardous, cramped and confined environments. In addition, manual processes can result in inconsistent coating thickness and surface preparation quality, leading to rework, increased costs and shortened coating life.

This Center for Naval Metalworking (CNM) project is developing an automated solution to blast and prime the ship in the panel stage. The system will integrate digital scanning, automated robotic path planning, automated blasting and robotic coating technologies to improve process efficiency, reduce labor hours and enhance coating quality. The solution will be designed to operate in shipyard environments, ensuring scalability and adaptability for various ship platforms.

Payoff

The Automated Panel Blast and Coat project will deliver significant benefits, including:

- **Labor Savings:** Reducing labor hours required for blasting and coating operations, improving overall productivity.
- **Improved Quality:** Enhancing consistency in coating thickness and surface preparation, reducing rework and inspection costs.
- **Enhanced Safety:** Minimizing worker exposure to hazardous blasting and coating environments.

By automating the blasting and coating processes, the project will improve efficiency, reduce costs and enhance the quality of surface preparation and coating for ship panels.

Savings

- Savings per CVN 78 Class Aircraft Carrier Hull: \$96M
- Five-Year Return on Investment (ROI): 3.4:1

Implementation

The project results will be implemented in FY2027 at Huntington Ingalls Industries – Newport News Shipbuilding (NNS) in Newport News, VA. The transition event will occur after the successful completion of prototype testing and system validation.



PERIOD OF PERFORMANCE:
November 2024 to February 2027

PLATFORM:
CVN 78 Class Aircraft Carrier

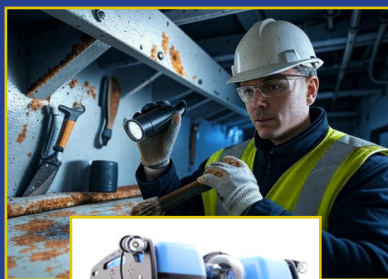
CENTER OF EXCELLENCE:
Center for Naval Metalworking (CNM)

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STAKEHOLDER:
PMS 378



Evaluating Technology to Reduce Impact of Tank Inspection on Fleet Operational Availability



PERIOD OF PERFORMANCE:
December 2023 to December 2024

PLATFORMS:
CVN 78 Class Aircraft Carrier
COLUMBIA Class Submarine (CLB)
DDG 51 Class Destroyer
VIRGINIA Class Submarine (VCS)

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced
Manufacturing (NSAM) Center

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STAKEHOLDERS:
Commander Navy Regional
Maintenance Center (CNRMC)
Submarine Maintenance Engineering
Planning and Procurement
(SUBMEPP)



R3035 — Noninvasive Tank Inspection

Objective

The Noninvasive Tank Inspection (NTI) project investigated commercial-off-the-shelf (COTS) technologies capable of conducting inspections of shipboard tanks without requiring the removal of the tank / system from operational status. The project focused on enabling pre-availability inspections to improve activity planning and budgeting, reduce growth work associated with shipyard tanks and enhance operational readiness.

This Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project was organized to achieve its objectives through five distinct tasks. The first task focused on project management and oversight, ensuring effective coordination, monitoring and control of all project activities. The second task involved assessing the baseline process and envisioning the desired future state to lay the groundwork for improvements and innovations. The third task centered on conducting a comprehensive technology assessment and selecting the most suitable technologies to meet project goals. The fourth task aimed to develop and document a noninvasive tank inspection process, providing a detailed framework for implementation. Lastly, the fifth task was dedicated to publishing the project results. Based on project findings, some project objectives changed. The project was unable to downselect any technology for in-depth piloting or process planning due to no clear path forward for implementation at this time.

Payoff

If implemented, the NTI project would deliver significant benefits, including:

- **Improved Planning and Budgeting:** Enhancing pre-availability inspection processes will reduce unplanned growth work, improving cost and schedule performance during maintenance availabilities.
- **Operational Efficiency:** Allowing tanks to remain operational during inspections, minimizing downtime and disruption to ship operations.
- **Safety and Environmental Benefits:** Reducing need for intrusive inspections will lower risks associated with confined space entry and hazardous material exposure.

Implementation

Based on project findings, there is no clear path forward for implementation at this time. A recommended path to implementation for stakeholders is to deploy ROVs for pre-inspections while ships remain operational to conduct early maintenance availability assessments for better planning. This will require the development of procedural guidance to safely deploy ROVs in tanks under operational conditions or early in maintenance cycles. NSAM continues to engage with other initiatives to determine if additional Navy ManTech support can provide value in later-stage piloting and implementation planning activities.

Modernizing Sheet Metal Fabrication for Enhanced Efficiency and Cost Savings

S3036 — Sheet Metal Shop Modernization

Objective

The Sheet Metal Shop Modernization project is aimed at addressing inefficiencies in the legacy workflow to deliver materials to Huntington Ingalls Industries – Newport News Shipbuilding (NNS) sheet metal shops. The current unoptimized workflow evolved to support the manufacturing and tracking of neat-cut, flat-state, sheet metal parts but has had an adverse impact on labor and material waste.

This Center for Naval Metalworking (CNM) project is streamlining NNS operations used to support sheet metal manufacturing by eliminating unnecessary processing, handling and tracking, which will impact labor costs while enabling improved material utilization and enhance shop throughput.

Payoff

The Sheet Metal Shop Modernization project will deliver significant benefits, including:

- **Labor Savings:** Reducing material processing, handling and tracking.
- **Material Optimization:** Improving material utilization reduces waste and associated costs.
- **Enhanced Productivity:** Increasing throughput and reduced production cycle times across the laser-cutting work centers will improve adherence to shop delivery schedule.

By modernizing the material delivery workflow to the sheet metal shops, the project improves efficiency, reduces costs and enables NNS to meet increasing production demands with fewer resources.

Savings

- Five-Year Savings across All Platforms: \$7.6M
- Five-Year Return on Investment (ROI): 8.9:1

Implementation

The project results will be implemented at NNS. The transition event will occur after achieving successful results from the virtual and physical pilots. Full implementation will be achieved in the third quarter of FY2027, with the modernized processes applied to VIRGINIA Class, COLUMBIA Class and CVN 78 Class platforms.



PERIOD OF PERFORMANCE:
April 2024 to April 2027

PLATFORMS:
CVN 78 Class Aircraft Carrier
COLUMBIA Class Submarine (CLB)
VIRGINIA Class Submarine (VCS)

CENTER OF EXCELLENCE:
Center for Naval Metalworking
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PMS 450



Improving Throughput and Schedule Adherence with Data-Driven Computational Modeling



PERIOD OF PERFORMANCE:
July 2025 to January 2028

PLATFORMS:
CVN 78 Class Aircraft Carrier
COLUMBIA Class Submarine (CLB)
VIRGINIA Class Submarine (VCS)

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced
Manufacturing (NSAM) Center

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PMS 450



S3038 — Workcenter Representation Model

Objective

The Workcenter Representation Model (WRM) project is optimizing work package throughput by developing a robust mathematical optimization model across multiple workcenters in shipbuilding. The WRM will reduce disruptions, increase throughput and validate model accuracy for workcenter operations. This Naval Shipbuilding and Advanced Manufacturing (NSAM) Center initiative builds upon the success of a single workcenter model deployed in the small components shop within the Huntington Ingalls Industries – Newport News Shipbuilding (NNS) engineering workcenter, which demonstrated a 17%-24% increase in throughput during a 12-month period.

The project will link 4, 5 and 6 workcenters together to optimize entire segments of the shipbuilding value stream. By integrating detailed mathematical analysis with computational modeling, the WRM will improve sustained throughput across chained workcenters, directly benefiting shipbuilding operations.

Payoff

The WRM project is expected to deliver significant benefits, including:

- Disruption Reduction: Minimizing disruptions at the workcenter level.
- Throughput Improvement: Sustaining throughput increases of 17%-24% across chained workcenters.
- Labor Savings: Reducing labor hours required for disruption recovery.

Savings

- Savings per CVN 78 Class Aircraft Carrier Hull: \$3.0M
- Savings per VIRGINIA Class Submarine Hull: \$462K
- Savings per COLUMBIA Class Submarine Hull: \$924K
- Five-Year Savings: \$13.9M
- Five-Year Return on Investment (ROI): 3.5:1

Implementation

The WRM will be implemented in phases, starting with the development of a 4-workcenter chain model, followed by 5- and 6-workcenter chain models. The project includes proof-of-concept testing, computational model fusion and deployment to selected value chain segments. Performance feedback will be gathered to refine the model and ensure its accuracy. Implementation is planned to occur in the third quarter of FY2028.

Enabling Cold Spray Repair Technology for On-Vessel Applications Using Ship Utilities

S3073 — Low Pressure Cold Spray for Preventative Maintenance, Expeditionary Repair and Sustainment

Objective

Cold spray has been widely adopted by Naval Sea Systems Command (NAVSEA) for critical, non-structural repairs, resulting in significant savings in repair cost and time through restoration over scrapping of damaged shipboard components. Early applications of qualified cold spray repair processes were conducted off-hull in industrial settings. Based on this success, portable and hatchable cold spray systems were developed allowing repairs at the point of need, including pier-side or shipboard. However, these systems still rely on access to a high-pressure air or nitrogen source and 480-volt three-phase power, limiting their use in difficult to access spaces and in-service maintenance. In addition, current on-board repair technology requires use of a robot and related equipment to be transported shipboard, which can lead to longer times for repair. Low-pressure cold spray (LPCS) systems have been recently introduced to NAVSEA to conduct shipboard cold spray repair and to evaluate cold spray as a protective coating. LPCS can be used in the hand-held mode, eliminating the need for a robot.

NAVSEA identified that ship repairs or maintenance aimed at preventing corrosion or providing improved surface for organic coatings are not only needed during major overhauls and availabilities, but also during intermediate maintenance or even underway repair. Currently, repairs conducted on Navy ships during deployment to mitigate corrosion involve grinding and painting. However, many of these repairs do not perform well or last a relatively short time, requiring constant rework. The rework can lead to further damage that needs to be addressed in a major maintenance availability through more extensive removal and replacement. A low-pressure, portable system offers greater opportunity for depot-level repair, repair during intermediate maintenance and shipboard repairs conducted while underway (e.g., expeditionary environment).

This Institute for Manufacturing and Sustainment Technologies (iMAST) project aims to develop a low-pressure, lightweight, portable cold spray system capable of running solely on ship's utilities (low pressure air and 100 volts) to repair corrosion, wear or impact damage on non-structural components; identifying candidate repairs; developing LPCS process parameters; evaluating LPCS performance for NAVSEA applications; and developing written procedures for LPCS operation.

Payoff

A LPCS will greatly expand the use of cold spray to repair damaged components and deposit corrosion coatings. An initial NAVSEA use case assessment reveals that adoption of on-board, low-pressure cold spray repair is expected to result in a 40% reduction in labor hours for air induction hull valve repair, conventionally thermal flame sprayed, and an 83% reduction in labor hours replacing conventional copper and nickel plating operations. This results in initial estimated five-year cost savings of \$4.8M and associated return on investment (ROI) of 1.6:1. Additional NAVSEA repair use cases are expected to be identified throughout the project, increasing the long-term ROI.

Implementation

Implementation of the portable LPCS system developed in this project will initially occur at a supporting NAVSEA 04 maintenance and repair shipyard. Full post-project implementation will require modest Navy investment for additional production units of the LPCS system from a qualified vendor as well as training for shipyard operators. Finally, the project team will monitor fleet interest in fielding the portable LCSP capability to enable expeditionary, shipboard repairs while deployed.



PERIOD OF PERFORMANCE:
April 2025 to July 2027

PLATFORMS:
CVN 78 Class Aircraft Carrier
COLUMBIA Class Submarine (CLB)
VIRGINIA Class Submarine (VCS)

CENTER OF EXCELLENCE:
Institute for Manufacturing and
Sustainment Technologies (iMAST)

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STAKEHOLDERS:
NAVSEA 05T
NAVSEA 04



DDG 51 Class Destroyer Projects

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DDG 51 Class Destroyer (U.S. Navy image)

Streamlining Hull Access Welding and Cutting with Automation

S2855 — Automated Hull Access Welding and Cutting Applications

Objective

Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) requires manual cutting and welding of temporary access holes along the exterior of ship hulls to facilitate interior blasting, painting and ventilation. These manual processes are labor-intensive, require highly skilled personnel and often result in inconsistently cut surfaces that lead to poor weldments and significant rework.

The Center for Naval Metalworking (CNM) partnered with Ingalls, Edison Welding Institute (EWI) and ARC Specialties to develop a semi-automated solution to improve productivity and increase first-time quality acceptance for hull access cut-out processing. The project reduced labor hours, improved weld quality and minimized rework by leveraging advanced cutting and welding technologies.

Payoff

The Automated Hull Access Welding and Cutting Applications project is expected to deliver significant benefits, including:

- Labor Savings: Reducing labor required to cut, fit and weld temporary access holes.
- Improved Weld Quality: Increasing first-time weld quality acceptance rates, reducing rework and inspection costs.

By automating the cutting and welding processes, the project enhanced productivity, reduced costs and improved schedule performance.

Savings

- Savings per DDG 51 Hull: \$1.5M
- Savings per LPD Hull: \$3.4M
- Savings per LHA Hull: \$4.8M
- Five-Year Savings for DDG 51, LPD and LHA: \$21.4M
- DDG 51 Return on Investment (ROI): 3.3:1
- All Platforms ROI: 11.5:1

Implementation

The project results will be implemented at Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) in Pascagoula, MS. The transition event occurred after the successful execution of the shipyard evaluation test plan in third quarter of FY2025. Partial implementation is currently in-process expected in the fourth quarter of FY2025 with full implementation anticipated in the first quarter of FY2027. Ingalls will submit capital expenditure requests to fund production equipment, training and procedure updates necessary for implementation in FY2026.



PERIOD OF PERFORMANCE:
December 2019 to July 2025

PLATFORMS:
DDG 51 Class destroyer
Amphibious Assault Ship (LHA)
Amphibious Transport Dock (LPD)

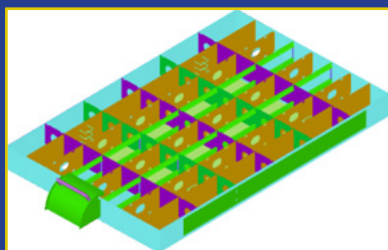
CENTER OF EXCELLENCE:
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STAKEHOLDER:
PMS 400D



Transforming Inner Bottom Construction for U.S. Navy Surface Ships



PERIOD OF PERFORMANCE:
December 2024 to November 2026

PLATFORMS:
DDG 51 Class Destroyer
Amphibious Assault Ship (LHA)
Amphibious Transport Dock (LPD)

CENTER OF EXCELLENCE:
Center for Naval Metalworking
(CNM)

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STAKEHOLDER:
PMS 400D



S2890 — Inner Bottom Transformation

Objective

The Inner Bottom Transformation project is revolutionizing the processes to construct inner bottom assemblies for surface ships. These assemblies are large, complex structures that are expensive to construct and consume significant build cycle time. Current processes rely on limited mechanized welding, leading to poor ergonomics and inefficiencies for shipbuilders. This project focuses on two major improvements: (1) reduction of reinforcing rings around openings inside the inner bottom structure and (2) development of a slotted construction process for the grid framework of the assemblies.

By proving that unreinforced openings and slotted construction meet performance requirements, this Center for Naval Metalworking (CNM) project will enable significant changes in construction requirements, paving the way for future mechanized and robotic process applications.

Payoff

The Inner Bottom Transformation project offers substantial benefits, including:

- **Labor Savings:** Reducing ship fitting and welding labor costs by 10% for reinforced openings and 20% for slotted construction implementation.
- **Material Efficiency:** Reducing steel material costs.
- **Improved Ergonomics:** Providing safer and more efficient working conditions for shipbuilders.
- **Enhanced Performance:** Increasing use of robotic and automated welding processes, consistent seam gaps and reduced part count in design and construction.

Savings

- Savings per DDG 51 Hull: \$1.3M
- Five-Year Savings All Platforms: \$15.4M
- Five Year All Platforms Return on Investment (ROI): 1.6:1

Implementation

The project is being implemented in two phases:

Phase 1: Unreinforced Openings: Testing and analysis have been completed, with 77% of candidate openings on LHA ships already modified. Similar efforts are underway for LPD and DDG 51 platforms.

Phase 2: Slotted Construction: Testing and development are ongoing, with fatigue testing, structural element testing and underwater explosion (UNDEX) / shock testing planned to validate the new construction methodology.

The target implementation site: Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls), with potential application to all Navy surface ships, including DDG 51, LHA and LPD platforms. Full Implementation is expected in the fourth quarter of FY2026.

Automating Shipbuilding Processes with Multi-Function Robotics

S2904 — Multi-Function Shipbuilding Robot

Objective

The Multi-Function Shipbuilding Robot project is revolutionizing the welding and inspection processes for vertical and horizontal erection joints in shipbuilding. Current methods rely heavily on manual labor and track welding systems, which are time-consuming, labor-intensive and prone to rework due to inconsistent weld quality. This Center of Naval Metalworking (CNM) project leverages emerging technologies to develop a robotic system capable of automating surface preparation, welding, interpass cleaning and inspection processes.

The robotic system will reduce labor hours, improve weld quality and decrease rework, ultimately enhancing shipbuilding efficiency and affordability.

Payoff

The Multi-Function Shipbuilding Robot project offers significant benefits, including:

- Labor Savings: Reducing scaffolding erection and welding setup hours.
- Improved Weld Quality: Reducing rework and inspection hours by 50%.
- Enhanced Safety: Reducing need for scaffolding and manual labor in hazardous environments.

Savings

- Savings per DDG 51 Hull: \$822K
- Savings for Combined Platforms: \$4.2M
- Five-Year All Platforms Savings: \$9.9M
- Five-Year All Platforms Return on Investment (ROI): 8.6:1

Implementation

Partial implementation is expected in the third quarter of FY2025 at Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) in Pascagoula, MS. Full implementation is expected in the first quarter of FY2027.



PERIOD OF PERFORMANCE:

April 2021 to July 2025

PLATFORMS:

DDG 51 Class Destroyer
Amphibious Assault Ship (LHA)
Amphibious Transport Dock (LPD)

CENTER OF EXCELLENCE:

Center for Naval Metalworking
(CNM)

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Revolutionizing Shipbuilding with Advanced Forming for Curved Plates



PERIOD OF PERFORMANCE:
July 2024 to June 2025

PLATFORMS:
DDG 51 Class Destroyer
Amphibious Assault Ship (LHA)
Amphibious Transport Dock (LPD)

CENTER OF EXCELLENCE:
Center for Naval Metalworking
(CNM)

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PMS 400D

S2927 — Advanced Forming for Curved Plates and Stiffeners

Objective

The Advanced Forming for Curved Plates and Stiffeners project aimed to address inefficiencies in the current manual processes for forming curved plates and stiffeners used in shipbuilding. These processes are labor-intensive, require extensive rework and result in inconsistent quality due to the complexity of forming and welding curved geometries.

This Center for Naval Metalworking (CNM) project focused on developing advanced forming technologies and processes to improve the accuracy, efficiency and quality of curved plates and stiffeners. Key objectives included reducing labor hours, minimizing rework and enabling the integration of advanced forming techniques into shipyard operations. The effort also explored the scalability of the solution for various ship platforms.

Payoff

The Advanced Forming for Curved Plates and Stiffeners project will deliver significant benefits, including:

- **Labor Savings:** Reducing labor hours for forming operations by 25%.
- **Improved Quality:** Enhancing accuracy and consistency of curved plates and stiffeners.
- **Scalability:** Establishing a scalable solution to form curved components across multiple ship platforms.

By modernizing the forming process, the project will improve efficiency, reduce costs and enhance the quality of curved components used in ship construction.

Savings

- **Five-Year Total Savings:** \$3.9M

Implementation

The project results will be implemented at Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) in Pascagoula, MS. The transition event will occur after the successful completion of prototype testing and system validation. Full implementation is targeted for the third quarter of FY2027 with the advanced forming processes integrated into production for DDG 51, LHA and LPD platforms. Full implementation is expected in the fourth quarter of FY2027.



Enhancing Efficiency with One-Sided Deck Tie-Down Welding

S2933 — One-Sided Deck Tie-Down Welding and Inspection

Objective

The One-Sided Deck Tie-Down Welding and Inspection project addressed inefficiencies in the current process to install and replace deck tie-downs on Navy surface ships. Traditionally, tie-downs require structural welding on both sides, which increases labor hours, inspection requirements and handling costs.

This Center for Naval Metalworking (CNM) project developed a program approved by the Naval Sea Systems Command (NAVSEA) to structurally weld deck tie-downs on only one side, eliminating the need for second-side welding and inspection. The solution improved efficiency, reduced labor hours and streamlined inspection processes while maintaining structural integrity and compliance with Navy standards.

Payoff

The project delivered significant benefits, including:

- **Labor Savings:** Reducing labor hours for fitting, welding and handling tie-downs, as well as inspection hours.
- **Improved Efficiency:** Reducing rigging and crane labor for turning assemblies, accelerating construction and sustainment schedules.
- **Return on Investment (ROI):** Projecting ROI of 4.4:1 across all platforms and 1:1 for DDG 51 Class destroyers.

By eliminating the requirement for second-side structural welding, the project improved productivity, reduced costs and enhanced the overall efficiency of deck tie-down installation and replacement.

Savings

- Savings per LHA Hull: \$1.3M
- Savings per LPD Hull: \$304K
- Five-Year Total DDG 51 Savings: \$1.8M
- Five-Year Total DDG 51, LHA and LPD Savings: \$4.9M
- All Platforms ROI: 4.4:1

Implementation

The project results will be implemented at Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) in Pascagoula, MS. The transition event will occur after the successful completion of final reporting and the approved testing by NAVSEA. Full implementation is targeted for the fourth quarter of FY2026, with the process integrated into production and sustainment activities for DDG 51 Class destroyers.



PERIOD OF PERFORMANCE:
January 2023 to September 2025

PLATFORMS:
DDG 51 Class Destroyer
Amphibious Assault Ship (LHA)
Amphibious Transport Dock (LPD)

CENTER OF EXCELLENCE:
Center for Naval Metalworking
(CNM)

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STAKEHOLDER:
PMS 400D



Advancing Shipboard Insulation Systems for Improved Performance and Cost Efficiency



PERIOD OF PERFORMANCE:
June 2025 to June 2027

PLATFORMS:
DDG 51 Class Destroyer
Other Navy ship classes that require advanced insulation systems

CENTER OF EXCELLENCE:
Composites Manufacturing
Technology Center (CMTC)

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STAKEHOLDERS:
PMS 400D
Naval Sea Systems Command
PEO Ships



S2940-2 — High Performance Insulation Materials & Processes, Phase 2

Objective

The High Performance Insulation Materials & Processes project aims to enhance shipboard insulation systems by identifying, testing and validating new materials and processes that improve thermal, acoustic and fire protection performance while reducing costs. Phase 2 builds upon the findings of Phase 1, focusing on pilot testing, material validation and process optimization to ensure suitability for shipboard environments. The ultimate goal of this Composites Manufacturing Technology Center (CMTC) project is to improve affordability, installation efficiency and life-cycle durability of insulation systems used in Navy vessels.

Payoff

The implementation of advanced insulation materials and processes is expected to deliver the following benefits:

- **Improved Performance:** Enhancing thermal, acoustic and fire protection properties to meet stringent Navy standards.
- **Reducing Labor Hours:** Minimizing material waste and improved installation efficiency, leading to significant cost reductions.
- **Life-Cycle Durability:** Increasing durability and reduced maintenance requirements, contributing to lower life-cycle costs.
- **Scalability:** Applying this project across multiple ship classes, including DDG 51 and other Navy vessels.

Savings

- Five-Year Savings DDG 51 Savings: \$10.1M
- Five-Year Return on Investment (ROI) = 4.6:1

Implementation

The equipment developed under this project is anticipated to be implemented in FY2028.

Driving Efficient Beam Director Optical Manufacturing

S2956 — Beam Director Manufacturing

Objective

Laser weapon systems offer warfighters unique solutions. The beam director assembly subsystem in the beam control system is an essential subassembly of every high energy laser (HEL) weapon system. To date, the Navy has integrated prototype directed energy weapons and HEL into DDG 51 Class destroyers. Additional platforms will be considered as the technology evolves and fleet needs are established.

The laser beam director is a precision assembly of many different optical, mechanical and electrical components. Building a laser beam director presents complex manufacturing challenges at both the component level and at the assembly level. The optics are large, high-value items that require special handling procedures to avoid damage and a poorly planned or poorly executed beam director manufacturing process results in a system with serious performance degradation and manufacturing inefficiencies that significantly adversely affect acquisition cost and limit production capacity.

The Navy has made several successful investments to improve manufacture of the beam director optical components. This Electro-Optics Center (EOC) project complemented these prior components' investments to address the manufacturing challenges of the integrated beam director assembly by defining a process for the interface, build and test of the beam director optical assembly.

Payoff

The project developed manufacturing aspects of these laser directed energy solutions concurrent with technology development to optimize the delivery schedule of this capability. The project addressed immediate needs of systems under development and enabled manufacturing capacity expansion across industry providers. Production cycle time and cost savings up to 30% are possible through a reduction in assembly and common testing methods for a wide variety of beam expander architectures.

Implementation

The project transition point for this effort was a demonstration covering the most complex aspects of the beam director manufacturing process using a full-size, high-fidelity hardware demonstrator of a laser beam director optical system. The project final report and process documentation package captured results for the transition partners to employ on new projects. The project team has shared this work with Department of War (DOW) teams to aid in manufacturing planning and execution of ongoing precision optics projects. Program Offices that will benefit from this project include both Army and Navy.



PERIOD OF PERFORMANCE:
June 2022 to September 2025

PLATFORM:
DDG 51 Class Destroyer

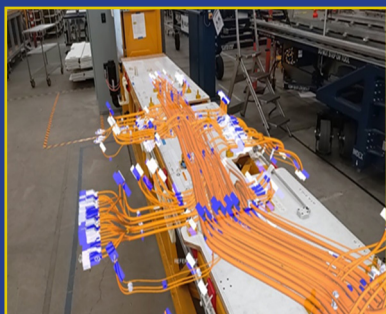
CENTER OF EXCELLENCE:
Electro-Optics Center (EOC)

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STAKEHOLDER:
PEO IWS 11.0



Advancing Cable Installation and Testing with Augmented Reality



PERIOD OF PERFORMANCE:

June 2023 to June 2025

PLATFORMS:

DDG 51 Class Destroyer
Amphibious Assault Ship (LHA)
Amphibious Transport Dock (LPD)

CENTER OF EXCELLENCE:

Naval Shipbuilding and Advanced
Manufacturing (NSAM) Center

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STAKEHOLDER:

PMS 400D

S2975 — Improved Cable Installation and Testing

Objective

The Improved Cable Installation and Testing project enhanced shipboard cable plant manufacturing and installation processes to improve first-time yield (FTY), reduce labor hours and lower material costs. This Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project focused on sensitive cable media, including coaxial and optical cable types and included improvements to cableway design, planning activities, installation and testing processes.

The initiative was executed in two phases:

- Phase 1: Identified mission requirements, documented use cases and developed functional and non-functional requirements. Proposed solutions were reviewed with shipyard management teams, and options were down-selected to address areas with the highest potential impact.
- Phase 2: Piloted proposed solutions in real-world trials, including a cable color coding and bundling system and augmented reality (AR) tools for cable installation.

The project resulted in the identification and evaluation of enhanced cable installation processes, optimized cable bundling methods, standardized cable coloring system and development and piloting of a shipyard-adapted version of Boeing's BARK AR Kit for installation guidance and upgraded cable testing procedures.

Payoff

The project demonstrated significant benefits, including:

- Reducing engineering labor costs by 10%.
- Reducing in material costs by 10%.

The solutions developed under this project are applicable to all Navy ship platforms constructed by Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls), including DDG 51, LHA and LPD.

Savings

- Five-Year Savings for Combined DDG 51, LHA, LPD: \$7.6M
- Five-Year Return on Investment (ROI): 3.4:1

Implementation

The technology developed during this project will be transitioned into production environments at Ingalls in the fourth quarter of FY2026. Implementation activities includes adoption of the cable color coding and bundling system to streamline installation processes, and deployment of Boeing's Augmented Reality Kit to improve cable installation accuracy and reduce rework.



Advancing Model-Based Enterprise Maturity

S2976 — MBE Maturity Index Update

Objective

The Model-Based Enterprise (MBE) Maturity Index has been widely adopted as a tool for quantifying the specific needs and benefits of MBE projects in the manufacturing industry. However, gaps in the current MBE Maturity Index limit its applicability across the broader manufacturing sector, including Navy shipyards and other Department of War (DOW) manufacturing programs.

In a joint effort with the Manufacturing x Digital (MxD) Manufacturing Innovation Institute and the Department of Energy's National Nuclear Security Administration, this Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project is evaluating and updating the existing MBE Maturity Index to address these gaps and developing a comprehensive guidebook for use by industry stakeholders. The updated MBE Maturity Index will enable organizations to identify requirements, constraints and priorities, ultimately advancing their MBE maturity efforts and achieving their desired goals.

The project will identify gaps in the existing MBE Maturity Index, develop recommendations to optimize the MBE Maturity Index for broader use and supplementing the MBE Maturity Index documentation with a guidebook aligned to the updated version.

Payoff

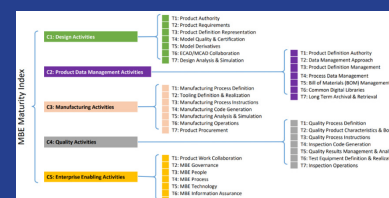
The updated MBE Maturity Index will provide Navy ManTech and partner organizations with a more effective tool to evaluate the capabilities of their original equipment manufacturers to undertake complex model-based enterprise projects. The project is expected to:

- Improve strategy development and execution in the digital enterprise domain.
- Enable broader adoption of the MBE Maturity Index across the DOW community and the industrial base.
- Enhance efficiency in MBE project planning and execution, leading to cost savings and improved performance.

Implementation

The updated MBE Maturity Index is expected to be implemented at Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) and General Dynamics Bath Iron Works (BIW) during the third quarter of FY2026. The guidebook will be distributed to Navy shipyards and other stakeholders to facilitate adoption and integration into existing processes.

Level Name	Drawing-Centric	Drawing Model-Centric	Validated Model-Centric	Formalized Model-Centric	Trusted Model-Centric	Integrated Model-Centric	Extended Model-Centric
Level Identifier	1.0	1.1	1.2	1.3	1.4	1.5	1.6
Level Description	2D Drawings Only (Unconnected)	2D Drawings & 2D/3D Connect From 3D Models (Unconnected)	2D Drawings & 3D Models with Interconnected Definitions from 3D Models (Unconnected)	3D Models with Semantic Data (Unconnected)	Digital Model-Based Definition (MBD) Certified & Authorized (Unconnected)	Enterprise Integrated from Trusted Digital Product Definition (Unconnected)	Enterprise Extended with Optimized Capabilities and Extended Parameters (Unconnected)
As-Is Adoption Levels	Low	Low	Low	Low	Medium	High	High
Categories w/Typical w/Features	Design Activities	Design Activities	Design Activities	Design Activities	Design Activities	Design Activities	Design Activities
Categories w/Typical w/Features	Design Activities	Design Activities	Design Activities	Design Activities	Design Activities	Design Activities	Design Activities



PERIOD OF PERFORMANCE:

July 2023 to April 2026

PLATFORM:

DDG 51 Class Destroyer

CENTER OF EXCELLENCE:

Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

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STAKEHOLDER:

PMS 400D



Planning and Coordinating Temporary Services



PERIOD OF PERFORMANCE:

May 2023 to August 2025

PLATFORM:

DDG 51 Class Destroyer
Amphibious Assault Ship (LHA)
Amphibious Transport Dock (LPD)

CENTER OF EXCELLENCE:

Naval Shipbuilding and Advanced
Manufacturing (NSAM) Center

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S2980 — Temporary Services Call Board

Objective

Temporary services, such as hot work, ventilation, welding lines, electric lighting, power, compressed air, scaffolding and various other services, are essential in the construction of Navy ship platforms. At Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls), these services are currently scheduled through a manual paper process, which introduces inefficiencies in planning and scheduling, potentially affecting the timely execution of individual work packages and overall adherence to the construction schedule.

The Temporary Services Call Board project developed an automated management toolset that provides immediate visibility to the location and performance of key service resources. This Naval Shipbuilding and Advanced Manufacturing (NSAM) Center tool reduces labor costs through increased process efficiency, minimizes travel distances of relocatable services to workstations, maximizes service availability and improves visibility of real-time status and location of equipment.

Payoff

Implementation of the Temporary Services Call Board is expected to result in significant cost savings across all Ingalls platforms. This tool will enhance process efficiency, reduce labor costs and improve productivity. Additional benefits include:

- Improving visibility of interdependence across work packages and platform construction programs.
- Reducing schedule delays caused by manual errors and inefficiencies.
- Enhancing decision-making through real-time data tracking and forecasting.

Savings

- Five-Year DDG 51, LHA, LPD Savings: \$10.3M
- Five-Year All Platforms ROI: 8:1

Implementation

The Temporary Services Call Board is expected to be implemented at Ingalls during the first quarter of FY2026. The project team has successfully conducted pilot testing of the digital call board system on DDG 51, LPD and LHA platforms. The pilot demonstrated the tool's effectiveness for hot work chits, service paint and combustible material tracking activities.

Ingalls intends to expand the use of the tool for additional use cases post-project completion. While the exact timeline for these additional implementations has not yet been developed, the Operations Department has expressed strong interest in leveraging the tool for broader applications.

The Temporary Services Call Board project has successfully demonstrated the feasibility of automating temporary service management processes at Ingalls. The tool's pilot testing results indicate significant potential for cost savings, improved efficiency and enhanced decision-making. Full-scale implementation is expected to deliver substantial benefits to shipbuilding operations, with opportunities for further expansion to additional use cases and platforms.



Revolutionizing Pipe Inspection with Portable Robotic Technology

S2981 — Portable Shipyard Pipe Inspection

Objective

The Portable Shipyard Pipe Inspection project addresses inefficiencies and safety concerns in the current manual pipe inspection process. Inspectors are required to crawl on their hands and knees with flashlights to inspect external pipe surfaces and conduct internal inspections from pipe entrances. This process is labor-intensive, prone to human error and limited in its ability to document findings effectively.

This Center for Naval Metalworking (CNM) project is developing and piloting a robotic system for visual pipe inspection. The system is designed to live-stream, photograph and store inspection pictures, enabling inspectors to remotely assess internal pipe surfaces. The robotic solution will improve inspection accuracy, reduce labor hours and enhance documentation capabilities.

Payoff

The Portable Shipyard Pipe Inspection project delivered significant benefits, including:

- Labor Savings: Reducing labor hours required for pipe inspections.
- Improved Accuracy: Enhancing inspection capabilities, reducing rework and improving first-time quality acceptance.
- Enhanced Documentation: Providing live-streaming and recording capabilities for improved inspection traceability.

By automating pipe inspections, the project will improve efficiency, reduce costs and enhance the quality and reliability of shipyard operations.

Savings

- Five-Year Total Savings: \$6.0M
- Five-Year Return on Investment (ROI): 2.4:1

Implementation

The project results will be implemented at Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) in Pascagoula, MS. The transition event will occur after the successful completion of prototype testing and shipyard evaluation. Full implementation is targeted for the second quarter of FY2027, with the robotic inspection system integrated into production and maintenance processes for DDG 51, LPD and LHA platforms.



PERIOD OF PERFORMANCE:
April 2024 to February 2026

PLATFORMS:
DDG 51 Class Destroyer
Amphibious Assault Ship (LHA)
Amphibious Transport Dock (LPD)

CENTER OF EXCELLENCE:
Center for Naval Metalworking
(CNM)

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Enhancing Forming Accuracy with Machine Learning-Driven Path Planning



PERIOD OF PERFORMANCE:
December 2023 to February 2027

PLATFORMS:
DDG 51 Class Destroyer
Amphibious Assault Ship (LHA)
Amphibious Transport Dock (LPD)

CENTER OF EXCELLENCE:
Center for Naval Metalworking
(CNM)

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STAKEHOLDER:
PMS 400D

S2985 — Machine Learning for Path Planning Software

Objective

The Machine Learning for Automated Forming Path Planning Software project will improve the accuracy and efficiency of forming processes for shipbuilding applications. Current path planning methods for forming rely on manual calibration and predefined algorithms, which are time-consuming, prone to errors and require significant human intervention.

This Center for Naval Metalworking (CNM) project is incorporating machine learning (ML) capabilities into the Path Planning Software (PPS) to enable automated updates to the forming database without human intervention. The ML-driven solution will improve forming accuracy, reduce calibration time for new materials and thicknesses and enhance overall system performance. The project will also extend the PPS database to accommodate additional materials and thicknesses, ensuring scalability for future shipbuilding needs.

Payoff

The Machine Learning for Automated Forming Path Planning Software project will deliver significant benefits, including:

- **Improved Accuracy:** Enhancing forming accuracy with a 20% improvement in root mean square percentage over current PPS results.
- **Reduced Calibration Time:** Achieving an 80% reduction in time required to calibrate the PPS for new material and thickness combinations.
- **Cost Savings:** Reducing labor hours and rework costs associated with forming inaccuracies, with significant savings over five years.
- **Scalability:** Establishing a scalable solution for automated forming path planning across multiple ship platforms.

By leveraging machine learning, the project will improve forming accuracy, reduce costs and enable shipyards to meet increasing production demands with fewer resources.

Savings

- Five-year Total Savings: \$5.0M

Implementation

The project results will be implemented at Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) in Pascagoula, MS. The transition event will occur after the successful completion of prototype testing and system validation. Full implementation is anticipated in the second quarter of FY2028, with the ML-driven PPS integrated into production processes for DDG 51, LHA and LPD platforms.



Transceiver Affordability Improvements to Reduce Cost, Improve Performance and Enable Technology Insertion

S2987 — SEWIP Block 3 Transceiver Affordability

Objective

Surface Electronic Warfare Improvement Program (SEWIP) Block 3 is the third in a series of evolutionary block upgrades to the AN / SLQ-32(V) electronic warfare system (EWS). SEWIP Block 3 substantially upgrades the AN / SLQ-32(V) EWS by providing Electronic Attack (EA) capability against anti-ship missiles. The SEWIP Block 3 transceiver subsystem enables both transmit and receive functionality. This Electronics Manufacturing Center (EMC) project will develop and transition a new transceiver solution and combine the functionality of various line replaceable units (LRUs) in the EA rack to reduce cost, improve performance and enable future technology insertion.

Payoff

The technical approach for this project includes updating the EA signal processor backplane and chassis to replace the current transceiver with an upgraded transceiver (and associated cables, cable supports and rack mounts), re-architecting and porting of the firmware to the new transceiver, combining some lower level components, conducting design verification test and creating new drawings.

Together, these tasks are expected to provide space and weight reduction eliminates multiple LRUs decreasing weight and maintaining spare backplane slots for technology refresh / insertion cycles), enhance performance, and provide \$1.3M cost savings per shipset with integration onto at least 50 surface combatants starting with the DDG 51 Class destroyer.

Implementation

DDG 51 is the initial transition platform. The results of this Navy ManTech project will transition to the Program Office. The Program Office intends to fund the additional development, qualification test and engineering change proposal development and processing to implement these affordability improvements into the SEWIP Block 3 production line. Implementation is expected in the third quarter of FY2027. Retrofits are planned for previously-fielded systems.



PERIOD OF PERFORMANCE:
November 2021 to June 2026

PLATFORMS:
DDG 51 Class Destroyer
CVN 78 Class Aircraft Carrier
Landing Helicopter Dock (LHD)

CENTER OF EXCELLENCE:
Electronics Manufacturing Center (EMC)

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STAKEHOLDER:
PEO IWS 2.0



Enabling Data Transfer in Large IR Focal Planes Using Photonics



PERIOD OF PERFORMANCE:
April 2024 to October 2025

PLATFORM:
DDG 51 Class Destroyer

CENTER OF EXCELLENCE:
Electro-Optics Center (EOC)

POINT OF CONTACT:
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STAKEHOLDERS:
Navy PEO IWS 2
Office of Naval Research Future Naval Capability
Army PM TS
Army PM Apache Helicopter

J2997 — Focal Plane Array Photonic Output

Objective

High-performance infrared (IR) imagers are used in land, sea, air and space domains to provide U.S. forces with overmatch capability. Previous IR imagers were typically smaller format with modest frame-rates. Higher frame-rates were available only in reduced formats or windowed areas of large imagers. Image bit depth was limited to the needs of human operators. Conventional means of electrical data transmission satisfied the needs for such systems. However, increasingly challenging threats call for imaging systems with much larger focal plane sizes, higher scene refresh rates and increasing bit depth designed for automated machine processing, such as aided target recognition. Data transmission rates required for these systems exceed the capability of the conventional electrical transmission solutions.

Recent cross-service research has matured several solutions to meet these emergent data transmission needs based on photonics, but an efficient and scalable manufacturing process for the photonic solution does not exist for military sensor systems. This Electro-Optics Center (EOC) project seeks to establish government-owned manufacturing processes for photonic data transmission from the cryogenic IR sensor environment.

Payoff

Improvements in the manufacture of IR system data transmission complements manufacturing technology investments for high-resolution, wide field of view and high update rate IR sensor systems. This project enables maximum imaging performance in a combat environment while increasing production capacity and affordability by reducing human labor in the manufacturing process. The ultimate benefit is accelerated delivery of advanced imaging capability to warfighters, but the solution also favorably impacts the cost of other camera-system components.

Implementation

The project transition point for this effort is a full signal chain demonstration of the manufacturing approach. The project final report and demonstration hardware will be transitioned to inform additional research projects in this topic area.

Transition pathways include target platforms across services with intelligence, surveillance and reconnaissance, fire control and navigation applications. Program Offices that will benefit from this project include Navy PEO IWS 2, Army PM TS and Army PM Apache Helicopter, as well as Office of Naval Research Future Naval Capability efforts and other DOW research efforts.



Improved Cryocooler Life Reduces Optical Sensor Life-Cycle Costs

S2999 — Cryocooler Reliability Improvements

Objective

Current cryocooler limitations in operating life and reliability for tactical applications, including the Shipboard Panoramic Electro-Optic Infrared (SPEIR) system, present a risk to the surface fleet and negatively impact the life-cycle cost of the system. Surface fleets rely on optical sensors in these systems for critical situational awareness capabilities and to support the “detect-to-engage” sequence to address threats. Tactical sensor packages utilize cryocoolers to cool the focal plane array to cryogenic temperatures to achieve the sensor performance required for the mid-wave infrared detection of threats.

This Electro-Optics Center (EOC) project will improve the life of tactical cryocoolers by demonstrating production of cryocoolers with life-extending technologies and then characterizing the life of the units against baseline test performance. The manufacturing technology demonstration will be performed by a subcontractor, leveraging internally developed improvements. Life testing will be performed at EOC in an environmental chamber to represent the field environment and will include both improved and the baseline cryocooler units. The simulated loads and cycling rates will be applied to map cryocooler life for creation of a use-dependent life model. Condition-based monitoring methods will be developed and demonstrated in the life testing to develop an approach to detect early indicators of failures and predict the remaining life of units in the field. The demonstration, testing and resulting life model will provide needed information for the fleet to predict the mean time to failure (MTTF) for the improved units while accounting for use profiles.

Payoff

This project is expected to reduce life-cycle costs by extending the MTTF of cryocooler by two-to-three times of the current unit, resulting in an expected 50% reduction in cryocooler replacement costs. Savings beyond the value of the cryocooler will be realized since the life extension applies to an integrated sensor unit of much higher value with significant logistical and spares cost for the program. Longer replacement intervals and early detection of failure indicators will also benefit system availability for improved protection of the fleet.

Implementation

The primary transition platforms for this EOC project are the DDG 51 Class destroyer, FFG 62 Class frigate and CVN 78 Class aircraft carrier. The first implementation is expected in the first quarter of FY2027 on the DDG 51 and shore-based systems for SPEIR Block I. System implementation of the life-extending manufacturing technology is expected to be included in production units for multiple applications and services upon completion of the life testing and characterization performed on this project.



PERIOD OF PERFORMANCE:
September 2022 to August 2026

PLATFORMS:
DDG 51 Class Destroyer
CVN 78 Class Aircraft Carrier

CENTER OF EXCELLENCE:
Electro-Optics Center (EOC)

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STAKEHOLDER:
PEO IWS 2.0



Optimizing Component Layout in Shipbuilding



PERIOD OF PERFORMANCE:
August 2023 to August 2026

PLATFORM:
DDG 51 Class Destroyer

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced
Manufacturing (NSAM) Center

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STAKEHOLDER:
PMS 400D

S3008 — Optimized Layout Process

Objective

The Optimized Layout Process project is replacing the manual, paper-based process of locating correct component placement locations in shipbuilding with a digital layout process. This Naval Shipbuilding and Advanced Manufacturing (NSAM) Center initiative focuses on reducing rework, minimizing manual measurement and improving overall production efficiency. The project leverages advancements in digital projection systems to automate data transmission from designers / planners to production, enabling real-time determination of correct foundation locations.

The primary focus is on the Hull Department at Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls), which performs most layout and outfitting tasks. Secondary use cases include the Pipe Department, depending on the size and scope of the layout system chosen.

Payoff

Implementation of the Optimized Layout Process is expected to result in significant cost savings, including:

- Labor Savings: Reducing labor hours required for layout and outfitting tasks.
- Cost Avoidance: Eliminating rework due to improved accuracy in component placement.
- Performance Enhancements: Improving production efficiency and reduced cycle times.

Savings

- Five-Year DDG 51 Savings: \$3.0M
- Five-Year Return on Investment (ROI): 1.8:1

Implementation

The Optimized Layout Process will be implemented at Ingalls during the fourth quarter of FY2026. The initial pilot use case will focus on the Hull Department with potential expansion to the Pipe Department based on system capabilities.



Advancing Welding Technology for High-Strength Steel Applications

T3018 — Hybrid Laser Arc Welding Parameter Development for High Strength Steels

Objective

The Hybrid Laser Arc Welding (HLAW) Parameter Development project is developing welding parameters for high-strength steels (HSS) used in Navy surface ships. HLAW technology combines laser welding and gas metal arc welding (GMAW) to achieve deep penetration welds with high precision and efficiency.

This Center for Naval Metalworking (CNM) project is analyzing the effects of filler metal chemistry and welding variables on the mechanical properties of HLAW weldments. Project goals are to develop HLAW parameters for HSS that improve mechanical properties, reduce defects and enhance throughput for ship construction. This effort represents a critical step in increasing structural fabrication automation and efficiency in Navy combatant construction.

Payoff

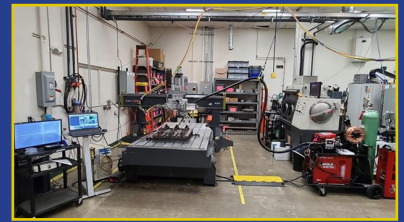
The HLAW Parameter Development project is expected to deliver significant benefits, including:

- **Improved Weld Quality:** Enhancing mechanical properties and reduced defects in HSS weldments.
- **Labor Savings:** Reducing labor hours required for welding and inspection processes.
- **Increased Throughput:** Accelerating ship construction schedules through improved welding efficiency and automation.

By refining HLAW parameters, the project will improve weld quality, reduce costs and enable the Navy to leverage advanced welding technologies for HSS applications.

Implementation

The project results will be implemented at Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) in Pascagoula, MS. At this time, there is no planned date for full implementation of the developed HLAW parameters into production processes.



PERIOD OF PERFORMANCE:
September 2024 to March 2026

PLATFORM:
DDG 51 Class Destroyer

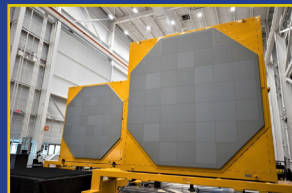
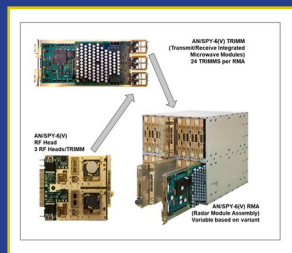
CENTER OF EXCELLENCE:
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STAKEHOLDER:
PMS 400D



Radio Frequency Head Manufacturing Improvements to Reduce Cost, Increase Throughput and Improve Performance



PERIOD OF PERFORMANCE:
March 2024 to March 2027

PLATFORMS:
DDG 51 Class Destroyer
FFG 62 Class Frigate
CVN 78 Class Aircraft Carrier
Landing Helicopter Assault (LHA)
Landing Platform Dock (LPD)

CENTER OF EXCELLENCE:
Electronics Manufacturing Center (EMC)

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STAKEHOLDER:
PEO IWS 2.0

S3020 — AN / SPY 6 (V) Radio Frequency Head Manufacturing Improvements

Objective

The AN / SPY 6 (V) is a Navy family of active electronically scanned array radars that performs air and missile defense and will be deployed to almost every combatant ship class. This radar enhances the ships' abilities to detect, track and discriminate air, surface and ballistic missile targets. Four array faces cover 360-degrees, providing integrated air and missile defense. The radar is designed on an architecture that is modular at the array face (radar modular assemblies [RMA]) and, therefore, scalable to meet the needs of each ship class. Each RMA contains transmit and receive integrated microwave modules (TRIMM) (common building block of the radar), and the radio frequency (RF) head is contained within the TRIMM. This Electronics Manufacturing Center (EMC) project is developing and implementing new materials, enhancing automation and introducing innovative manufacturing processes to lower costs, boost throughput and enhance performance.

Payoff

The technical approach for this project includes several key initiatives: optimizing vent seal materials and implementing semi-automated or fully automated dispensing, enhancing inspection processes for RF head monolithic microwave integrated circuit (MMIC) subassemblies with a new automated inspection tool, improving RF and thermal pathways using cost-effective materials and refining gallium nitride via etch and plating processes.

Together, these tasks are expected to provide automation of manual inspection steps that not only reduce cost but improve defect detection accuracy and repeatability, reduce material costs and eliminate hazardous materials and provide over \$50.0M cost savings for the SPY-6 program. The common processes developed and transitioned under this Navy ManTech project also have direct benefit to other Navy and Department of War (DOW) programs with MMIC / RF head content.

Implementation

Transition of the manufacturing improvements developed under this ManTech project is accomplished when the individual processes are approved by the Raytheon internal configuration control board and the relevant process control documentation for the production line is updated and the new processes are introduced into the AN / SPY 6 (V) production line. Implementation is expected to occur in the second quarter of FY2027.



Radio Frequency Head Manufacturing Improvements to Reduce Cost, Increase Throughput and Improve Performance

S3020-2 — AN / SPY 6 (V) Radio Frequency Head Manufacturing Improvements, Phase 2

Objective

The AN / SPY 6 (V) is a Navy family of active electronically scanned array radars that performs air and missile defense and will be deployed to almost every combatant ship class. This radar enhances the ships' abilities to detect, track and discriminate air, surface and ballistic missile targets. Four array faces cover 360-degrees, providing integrated air and missile defense. The radar is designed on an architecture that is modular at the array face (radar modular assemblies [RMA]) and, therefore, scalable to meet the needs of each ship class. Each RMA contains transmit and receive integrated microwave modules (TRIMM) (common building block of the radar), and the radio frequency (RF) head is contained within the TRIMM. This Electronics Manufacturing Center (EMC) project is developing automated inline inspection, optimizing equipment fixturing and reticle layout of the gallium nitride (GaN) and gallium arsenide (GaAs) monolithic microwave integrated circuits (MMICs) and introducing innovative manufacturing processes to lower costs, boost throughput and enhance performance.

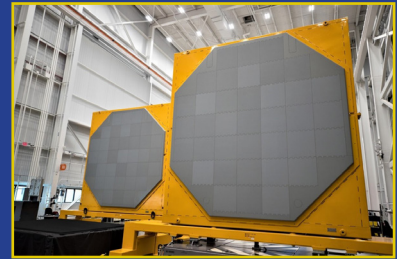
Payoff

The technical approach for this project includes two key initiatives: introducing automated inline inspection at various process steps throughout the wafer fabrication process to isolate the process steps and root causes of the foreign material and developing process improvements to reduce defects and improve die visual yield for both GaN and GaAs MMICs and either shifting the position of the die relative to the wafer (optimize reticle layout) or modifying equipment fixturing to reduce the exclusion ring for the wafer.

Together, these tasks are expected to provide automation of manual inspection steps that not only reduce cost but improve defect detection accuracy and repeatability and provide over \$29.0M cost savings for the SPY-6 program. The common processes developed and transitioned under this Navy ManTech project also have direct benefit to other Navy and Department of War (DOW) programs with MMIC / RF head content.

Implementation

Transition of the manufacturing improvements developed under the ManTech project is accomplished when the individual processes are approved by the Raytheon internal configuration control board and the relevant process control documentation for the production line is updated and the new processes are introduced into the AN / SPY 6 (V) production line. Implementation is anticipated to occur prior to the end of this project, during late FY2027.



PERIOD OF PERFORMANCE:
February 2025 to August 2027

PLATFORMS:
DDG 51 Class Destroyer
FFG 62 Class Frigate
CVN 78 Class Aircraft Carrier
Landing Helicopter Assault (LHA)
Landing Platform Dock (LPD)

CENTER OF EXCELLENCE:
Electronics Manufacturing Center (EMC)

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STAKEHOLDER:
PEO IWS 2.0



Advanced, Automated Paint Removal Process for USMC to Enhance Repair and Overhaul Activity



PERIOD OF PERFORMANCE:
April 2024 to April 2026

PLATFORM:
DDG 51 Class Destroyer

CENTER OF EXCELLENCE:
Institute for Manufacturing and
Sustainment Technologies (iMAST)

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STAKEHOLDERS:
PMS 460
PMS 400D

S3021 — Clean Alternative Paint Removal

Objective

Shipyards use grinding, blasting and needle-guns, etc. to remove paint or rust during late-stage manufacturing, which are typically out-of-sequence paint and rust removal activities. Due to the phase in which these activities occur and the processes that are currently used to conduct the removal, a significant amount of set-up / clean-up is needed. This causes significant workflow disruptions, may require items be removed from the ship, is very labor-intensive, must be segregated from other work, contributes to ergonomic injuries and can expose mechanics to health hazards. This Institute for Manufacturing and Sustainment Technologies (iMAST) project is identifying and evaluating potential clean alternative paint removal (CAPR) solutions to be used for out-of-sequence paint (and rust) removal and developing the solutions that best fit typical shipyard needs.

iMAST, working with General Dynamics Bath Iron Works (BIW) has identified and is evaluating alternative portable paint removal / corrosion cleaning technologies, including conducting testing for identified use cases. Ultimately, demonstrations will be performed using successful technologies, not only for BIW stakeholders, but for the U.S. Navy shipbuilding and sustainment community. Candidate removal use cases involved back-side paint removal, tank touchup and repair, corrosive staining removal, hardware used during paint application, in-situ parts different coating systems (e.g., ultra-high solids, powder coating, etc.) and various substrates (e.g., various steels, soft metals, rubber mounts and flexible hoses). Alternative methods considered included laser ablation, plasma blast, various media blasting, environmentally acceptable chemical strippers and induction tools. Technology was selected for trial based on cleanliness and the ability to efficiently remove paint / corrosion across broad use cases at the shipyard. A Phase 1 “go” decision was provided by ManTech, and preliminary evaluations of selected technologies have commenced, showing much promise for unintentional paint removal and corrosive staining due to metal shaving presence after metalworking operations.

Payoff

Significant labor savings are anticipated as a result of this project, primarily in the reduction of setup time, more efficient paint removal methods and limited disruption to other production work. Implementing clean alternative paint removal technologies will also reduce use of consumables (media), waste and worker injuries. Conservative Phase 1 savings projections and the planned procurement of multiple laser ablation tools and jeweler blast tools for use in high-priority applications in dedicated areas resulted in estimated five-year savings of \$5.1M and return on investment (ROI) of 2.1:1 for DDG 51 production. Results of this project also can be leveraged by multiple shipyards and other government contractors for rapid adoption and application to many different platforms across the Department of War (DOW).

Implementation

Implementation at BIW will consist of initial deployment of CAPR solutions to be used for the most beneficial use case(s), as identified to be the most technically feasible and economically viable with the greatest impact on production. Implementation is expected in mid-FY2027. The results of this project will also provide guidance for applications beyond BIW through the comparison of available technologies and best-value applications to address common shipyard paint and corrosion removal issues.



Permanent Monuments Support Accuracy Control Throughout a Ship's Life-Cycle

S3022 — Permanent Accuracy Control Monuments

Objective

U.S. Navy vessel accuracy control (AC) assessments consist of measurements taken during construction, life-cycle support and if damage is sustained while a ship is active in the fleet. During construction, measurements are assessed relative to the digital model for accurate ship construction. Post-delivery measurements are assessed relative to both the digital model (twin) and the as-is physical ship condition, in order to develop an upgrade / repair design. Throughout all, measurements are taken to support alignment of critical ship systems, including combat systems, propulsion and ship structure. While a few monuments currently exist in the ship model that are installed during construction, lack of an extensive monument system provides limited ability for AC personnel to tie into the ship's coordinate system quickly and only serve as a reference location.

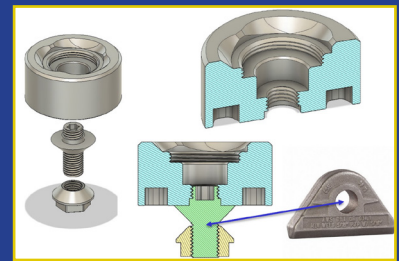
The Institute for Manufacturing and Sustainment Technologies (iMAST) is performing a Phase 1 study and requirements definition to assess the feasibility of placing permanent, agnostic, AC monuments in Navy vessels that can be integrated with existing metrology systems and source digital data. After the Phase 1 gate approval (received May 2025), iMAST and General Dynamics Bath Iron Works (BIW) began planning the Phase 2 proof-of-concept initiative on an in-construction DDG 51 or surrogate ship. At the end of the project, an action plan will be developed outlining the location and numbers of monuments required to achieve the goals / metrics outlined during Phase 1, with the ultimate goal of supporting future ship platforms, such as the DDG(X) Class destroyers.

Payoff

The inclusion of an agnostic, robust monument / receptor network tied back to the ship's coordinate system is expected to greatly reduce setup and measurement time in new construction and sustainment. iMAST and BIW developed an initial cost benefit analysis during Phase 1 that illustrated potential setup and measurement labor savings of 75% and greater for specific use cases, resulting in estimated five-year savings of \$7.0M and a return on investment (ROI) of 3.1:1. During Phase 2, these values will be better defined to include potential labor savings, costs for installation and any potential non-cost benefits.

Implementation

This project ultimately targets the DDG(X) as the implementation platform, as this presents the greatest opportunity for design consideration of permanent monuments well before construction begins. The project results also extend across all platforms, including existing platforms (e.g., DDG 51) with a retrofit.



PERIOD OF PERFORMANCE:
March 2024 to December 2025

PLATFORM:
DDG 51 Class Destroyer

CENTER OF EXCELLENCE:
Institute for Manufacturing and
Sustainment Technologies (iMAST)

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STAKEHOLDERS:
PMS 460
PMS 400D



Optimizing Underwater Hull Inspection with Remotely Operated Technology



PERIOD OF PERFORMANCE:
March 2025 to August 2027

PLATFORMS:
DDG 51 Class Destroyer
Amphibious Assault Ship (LHA)
Amphibious Transport Dock (LPD)

CENTER OF EXCELLENCE:
Center for Naval Metalworking
(CNM)

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STAKEHOLDER:
PMS 400D

S3039 — Underwater Hull Inspection

Objective

The Underwater Hull Inspection project is addressing inefficiencies and safety concerns in the current manual inspection process for ship hulls. Divers are required to physically enter the water to perform inspections, often in poor visibility conditions caused by silt, debris and low light. This process is labor-intensive, poses safety risks and requires extensive preparation, including locking and tagging out ship systems.

This Center for Naval Metalworking (CNM) project is developing a remotely-operated underwater inspection system capable of performing hull inspections without requiring divers to enter the water. The system will operate in turbid water conditions, capture high-resolution video and data and enable remote assessment and verification by human inspectors. The goal is to improve inspection efficiency, reduce labor hours and enhance safety while maintaining high-quality inspection standards.

Payoff

The Underwater Hull Inspection project will deliver significant benefits, including:

- **Improve Safety:** Eliminating the need for divers to enter hazardous underwater environments.
- **Labor Savings:** Reducing labor hours required for hull inspections and associated preparation activities.
- **Enhance Inspection Capabilities:** Providing high-resolution video and data archives for improved assessment, reporting and record-keeping.

By leveraging robotic technology, the project will improve efficiency, reduce costs and enhance the safety and reliability of underwater hull inspections.

Savings

- Five-Year Total Savings: \$6.8M
- Five-Year Return on Investment (ROI): 4.7:1

Implementation

The project results will be implemented at Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) and at General Dynamics Bath Iron Works (BIW). Full implementation is expected in the third quarter of FY2028, with the robotic inspection system integrated into production and maintenance processes at BIW for DDG 51, LHA and LPD platforms.



Streamlining Grand Block Assembly with Advanced Alignment Technology

S3040 — Improved Unit Alignment

Objective

The current process to level, set and align units during grand block assembly is labor-intensive, time-consuming and reliant on highly skilled personnel. It involves manual processes, scaffolding and extended crane support, which increase costs, schedule delays and safety risks. Additionally, the reliance on accuracy control personnel and sophisticated metrology equipment limits efficiency.

This Center for Naval Metalworking (CNM) project is developing operator aids to guide measurement, placement and alignment during the entire grand block assembly process. The solution will improve process efficiency and tooling that can be used in challenging environments, such as elevated heights and extreme conditions. The final deliverable will be an integrated system with convenient measurement hardware and a digital user interface, enabling enhanced monitoring and control of unit leveling and alignment.

Payoff

The Improved Unit Alignment project is expected to deliver significant benefits, including:

- **Labor Savings:** Saving cost per hull across DDG 51, LHA and LPD platforms over five years.
- **Efficiency Gains:** Reducing reliance on accuracy control personnel, minimized rework and improved throughput.
- **Safety Improvements:** Reducing need for scaffolding and ladders, enhancing worker safety.

By streamlining the alignment process, the project will reduce labor hours, improve accuracy and decrease rework, ultimately accelerating shipbuilding schedules and reducing costs.

Savings

- Five-Year Total Savings: \$4.6M

Implementation

The project results will be implemented at Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) in Pascagoula, MS. The transition event will occur after the successful execution of prototype acceptance testing. Full implementation is targeted for the first quarter of FY2028. The implementation plan includes training, procedure updates and capital investments to integrate the solution into production processes for DDG 51, LHA and LPD platforms.



PERIOD OF PERFORMANCE:
June 2025 to November 2027

PLATFORMS:
DDG 51 Class Destroyer
Amphibious Assault Ship (LHA)
Amphibious Transport Dock (LPD)

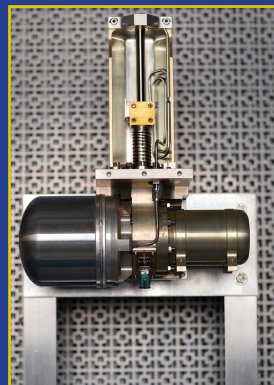
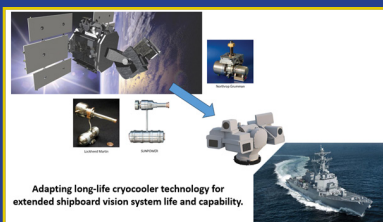
CENTER OF EXCELLENCE:
Center for Naval Metalworking
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STAKEHOLDER:
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Cryocooler Technology Adapted from Space for Extended Life on Ships



PERIOD OF PERFORMANCE:
February 2025 to February 2029

PLATFORMS:
DDG 51 Class Destroyer
CVN 78 Class Aircraft Carrier

CENTER OF EXCELLENCE:
Electro-Optics Center (EOC)

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STAKEHOLDER:
PEO IWS 2.0

S3042 — Advanced Cryocooler for Large Focal Plane Arrays

Objective

Surface fleets rely upon optical sensors, like those in the Shipboard Panoramic Electro-Optic Infrared (SPEIR), for critical situational awareness capability and to support the “detect-to-engage” sequence to address threats. Large focal plane arrays for the next generation of wide field of view detectors will need cryocoolers with much longer life and higher lift than previously required. Advanced cryocooler technologies, typically used in space applications to extend life, are not available in an affordable, high-lift configuration for shipboard applications.

This Electro-Optics Center (EOC) project will facilitate development of the capability to domestically manufacture these advanced cryocooler designs for large infrared (IR) sensors. The effort will be accomplished through a two-phased project that first catalogs the available technologies through industry engagement. An industry partner will then be selected to mature the manufacturability of the cryocooler technology through design for manufacture, process development and a manufacturing demonstration of test units. The documented process improvements and product characterization will be provided to the SPEIR program to inform system architects of the production and performance capabilities of these cryocoolers for implementation.

Payoff

This project is expected to reduce life-cycle costs by providing affordable space cryocooler technology to SPEIR with over five times the mean time to failure of traditional cryocooled IR sensors. This significant extension in cryocooler life results in expected cost reductions of 25% for replacement units, labor and spares. It also provides a technical approach to meet the system reliability requirements. The advanced cryocooler technology is also expected to provide improved system availability and performance for the warfighter.

Implementation

The primary transition platforms for this project are the DDG 51 Class destroyer and CVN 78 Class aircraft carriers. The first implementation is expected to be integration of the advanced cryocooler technology into the integrated dewar cooler assembly for the SPEIR Block II systems planned for these platforms.



Fusion Spliced Fiber Optic Process Improvements for Shipbuilding Environments

S3046 — Fusion Spliced Fiber Optic Connectors

Objective

Fiber optic connectors are challenging to terminate and install, especially in a shipboard environment. It is difficult to address quality issues, particularly with polishing single mode fiber connectors. Use of the existing method results in an undesirable yield and production delays associated with failed connector testing. This process can be replaced by fusion splicing factory-made connectors to the fibers. This project is bringing fiber optic fusion efficiencies into combatant shipbuilding to meet larger data requirements within system interconnections. The project is researching and evaluating commercial-off-the-shelf (COTS) products. The benchmark will be determined for an existing COTS fiber optic splicer to attach terminations and connectors. To maintain sustainability and availability of these fiber optic connections, development of an alternate technique is a desirable path forward for better performance of these fiber optics.

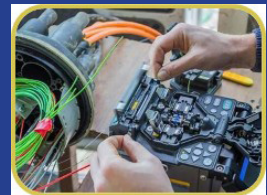
Payoff

This project will reduce risk of failure and poor performance of critical fiber optic cables that are found on DDG 51 Class destroyers. Additionally, cleanly attaching terminations using fusion splicing is a highly desirable path that further reduces cable re-runs, testing time, signal loss and re-work, while simplifying and improving access to splicing in constrained spaces. The manufacturing process improvement seeks to reduce associated labor by 75%.

This project is documenting current project needs and benchmarking different products against the requirements to ensure maximum applicability. Readily available COTS parts will be leveraged to ensure that an appropriate pathway toward procurement and implementation exists that satisfies the Navy's needs and provides suitable benefit. Finally, processes and sequencing will be updated to support current shipbuilding efforts. This foundation will serve future shipbuilding efforts where there is significant demand in fiber optic capabilities.

Implementation

This project will implement relevant processes to improve the manufacturing techniques for fusion spliced fiber optic connectors through improved yield and reduced rework and delays, as well as reduced need for cable testing later in the build. These processes will be fully developed, validated, documented and approved for implementation on the DDG 51 Class destroyer production program prior to the completion of this program.



PERIOD OF PERFORMANCE:
March 2025 to March 2026

PLATFORM:
DDG 51 Class Destroyer

CENTER OF EXCELLENCE:
Electro-Optics Center (EOC)

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PMS 400D



Mobile Ship Compartment Validation with Label Detection



PERIOD OF PERFORMANCE:
December 2024 to September 2027

PLATFORM:
DDG 51 Class Destroyer

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced
Manufacturing (NSAM) Center

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STAKEHOLDER:
PMS 400D

S3068 — Ship Compartment Validation

Objective

The Ship Compartment Validation project is developing an application to support ship compartment validation activities at Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls), capturing, confirming and storing naval ship compartment validation data, such as part identifiers and locations, for use in completing mandatory Navy component validation checks required at key ship construction and delivery milestones. This Naval Shipbuilding and Advanced Manufacturing (NSAM) Center software application will utilize a portable data capture / recall device, such as a tablet or iPad, to execute ship compartment component validation checks.

The system will allow users to scan component label plate data and compare it to ship design details (e.g., change papers, models, drawings). It will flag discrepancies, such as missing components or components that should not be present and automate data transfer and synchronization processes. This solution will eliminate the need for pre-loading inspection data, reduce reliance on paper drawings and streamline the validation workflow.

Payoff

The project is expected to reduce labor hours associated with compartment validation by 25%, including reductions in checklist compilation, validation execution, data post-processing and data transfer to the Navy. Additionally, it will optimize critical component verification processes, reducing deferred record research and adjudication, component verification, data collection and label generation by 25%.

The streamlined workflow will improve efficiency, reduce errors and enhance the accuracy of ship compartment validation, ultimately supporting timely ship delivery and reducing costs.

Savings

- Five-Year Savings: \$4.7M
- Five-Year Return on Investment (ROI): 3.1:1

Implementation

- The solution will be implemented at Ingalls and integrated into the Model-Based Product Support (MBPS) system during the fourth quarter of FY2027. The portable device will be used for ship compartment validation checks, with automated data synchronization and transfer to the Navy. The system will be tested and validated in shipyard environments to ensure reliability and accuracy.



Automated Drone Demonstration using Targetless Metrology

SP3082 — Drone Photogrammetry Shipyard Demonstration

Objective

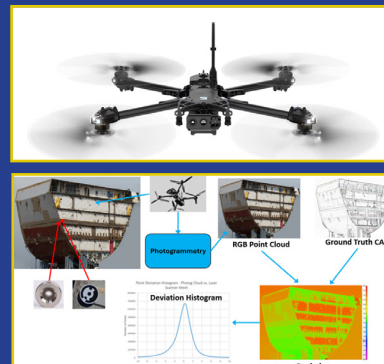
Results from the Electro-Optics Center project titled “S2828 Automated Metrology for Structural Assembly” showcased the ability for drone-based targetless photogrammetry to capture accuracy point clouds that can be used to create a model of the as-built conditions of large volume structure. This effort highlighted the ability for the metrology technique to achieve comparable or better results compared to conventional practices at a reduced cost but requires a proof-of-concept to gain buy-in for implementation by government and government contractors. As-built information is necessary in shipbuilding and the digital twin environment will be necessary to assure efficient sustainment and upgrade practices for the future. This Electronics Manufacturing Center (EMC) project is generating a dense digital twin using a drone-based targetless photogrammetry approach, comparing it with standard data collected simultaneously using present methods, to assure that the captured data can improve accuracy for retrofits and provide true, as-built models of the ship structure.

Payoff

Showcasing the benefits of drone-based targetless photogrammetry will enable ready adoption by government personnel and contractors. Adoption of this technology as a replacement to conventional practice will decrease direct labor costs associated with metrology and inspection tasks, reduce facilities requirements (e.g., turning a ship for pier-side measurement, etc.) and provide significant data coverage that can be used to accurately represent as-built structure and compare it directly to the model to understand deviations, inspect for damage, or create models that can be used for system retrofits.

Implementation

After conducting the on-ship comparative testing / evaluation of conventional practice against the targetless photogrammetry approach using Skydio X2D and X10D drone platforms, the team will perform data analysis. Data analysis compares targetless photogrammetry results against results from conventional practices for large volume metrology. Demonstration and results are geared to help achieve from General Dynamics Bath Iron Works (BIW) and other shipyards for potential implementation during FY2027.



PERIOD OF PERFORMANCE:
August 2025 to April 2026

PLATFORM:
DDG 51 Class Destroyer

CENTER OF EXCELLENCE:
Electronics Manufacturing Center (EMC)

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PEO IWS



CLB / VCS Submarines Projects

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The VIRGINIA Class attack submarine USS Delaware (SSN 791) conducts Bravo sea trials in the Atlantic Ocean. *U.S. Navy photo courtesy of HII by Ashley Cowan*

Pipecrawler to Repair Internal Weld Defects

S2911 — Robotic Blending of Large Diameter Internal Piping

Objective

In submarine construction at General Dynamics Electric Boat (GDEB), final pipe installations create closure joints, where the last welds seal off access to the pipe's interior. Unlike earlier joints, which allow for internal rework, defects in closure joints can result in costly delays and increased labor.

This Center for Naval Metalworking (CNM) project developed a system capable of entering through small access points, navigating within the pipe and performing internal grinding and blending operations while maintaining strict cleanliness standards. This solution reduces the need to remove critical equipment, enhances access through smaller openings and supports non-closure joints where inner diameter access remains a challenge.

Payoff

The Pipecrawler project delivered significant benefits, including:

- Eliminating the need to remove critical equipment or previously installed piping.
- Transforming a process that once took weeks into a task completed in a single shift.
- Removing 100% of defects visually from closure joints.
- Reducing the average time to repair a defect to only 20 hours.
- Investigating broader consideration beyond its initial use case.

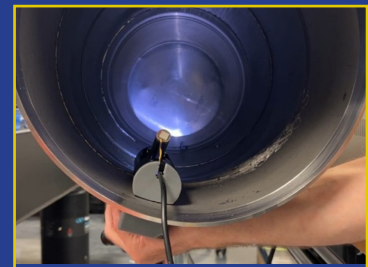
The compact form factor and exceptional image quality of the prototype have drawn interest from additional shipyards.

Savings

- Five-Year Total Savings: \$10.7M
- Five-Year Return on Investment (ROI): 3.6:1

Implementation

The project results are being implemented at GDEB in Groton, CT, and Quonset Point, RI. Full implementation is expected in the fourth quarter of FY2025, with inspection and blending operations integrated into production and repair processes for submarine platforms.



PERIOD OF PERFORMANCE:
July 2021 to May 2025

PLATFORMS:
COLUMBIA Class Submarine
VIRGINIA Class Submarine

CENTER OF EXCELLENCE:
Center for Naval Metalworking
(CNM)

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STAKEHOLDERS:
PMS 397
PMS 450



Improved Safety and Efficiency in Molten Lead Pouring



PERIOD OF PERFORMANCE:
July 2021 to April 2025

PLATFORMS:
COLUMBIA Class Submarine
VIRGINIA Class Submarine

CENTER OF EXCELLENCE:
Center for Naval Metalworking
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STAKEHOLDERS:
PMS 397
PMS 450

S2915 — Lead Ladle Replacement

Objective

The Lead Ladle Replacement project addressed inefficiencies and safety concerns associated with the traditional manual handling of molten lead during submarine construction and repair operations. The legacy process relied on outdated ladle systems that posed significant risks to worker safety, required extensive labor and resulted in inconsistent lead application.

This Center for Naval Metalworking (CNM) project is developing an advanced lead handling system to replace the traditional ladle process. The new system incorporated automated pouring mechanisms, improved temperature control and enhanced safety features to reduce labor hours, improve lead application consistency and minimize worker fatigue.

Payoff

The Lead Ladle Replacement project delivered significant benefits, including:

- **Improved Safety:** Reducing worker exposure to molten lead, minimizing the risk of burns and other injuries.
- **Labor Savings:** Reducing labor hours required for lead handling and application processes by 30%.
- **Enhanced Quality:** Improving consistency in lead application, reducing rework and inspection costs.

Savings

- Five-Year Total Savings: \$2.1M
- Five-Year Return on Investment (ROI): 1.2:1

Implementation

The project results are being partially implemented at General Dynamics Electric Boat (GDEB) in Quonset Point, RI. Full implementation is targeted for the second quarter of FY2026, with the advanced lead handling system integrated into production and repair processes for submarine platforms.



Maturing Additive Manufacturing to Improve Submarine Supply Chain and Shipyard Readiness

Q2924 — Modern Shipbuilding Manufacturing to Support VIRGINIA and COLUMBIA Class Submarines

Objective

This Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project developed additive manufacturing (AM) capabilities in the shipbuilding industry to meet the increased construction demands of one COLUMBIA Class submarine and two VIRGINIA Class submarine hulls per year. This project advanced the Technology Readiness Level (TRL) of Directed Energy Deposition (DED) AM for materials common in critical submarine components and established a framework for General Dynamics Electric Boat (GDEB) and AM vendors nationwide to assess the opportunities posed by using AM in manufacturing workflows.

The project executed three main tasks:

- Establishing processes for AM application during design and created databases to capture information on materials, processes, machines and vendor capabilities.
- Identifying applications for AM technologies in non-shipboard components, fabricate prototype and conducted functional testing.
- Identifying applications for AM technologies in shipboard components, perform material characterization testing, conducted prototype builds and developing strategies to qualify parts for installation on submarines.

Payoff

This project advanced the TRL of AM technologies and expanded its accessibility across the shipbuilding industry, ultimately improving the readiness of the submarine manufacturing supply base to meet the construction demands. The direct benefits of this project include:

- Expanding knowledge base of DED-AM technology and capabilities for 70/30 copper-nickel and nickel-aluminum bronze for shipbuilding applications. Findings include that heat treatment can result in AM components demonstrating material properties, such as yield strength and ultimate tensile strength, superior to those made with traditional manufacturing methods.
- Faster delivery of tools, repair parts and fitting aids, reducing downtime and improving schedule performance.
- Cost savings through improved quality, minimized rework on challenging builds, reduced material waste and improved efficiency through automation.

Implementation

Implementation requires additional efforts at GDEB beyond the objectives that were met under this project. This project has implemented the following in FY2025:

- Established an intake procedure for receipt and evaluation of potential AM applications within GDEB.
- Production of AM-created tooling and fixtures to mitigate schedule interruptions.
- Ongoing collaboration with the Additive Manufacturing Center of Excellence (AMCOE) in Danville, VA, to support supplier development and inform Naval Sea Systems Command technical publications.



PERIOD OF PERFORMANCE:

September 2021 to December 2024

PLATFORMS:

COLUMBIA Class Submarine (CLB)

VIRGINIA Class Submarine (VCS)

CENTER OF EXCELLENCE:

Naval Shipbuilding and Advanced Manufacturing (NSAM) Center

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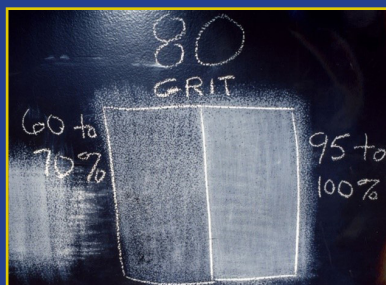
STAKEHOLDERS:

PMS 397

PMS 450



Advancing Surface Preparation Processes to Enhance Shipyard Efficiency and Reduce Life-Cycle Costs



PERIOD OF PERFORMANCE:
October 2023 to April 2026

PLATFORMS:
COLUMBIA Class Submarine (CLB)
VIRGINIA Class Submarine (VCS)

CENTER OF EXCELLENCE:
Composites Manufacturing
Technology Center (CMTC)

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STAKEHOLDERS:
PMS 450
PMS 397

S2968 — Improved Surface Preparation Processes, Phase 1

Objective

The current surface preparation processes in shipyards rely heavily on manual labor, which is time-consuming, ergonomically challenging and prone to inconsistencies. This project aims to identify and evaluate technology solutions that improve surface preparation methods, focusing on reducing preparation time, enhancing polymeric adhesion and enabling more flexible scheduling. The ultimate goal of this Composites Manufacturing Technology Center (CMTC) project is to develop a trade study report and recommend technology solutions for Phase 2 development.

Payoff

The implementation of improved surface preparation processes is expected to deliver the following benefits:

- **Time Savings:** Faster surface preparation methods, potentially amenable to robotic or automated applications.
- **Cost Reductions:** Labor savings will drive return on investment (ROI).
- **Improved Quality:** Enhancing adhesion performance and reduced instances of rework associated with missed recoat windows or coating system breakthrough.
- **Flexibility:** Methods to reopen recoat windows on demand will provide shipyards with greater scheduling flexibility and reduce rework scenarios.

Savings

- Cost reduction of at least \$6.5K per unit resulting in five-year program savings of over \$7.0M

Implementation

The equipment developed under this project is anticipated to be implemented in FY2030.



Optimizing Warehousing Processes and Space Utilization

S2973 — Improved Warehouse Efficiency

Objective

The Improved Warehouse Efficiency project aims to address inefficiencies in warehousing processes at Huntington Ingalls Industries – Ingalls Shipbuilding (Ingalls) and General Dynamics Electric Boat (GDEB). This Naval Shipbuilding and Advanced Manufacturing (NSAM) Center project focuses on automating manual processes, optimizing storage designs and integrating advanced technologies to improve material handling, reduce bottlenecks and enhance overall operational efficiency.

This project aims to automate paper-based processes to reduce human error and improve data accuracy, investigate advanced storage solutions, such as vertical lift modules and vertical buffer modules, to maximize space utilization, integrate forklift safety monitoring systems and mobile scanners with radio-frequency identification (RFID) for efficient material tracking and handling and conduct gap analysis to identify areas to improve and align future state processes with best practices.

Payoff

The project is expected to deliver significant benefits, including:

- **Cost Savings:** Reducing labor costs and material handling inefficiencies resulting in significant cost savings across all Ingalls and GDEB platforms.
- **Space Optimization:** Improving utilization of warehouse space, addressing the need for additional capacity.
- **Operational Efficiency:** Faster material handling processes, reducing bottlenecks and improving throughput.
- **Safety Improvements:** Enhancing worker ergonomics and reduced exposure to hazardous conditions.

Savings

- DDG 51 Return on Investment (ROI): 2.5:1
- All Ingalls ROI: 4.5:1
- VIRGINIA and COLUMBIA Class Submarine ROI: 3.3:1

Implementation

Ingalls and GDEB will implement the solution in a production warehouse environment beginning in the second quarter of FY2027 for all platforms manufactured at Ingalls and the VIRGINIA and COLUMBIA Class submarines at GDEB.



PERIOD OF PERFORMANCE:
September 2023 to January 2026

PLATFORMS:
COLUMBIA Class Submarine (CLB)
DDG 51 Class Destroyer
VIRGINIA Class Submarine (VCS)

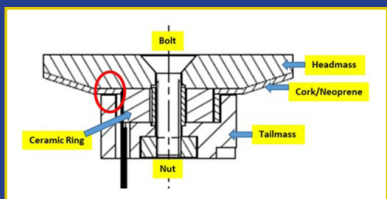
CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced
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STAKEHOLDERS:
PMS 450
PMS 397
PMS 400D



Sensor Assembly Improvement Reduces Sensor Cost and Allows for Use in Other Submarine Acoustic Systems



PERIOD OF PERFORMANCE:
May 2023 to January 2026

PLATFORMS:
COLUMBIA Class Submarine (CLB)
VIRGINIA Class Submarine (VCS)

CENTER OF EXCELLENCE:
Electronics Manufacturing Center (EMC)

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STAKEHOLDERS:
SP-24
Naval Surface Warfare Command –
Crane Division
PMS 401

S3003 — Manufacturing of Advanced Textured Ceramic Sensor Elements for a Navigational Sonar System

Objective

The objective of this Electronics Manufacturing Center (EMC) project is to improve the assembly process for the acoustic sensor device used in an existing sensor array. With material and manufacturing improvements to improve sensor repeatability and shock tolerance, this sensor can be used to create a modern, flexible and sustainable navigational sonar transducer for VIRGINIA and COLUMBIA Class submarines. This enables the creation of a navigational sonar system (NSS) that meets or exceeds the desired system performance without requiring the addition of more hull penetrations to new or legacy platforms.

Payoff

COLUMBIA Class Submarine Benefits: Improved manufacturing for NSS-type sensors will improve the sustainability of the NSS by using simple-to-manufacture ceramic elements coupled with a sensor that is well understood and commonly used across the submarine fleet, including VIRGINIA Class submarines. This should also result in improved availability of COLUMBIA Class submarines by improving system reliability. Success of the project may also enable pier-side replacement or repair of the NSS, which is currently not possible. Savings and cost avoidance are estimated at \$1.0M per hull.

VIRGINIA Class Submarine Benefits: While the primary platform benefit is for COLUMBIA platforms, any manufacturing improvements developed under this effort are intended to be backward compatible to the sensor arrays used on VIRGINIA Class platforms.

Implementation

Following the conclusion of this project, SP-24 will implement the results of the effort in FY2026 array design efforts for next-generation systems. This effort will culminate in the testing of prototype elements and creation of a data set that allows the pursuit of array design and qualification for system insertion. In addition, several data sets on ceramic performance as a function of uniaxial applied pressure were created and will be made available for design of other forms of transducers, benefiting wider fleet applications in the future.



Composite Shafting Special Study to Enhance Naval Propulsion Performance

SP3030 — Composite Shafting Special Study

Objective

The U.S. Navy sought to evaluate the feasibility of composite propulsion shafting technologies to replace traditional steel shafting in naval applications. This Composites Manufacturing Technology Center (CMTC) study assessed the potential benefits of composite shafting, including weight reduction, improved corrosion resistance and enhanced fatigue life, while maintaining or exceeding the performance requirements of current steel shafting. The project focused on identifying manufacturing processes, material configurations and design approaches that meet the Navy's operational and life-cycle cost goals.

Payoff

The study was conducted in collaboration with industry and academic partners to evaluate the feasibility of composite shafting technologies. The results of the study determined that composite shafting has potential to deliver the following benefits dependent on the application, platform, follow on development and implementation path.

- **Weight Reduction:** Significant weight savings compared to steel, improving vessel efficiency and payload capacity.
- **Corrosion Resistance:** Enhancing resistance to marine environments reduces maintenance costs and extends service life.
- **Improved Fatigue Life:** Providing better fatigue performance, reducing the risk of failure in high-cycle applications.
- **Cost Savings:** Life-cycle cost reductions due to lower maintenance requirements and improved durability.
- **Scalability:** The study explored manufacturing processes capable of producing shafts up to 70 feet in length and 60 inches in diameter, with wall thicknesses up to 5 inches.

Implementation

The U.S. Navy may elect to pursue follow-on projects or implementations based on the results of the study.



PERIOD OF PERFORMANCE:
October 2023 to March 2026

PLATFORMS:
Future Naval Platforms
Submarines and Surface Combatants

CENTER OF EXCELLENCE:
Composites Manufacturing
Technology Center (CMTC)

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STAKEHOLDERS:
Naval Sea Systems Command



Improved Polymer Moldings for Electrical Fittings to Enhance Manufacturing Efficiency and Reduce Defects



PERIOD OF PERFORMANCE:
June 2023 to June 2027

PLATFORMS:
COLUMBIA Class Submarine (CLB)
VIRGINIA Class Submarine (VCS)

CENTER OF EXCELLENCE:
Composites Manufacturing
Technology Center (CMTc)

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STAKEHOLDERS:
PMS 379
PMS 450



S3031 — Polymer Moldings for Electrical Fittings

Objective

In shipbuilding, polyurethane (PUR) encapsulation is the specified method to waterproof cable-splices and cable-assembly end-connectors. While similar to commercial products, Navy variants are orders of magnitude larger with more stringent quality requirements. However, without specific tools, shipbuilders rely on the same tools used on commercial electronics. This results in shipbuilders using suboptimal methods to fabricate products in both shop and field environments. This creates a labor-intensive, time-consuming manufacturing process that experiences elevated rework rates.

This Composites Manufacturing Technology Center (CMTc) project focuses on developing tools to efficiently manufacture ultra-large overmolds to Navy specifications. One priority is to improve material delivery to the mold. Currently, manual dispensing guns deliver the content of a single, standard-size PUR vial that has been externally pre-heated to pour temperature. With most molds requiring multiple vials to fill, multiple start-stops are incurred with each potential point introducing defect-forming air into the stream. To increase productivity and first-time quality, this effort will develop a system to deliver multiple vials of heated PUR as a single volume. Second, a tool will be developed to condition the mold through the application of heat and vacuum. By applying a vacuum during mold fill and cure, the PUR can be degassed, effectively eliminating the source of defects. Application of heat expedites the material curing, allowing the process time to be reduced, thus increasing productivity.

Payoff

The transition of the solutions developed in this project is expected to deliver the following benefits:

- Reduction in Labor Hours: Enhancing mold flexibility and reduced defect rates are projected to reduce labor hours by 25%.
- Improved Part Quality: 50% reduction in part rework due to first-time production defects.
- Enhanced Efficiency: Allowing operators to continue with subsequent tasks sooner by reducing processing time.

Savings

- Five-Year Total Savings: \$20.3M
- Five-Year Return on Investment (ROI) with 50% savings reserve: 5.7:1
- Five-Year ROI with 25% Savings Reserve: 9:1

Implementation

The additive manufacturing-supported mold designs will be validated and transitioned to production in FY2028.

Manufacturing Improvements for Advanced Piezo-Ceramics Enables Sonobuoy Performance Upgrades

S3070 — Advanced Ceramics for UnderSea Advantage Block Upgrade

Objective

This project supports manufacturing of advanced ceramics in conjunction with the Office of Naval Research (ONR) Future Naval Capability (FNC) program UnderSea Advantage Block Upgrade (USABU) in order to provide lower cost projectors for the SSQ-125 transmit sonobuoy. This draws upon decades of piezoelectric material research conducted at ONR and the Penn State University – Applied Research Laboratory (PSU-ARL) on high-performance, textured, ceramic transducer materials, applied provide significant advances in power output and bandwidth increases for the SSQ-125 transmit transducer. As a result, increases in data rate per sonobuoy pair will cause an increase in covered area per sonobuoy, allowing a smaller network of buoys to quickly localize threats and provide critical targeting data to VIRGINIA Class submarines and DDG 51 Class destroyers as part of the kill chain. This Electronics Manufacturing Center (EMC) project will also optimize the capability of the U.S. piezo-ceramic industrial base to meet the requirements for the advanced ceramic needed for upgraded sonobuoys to achieve their required performance metrics. Suppliers will be able to deliver consistent product for repeatable, high-source-level, wide-band, low-harmonic distortion acoustic projectors.

Payoff

Significant power output and bandwidth increases for the transmitter enables a substantial increase in area covered per sonobuoy. Larger area coverage permits fewer sonobuoys to prosecute a given mission, allowing efficient use of limited resources to track multiple targets. Estimated project savings are \$12.5M per year based on the number of sonobuoys deployed. Further qualitative benefits will come from the fidelity of the available data.

Implementation

Manufacturing improvements will be implemented during FY2029 by Naval Air Systems Command (NAVAIR) as part of sonobuoy procurement for the program of record. This ManTech effort runs in parallel with an ONR FNC to ensure that the industrial base is positioned to respond to the demand signal for advanced ceramic technology from NAVAIR as well as from multiple future Naval Sea Systems Command (NAVSEA) Program Offices. Following the conclusion of this program, the piezo-ceramic industrial base will be capable of providing high-performance, advanced ceramic material to the upgraded SSQ-125 procurement effort.



PERIOD OF PERFORMANCE:
August 2025 to August 2028

PLATFORMS:
P-8 Poseidon Aircraft
VIRGINIA Class Submarine (VCS)

CENTER OF EXCELLENCE:
Electronics Manufacturing Center (EMC)

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STAKEHOLDERS:
PMA-264
PMS 485
PMS 450



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F-35 Lightning II Aircraft. U.S. Navy photo.

Manufacturing and Producibility Improvements for CIAM Assembly for Total Life-Cycle Cost Savings

A2827-2 — CIAM Manufacturing and Producibility Improvement, Phase 2

Objective

The objective of this Composites Manufacturing Technology Center (CMTc) effort was to execute redesign and manufacturing improvements to the CIAM components. This effort encompassed redesign of components, manufacturing of hardware for testing, component-level testing and detailed design approval of a solution ready for production verification and validation testing.

The goals of the project were to deliver a solution into production that:

- Reduces rework costs by minimizing rework hours and scrap rate
- Decreases weight
- Reduces part fabrication recurring costs

Payoff

The project has an estimated return on investment (ROI) of 5.8:1. Key drivers include:

- Cost Reduction: Production life-cycle labor cost reduction realized through the elimination of disbands and silicone blowout events.
- Improved Reliability: Eliminating rework by the hardware supplier to aid in cycle time reduction and delivery reliability.

Savings

- Reduce total life-cycle cost by \$19.0M.

Implementation

This Phase 2 effort ended in December FY2024. Work has commenced for qualification to implement in production. Qualification activities include test hardware, test activities, material qualification, production process validation and tooling to achieve production implementation. The project is targeted to implement in the second quarter of FY2026.



PERIOD OF PERFORMANCE:
July FY2021 to December FY2025

PLATFORM:
F-35 Lightning II

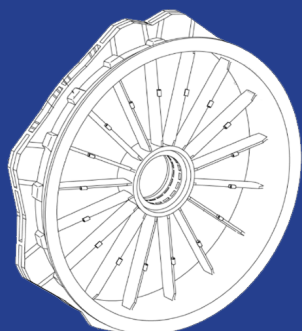
CENTER OF EXCELLENCE:
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STAKEHOLDER:
F-35 Lightning II Joint Program Office



Achieving Increased Throughput and Reduced Cost for the F135 Fan Inlet Case



PERIOD OF PERFORMANCE:
November FY2021 to December
FY2024

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
Composites Manufacturing
Technology Center (CMTC)

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STAKEHOLDER:
F-35 Lightning II Joint Program Office

A2868 — Preform Consolidation for F135 Fan Inlet Case

Objective

The F135 Fan Inlet Case is a critical structural component of the F-135 engine, supporting the front engine mounts, main shaft bearing and other functions. Its complex design involves the assembly of numerous preforms, creating opportunities for defects and inefficiencies. This Composites Manufacturing Technology Center (CMTC) project optimized the preform count, improved joint design and enhanced manufacturing processes to reduce labor, improve quality and increase production rates. The project focused on advancements in tooling, assembly aids and automated preform layup to achieve these objectives.

Payoff

The project is expected to deliver significant cost savings and production efficiencies:

- **Labor Reduction:** Streamlined processes will reduce labor hours required for preform assembly.
- **Improved Quality:** Optimized preform designs and joint improvements will reduce rework and scrap rates.
- **Increased Throughput:** Enhanced manufacturing processes will improve production rates, supporting the F-35 Lightning II program's full-rate production goals.

Savings

- Five-Year Total Savings: \$7.0M.

Implementation

The validated changes will be incorporated into the production definition anticipated for FY2028.



Streamlining Hole Inspection Processes for F-35 Aircraft

A2893 — Rifled Hole Assessment

Objective

The Rifled Hole Assessment project addressed the challenges associated with inspecting and repairing rifled holes in metallic and composite panels of the F-35 aircraft. Current inspection methods are manual, subjective and time-consuming, leading to high rework rates during pressure and seal tests. This Center for Naval Metalworking (CNM) project developed a portable, automated inspection system capable of providing precise, repeatable measurements of hole defects, including rifling, elongation and scratches. The system enables faster and more accurate defect identification, reduces inspection hours and improves repair processes.

Key objectives included:

- Developing a reliable and repeatable process for measuring hole defects.
- Enabling inspectors to collect 360° surface data for digital twin mapping and defect tracking.
- Reducing inspection time per aircraft by up to 15%.

Payoff

The Rifled Hole Assessment project offers significant benefits, including:

- Improved Efficiency: Reduction in inspection hours per aircraft by 15%.
- Enhanced Precision: Improved precision-to-tolerance from 60% to 15%, enabling more accurate defect measurements.

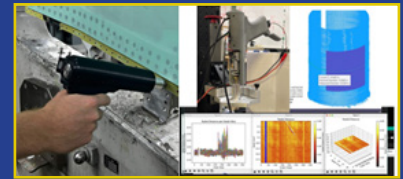
Savings

- Five-year savings on 478 aircraft: \$6.8M
- Life of Program savings on approximately 1672 aircraft: \$23.7M
- Five-Year Return on Investment (ROI): 3.7:1
- Life of Program ROI: 15.6:1

Implementation

Target Implementation Sites: Lockheed Martin facilities and Fleet Readiness Center East. Key Milestone:

- Full Implementation: Third Quarter of FY2026.



PERIOD OF PERFORMANCE:

September FY2021 to June FY2025

PLATFORM:

F-35 Lightning II

CENTER OF EXCELLENCE:

Center for Naval Metalworking (CNM)

POINT OF CONTACT:

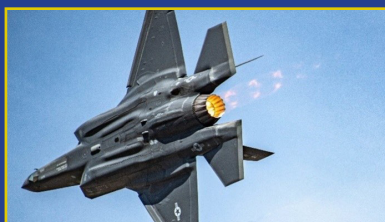
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STAKEHOLDER:

F-35 Lightning II Joint Program Office



Automated Laser Surface Treatment to Enhance Bonding and Reduce Costs for F135 Fan Inlet Variable Vanes



PERIOD OF PERFORMANCE:
September FY2024 to September
FY2026

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
Composites Manufacturing
Technology Center (CMTC)

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STAKEHOLDER:
F-35 Lightning II Joint Program Office

A2912 — Laser Surface Treatment for F135 Fan Inlet Variable Vane Adhesive Joint

Objective

An F135 engine fan component utilizes adhesive bonding between the titanium spar and carbon composite structure. This Composites Manufacturing Technology Center (CMTC) project presents an opportunity to enhance the current etch process by replacing the manual chemical etch method with an automated laser surface treatment technique. The laser surface treatment is designed to improve bonding performance and streamline production while reducing manufacturing variability. This innovative approach builds on advancements developed under the NASA Advanced Composites Consortium for epoxy composite-to-titanium adhesive joints.

Payoff

Implementation of laser surface treatment technology is expected to deliver the following benefits:

- **Elimination of Chemical Etch Process:** Reduces reliance on hazardous chemicals and associated environmental concerns.
- **Improved Bond Quality:** Enhanced chemical interaction and interlocking at the adhesive joint interface, leading to stronger and more durable bonds.
- **Reduced Labor and Cycle Time:** Automation minimizes manual intervention, accelerates production and reduces Material Review Board activities.
- **Scalability:** The process can be applied to other metal-to-composite adhesive joints in aerospace manufacturing.

Savings

- Total Five-Year Savings: \$3.0M
- Total Life-of-Program Savings \$7.0M
- Life-of-Program Return on Investment (ROI): 2.3:1

Implementation

The laser surface treatment process is anticipated to be implemented after project completion on future production buys beginning FY2028.



Advancing Sustainment Processes for Aluminum Etch Pit Mitigation

A2931 — Aluminum Etch Pit Removal Advancement

Objective

The Aluminum Etch Pit Removal Advancement project is addressing the fatigue life reduction caused by etch pits on F-35 aluminum components. These pits are created during the standard production pre-penetrant etch and anodization processes, which are necessary for manufacturing but inadvertently compromise the structural integrity of the components.

Currently, depots like Fleet Readiness Center East (FRCE) and Ogden Air Logistics Complex (OO-ALC) mitigate etch pits using manual sanding, a process that is time-consuming, labor-intensive and prone to inconsistencies. This Center for Naval Metalworking (CNM) project is developing an optimized, mobile peening system leveraging commercial-off-the-shelf laser peening technology as a superior alternative to manual sanding. The solution aims to provide a more controlled, effective and less damaging method to mitigate fatigue life reduction, improving the reliability and maintainability of the F-35 aircraft.

Payoff

The Aluminum Etch Pit Removal Advancement project delivers significant benefits, including:

- **Improved Fatigue Life:** Enhanced structural integrity of aluminum components, reducing the risk of fatigue failure.
- **Labor Savings:** Reduced labor hours required for etch pit mitigation, improving depot throughput.
- **Enhanced Reliability:** A consistent and repeatable process for etch pit removal, reducing rework and inspection costs, offering a solution to avoid future grounding of F-35 aircraft.

By replacing manual sanding with a mobile peening system, the project will improve process efficiency, reduce costs and enhance the sustainment workflow for F-35 aluminum components.

Savings

- Life of Program Savings: \$6.8M
- Life of Program Return on Investment (ROI): 3.3:1

Implementation

The project results will be implemented at Lockheed Martin during the first quarter of FY2027. The transition event will occur after the successful completion of Phase 2, which includes prototype validation and a live demonstration at FRCE. Full implementation will involve training, procedure updates and capital investments to integrate the mobile peening system into sustainment operations.



PERIOD OF PERFORMANCE:
July FY2024 to July FY2026

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
Center for Naval Metalworking
(CNM)

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STAKEHOLDER:
F-35 Lightning II Joint Program Office



Improving F-35 Scuff and Recoating Operations Using Laser Technology



PERIOD OF PERFORMANCE:
April FY2023 to April FY2026

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
Naval Shipbuilding and Advanced
Manufacturing (NSAM) Center

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STAKEHOLDER:
F-35 Lightning II Joint Program Office

A2960 — Automated Laser Coating Removal

Objective

The Automated Laser Coating Removal (ALCR) project is developing and transitioning an automated method to measure and remove coatings on F-35 aircraft across tight tolerances and contours. This Naval Shipbuilding and Advanced Manufacturing (NSAM) Center initiative seeks to replace the current labor-intensive, hand-sanding process used to remove a prescribed thickness of paint layer during scuff and refresh operations. The extensive removal time reduces platform availability and increases refurbishment costs. Errors in hand-sanding on complex geometries can lead to damage of the composite substrate, further increasing costs, extending downtimes and reducing mission readiness.

The project leverages an existing F-16 laser coating removal system as a baseline, modifying it to accommodate all F-35 Lightning II variants. Specific objectives include:

- Reducing coating removal time by 30%.
- Validating the accuracy of the measurement system.
- Ensuring precise removal across tight tolerances and contours.
- Reducing occupational exposure to hazardous chemicals and airborne dust.
- Minimizing material waste, including masking materials and sanding disks.

Payoff

The cost benefit of this project arises from a significant reduction in coating removal time, preparation, cleanup and inspection. For the first aircraft, the process time is comprised of 30% on masking and measuring with 70% on stripping and repainting. The automated process is estimated to reduce hours per jet by 50%, equating to significant time and cost savings. Benefits include:

- 50% reduction in number of days required for scuff and refresh aircraft maintenance.
- 50% reduction in labor-hours for scuff and refresh aircraft maintenance.
- 75% reduction in total costs for scuff and refresh aircraft maintenance.
- Improved surface quality after coating removal.
- Reduced likelihood of damage to aircraft substrates.
- Enhanced mission readiness through increased platform availability.

Implementation

Implementation is planned for sustainment operations at Fleet Readiness Center East during the third quarter of FY2029. The Air Force is funding investigations related to the F-35A variant, including modifications to the existing full aircraft stripping system at Ogden Air Logistics Center. The Navy is collaborating with Commander Fleet Readiness Center and the F-35 Joint Program Office (JPO) to fund prototype equipment fabrication and installation at Fleet Readiness Centers.

Successful implementation requires precise partial coating removal, accurate measurements of coating thickness and expanded surface coverage. Qualification and certification approvals by Lockheed Martin and JPO authorities are necessary for implementation.



Accelerated Cure Technology to Reduce Manufacturing Cycle Times and Enhance Sustainment Efficiency

A2969 — Accelerated Cure for Manufacturing and Sustainment

Objective

This Composites Manufacturing Technology Center (CMTC) project is developing tools and processes to support accelerated curing within manufacturing and sustainment environments. By leveraging controlled heat application to moldable plastic shim, the solution will enable faster cure times, reducing cycle times and improving efficiency. The primary focus is on the F-35 platform, specifically targeting the belly band skin 270 mate joint within the Electronic Mate and Alignment System build station. The technology also has potential applications in other areas, such as wing-to-body fairing installation and fuselage joints.

Payoff

The implementation of accelerated cure technology is expected to deliver the following benefits:

- **Cycle-Time Reduction:** Estimated 30-50% reduction in cure times, with potential for up to 80% reduction for high-temperature applications.
- **Cost Savings:** Elimination of manual processes, such as operator “babysitting” heat guns, plastic covers and thermocouples.
- **Improved Efficiency:** Enhanced curing consistency and reduced labor requirements.
- **Broader Applicability:** The technology can be applied to other liquid shim areas, improving overall manufacturing and sustainment processes.

Savings

- Five-year Savings: \$6.0M
- Life-of-Program Savings: \$16.4M
- Total Program ROI: 5.5:1

Implementation

The project is scheduled for implementation in FY2028.



PERIOD OF PERFORMANCE:

August FY2024 to November FY2027

PLATFORM:

F-35 Lightning II

CENTER OF EXCELLENCE:

Composites Manufacturing Technology Center (CMTC)

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STAKEHOLDER:

F-35 Lightning II Joint Program Office



Modernizing F-35 Leak Detection Through Advanced Inspection Technology



PERIOD OF PERFORMANCE:
February FY2024 to April FY2026

PLATFORM:
F-35 Lightning II

CENTERS OF EXCELLENCE:
Naval Shipbuilding and Advanced
Manufacturing (NSAM) Center

Institute for Manufacturing and
Sustainment Technologies (iMAST)

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STAKEHOLDER:
F-35 Lightning II Joint Program Office

A2979-A-B — Improved Leak Detection

Objective

The Improved Leak Detection project will develop and implement advanced technologies to enhance the accuracy, efficiency and reliability of leak detection processes for F-35 Lightning II fuel tanks during production and sustainment phases. Current methods, such as the soap bubble technique and helium sniffer tests, are labor-intensive, prone to variability and rely heavily on inspector expertise, leading to inconsistent results and increased costs.

This Naval Shipbuilding and Advanced Manufacturing (NSAM) Center and Institute for Manufacturing and Sustainment Technologies (iMAST) project investigates acoustic imaging and other innovative technologies that enable mechanics to quickly and accurately identify and troubleshoot leaks. The ultimate goal is to reduce process time, lower costs and increase confidence in leak detection technology, potentially allowing for applications beyond F-35 production.

Payoff

The implementation of improved leak detection technologies is expected to result in significant benefits, including:

- **Time Savings:** Reduction of leak detection and troubleshooting time by approximately 20 hours per aircraft in production and 17 hours in sustainment.
- **Fleet Readiness:** Improved aircraft availability and reduced maintenance time at depots.
- **Safety and Airworthiness:** Enhanced flight safety through more reliable leak detection methods.
- **Process Improvement:** Elimination of subjective processes with clear inspection parameters, minimizing false alarms.

Additional benefits include potential applications for other airframes / platforms, rapid compartment leak checks and enabling forward-deployment inspections.

Savings

- Five-Year F-35 Savings: \$2.5M
- Five-Year Return on Investment (ROI): 1.1:1

Implementation

The project is being executed in collaboration with Lockheed Martin. The anticipated implementation target is the fourth quarter of FY2026. The technology will be deployed at Lockheed Martin facilities for F-35 production and Fleet Readiness Center East for F-35 sustainment activities.



Enhancing Fastener Removal Processes for Composite Substrates

A3007 — Alternate Permanent Fastener Removal

Objective

The Alternative Permanent Fastener Removal project is developing an improved process and capability to transition the Electric Discharge Machining (EDM) fastener removal system to sustainment environments. The current EDM system is authorized for limited use on composite substrates but faces challenges such as variability in operator performance, substrate damage due to misalignment and unreliable visual inspection methods. This Center for Naval Metalworking (CNM) project focuses on:

1. Developing a process to measure offset using gage reliable and repeatable principles.
2. Establishing comparisons between EDM fastener removal systems to determine the approved process.
3. Increasing allowable repair process offset to 0.040 inches.
4. Reducing defects caused by misalignment.
5. Developing a recommended process for bonded nut plate fastener removal.

These advancements will improve reliability, reduce defects and enable broader implementation of the EDM system in production and sustainment environments.

Payoff

The Alternative Permanent Fastener Removal project offers significant benefits, including:

- Improved Reliability: Enhanced accuracy and repeatability in fastener removal processes.
- Reduced Rework Burden: Fewer defects and improved substrate integrity.
- Enhanced Sustainment: Reliable processes for sustainment environments, reducing maintenance costs and improving operational readiness.

Savings

- Five-Year Return on Investment (ROI): 2.9:1
- Life of Program ROI: 22:1

Implementation

The project results will be implemented at Lockheed Martin during the first quarter of FY2027. The transition event in this project is the successful demonstration of the EDM tool and alignment fixture at Lockheed Martin and the Fleet Readiness Center – East (FRC-E) along with a repeatable and reproducible inspection tool.



PERIOD OF PERFORMANCE:
August FY2024 to August FY2026

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
Center for Naval Metalworking
(CNM)

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In-line FIB-SEM Process Monitoring Reduces Scrap Wafers and Improves Process Control



PERIOD OF PERFORMANCE:
June FY2024 to June FY2026

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
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STAKEHOLDER:
F-35 Lightning II Joint Program Office

A3013 — In-Line Metrology using FIB-SEM

Objective

The Electro-Optic Targeting System (EOTS), a high performance, lightweight, multifunctional infrared imaging system, is an enabling technology for F-35 Lightning II. At the heart of EOTS are semiconductor detectors. These detectors have historically had poor yield and high cost. Among the drivers of these issues is the need to scrap entire wafers to do Focused Ion Beam Scanning Electron Microscope (FIB-SEM) analysis of defects at outside facilities. This incurs additional cost for the FIB-SEM service in addition to removing potentially yielding wafers from the production line. In addition, in-line process monitoring of metrics, such as etch depth or passivation coverage, cannot be performed.

This Navy ManTech project will bring this FIB-SEM capability online inside the production cleanroom allowing for both in-line monitoring and defect analysis. This will reduce wafer scraps, reduce the cost of outside FIB-SEM services and improve yield through tighter process control.

Payoff

This Electro-Optics Center (EOC) project will implement the relevant methods, recipes and automation to perform in-line production quality monitoring of detector wafer processing and focalplane array (FPA) assembly using a new in-line dual beam FIB-SEM metrology tool.

In-line metrology to monitor wafer processing and FPA assembly is critical for monitoring and improving yield. FIB-SEM provides a state-of-the-art, in-line metrology capability that enables nanoscale defect imaging and chemical analysis. By installing a FIB-SEM in the production cleanroom, parts that are works in progress can be measured and then returned back to the production line, rather than having to scrap them and send them offsite for analysis. The FIB-SEM metrology tool will also assist in cost avoidance. The in-line monitoring will enable quality checks that were previously not available to ensure that only A-grade detectors are kitted to the FPA line.

This affordability project will reduce the annual wafer scrap rate by a factor of three. In addition, over \$100K per year costs in outside FIB-SEM services will be avoided. Finally, the overall process yield is anticipated to improve by 1-2%. All of this will result in a lifetime return on investment of 4.4:1 for the F-35 Lightning II Program.

Implementation

The F-35 Lightning II EOTS is the transition platform. These process changes are required to be reviewed and approved by the manufacturer's Process Control Review Board. Implementation of the FIB-SEM capability enabled EOTS wafer process changes is anticipated by the first quarter of FY2026 in support new F-35 Lightning II acquisitions.



Etch Optimizations and Automated Inspection Improve Yield and Reduce Cost of Infrared Detectors

A3014 — III-V Detector Etch Optimization and Edge Inspection

Objective

The Electro-Optic Distributed Aperture System (EODAS) provides unprecedented battle space awareness to pilots of the F-35 Lightning II. The basis of this system is infrared detectors. This Electro-Optics Center (EOC) project developed process improvements that will increase yield and improve the performance of the detectors as well as improve in-line screening. The in-line screening will reduce costs through automation, by identifying rework opportunities and by scrapping defective parts earlier in the process.

Payoff

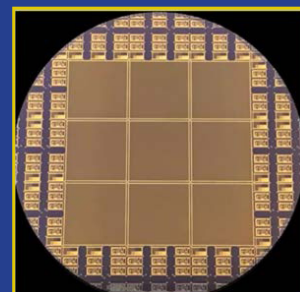
Previous research has demonstrated a new etch chemistry for the delineation of pixels in the III-V semiconductor detector material. This project optimized this process to better control the etch depth and, thereby, increase process margin and more tightly control detector performance.

Additionally, the yield of infrared detectors in many cases cannot be assessed until assembled into a sensor chip assembly (SCA), which is very late in the production process. There can be imperfections as early as the starting material that are not easily identified by manual inspection, with opportunities for additional defects to occur throughout the manufacturing process. Not identifying these defects early results in “escapes” that can then propagate through the fabrication and assembly process. Each escape results in additional wasted processing time and costs on material that will ultimately be scrapped. In addition, final inspection is done manually in a tedious process prone to human error that can contribute to even more escapes. This leads to non-optimal detectors being hybridized into SCAs at additional expense. To improve the current processes, automated inspection will be added at several steps in the production process.

Together, these tasks are expected to increase EODAS detector yield by 5-10%, resulting in proportional acquisition cost savings for F-35 Lightning II.

Implementation

The F-35 Lightning II EODAS is the transition platform. These producibility improvements will follow a rolling implementation process – processes will be implemented as they are completed, validated, approved and cut into production prior to completion of this project. These process-level changes are required to be reviewed and approved by the manufacturer’s Change Control Board. This EOC project will implement multiple, industry-approved process changes through FY2027.



PERIOD OF PERFORMANCE:
November FY2023 to November FY2025

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
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STAKEHOLDER:
F-35 Lightning II Joint Program Office



BMI Composite Heat Damage Assessment and Repair to Enhance Aircraft Readiness



PERIOD OF PERFORMANCE:

February FY2025 to August FY2027

PLATFORM:

F-35 Lightning II

CENTER OF EXCELLENCE:

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F-35 Lightning II Joint Program Office

A3015 — BMI Composite Heat Damage Assessment and Repair

Objective

The goal of the BMI Composite Heat Damage Assessment and Repair project is to develop and validate inspection and repair processes for BMI (bismaleimide) composite materials used in advanced aircraft structures, such as the F-35 Lightning II. Heat damage to BMI composites can compromise structural integrity, leading to costly replacements and extended aircraft downtime. This Composites Manufacturing Technology Center (CMTC) project leverages Fourier Transform Infrared (FTIR) spectroscopy to assess damage depth and severity, alongside repair validation testing to ensure structural plies are repairable. The ultimate goal is to reduce sustainment costs, mitigate scrapped parts and improve aircraft readiness.

Payoff

The validated inspection and repair processes will deliver the following benefits:

- **Reduced Sustainment Costs:** By enabling repair of damaged BMI composites, the project will reduce the need for costly replacements, saving millions over the program's life-cycle.
- **Improved Aircraft Readiness:** Faster repair processes will minimize downtime, ensuring aircraft availability for critical missions.
- **Mitigation of Scrapped Parts:** The FTIR-based assessment will allow precise identification of repairable damage, reducing waste and improving resource utilization.

Savings

- Life of Program Return on Investment (ROI): 2.4:1

Implementation

Following validation, the implementation of this process to F-35 domestic depots is expected in the fourth quarter of FY2028.



Multistep Etch Automation and Sputtered Contact Metallization Increase Yield and Reduce Cost of Infrared Detectors

A3041 — III-V SLS Etch Chamber Automation and Sputtered Metallization

Objective

The Electro-Optical Distributed Aperture System (EODAS) is a multi-sensor system that collects and sends high-resolution, real-time imagery to the pilot's helmet from the infrared sensors mounted around the aircraft, allowing pilots to see the environment around them – day or night. EODAS provides pilots unprecedented situational awareness of the battlespace. The objective of this project is to reduce the acquisition and life-cycle costs of EODAS through two manufacturing technology process improvements.

This Electro-Optics Center (EOC) project will reduce touch time and increase yield through the automation of hardmask etching, pixel mesa etching and hardmask stripping. Combining these steps will also increase throughput by reducing the “shelf time” of wafers during production.

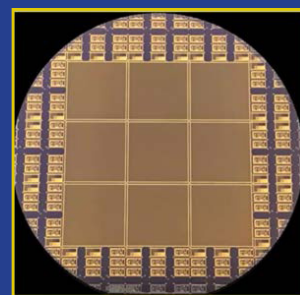
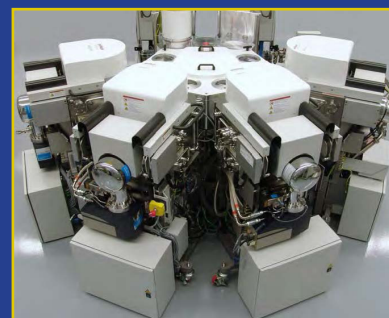
Replacing lift-off-patterned, evaporated contact metal with a sputtered and etched back metal will reduce yield loss by improving the sidewall coverage over deeply etched pixel mesas. This process also has the potential to improve performance by reducing the contact resistance to each pixel.

Payoff

The existing etch process involves separate runs for hardmask patterning, mesa etch and hardmask stripping, each with additional handling, shelf time and wet processing in between each run. This greatly increases the likelihood of defects arising and lowers throughput. Automating this process in a single vacuum run in a cluster tool with a central robotic handler reduces this yield hit while improving overall throughput. It also reduces operator touch time, reducing costs. On the whole, this task is expected to improve yield by 3%, providing cost savings for F-35 Lightning II EODAS acquisitions. Evaporated metals have poor step coverage and adhesion, leading to inadequate contact resistance. Moving the contact metal to a sputter and etch back process improves step coverage over the steep sidewalls of pixel mesas, which are critical for making good connection to the ground contact. A lower contact resistance to each pixel is expected as well. This leads to higher yield by an expected 2%. In total, this project will save the F-35 Lightning II Program nearly \$6.0M over the life of the platform.

Implementation

The F-35 Lightning II EODAS is the transition platform. These producibility improvements will follow a rolling implementation process; processes will be implemented as they are completed, validated, approved and cut into production prior to completion of this project. These process-level changes are required to be reviewed and approved by the manufacturer's Change Control Board. Implementation of these industry-approved process changes is anticipated in the first quarter of FY2027.



PERIOD OF PERFORMANCE:
January FY2025 to January FY2027

PLATFORM:
F-35 Lightning II

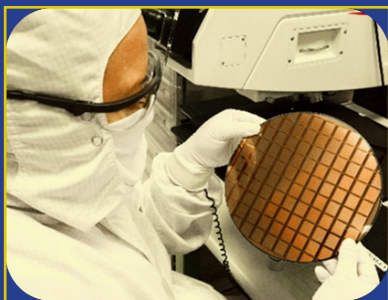
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F-35 Lightning II Joint Program Office



Capitalizing on Automation Ensures Manufacturing Repeatability, Improves Quality and Reduces Costs for Navy MWIR Cameras



PERIOD OF PERFORMANCE:
November FY2024 to November FY2026

PLATFORM:
F-35 Lightning II

CENTER OF EXCELLENCE:
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A3043 — Automation of nBn Film Application and Dewar Inspection

Objective

This Electro-Optics Center (EOC) project continues to execute cost and risk reductions for midwave infrared (MWIR) integrated dewar cooler assemblies that are critical to a number of Navy acquisition programs. The objective of this project is to implement three manufacturing technology process improvements:

1. Implement a new automated, cluster machine for contact metal and hardmask deposition.
2. Automate the visual inspection of dewar parts and subassemblies using a custom inspection system with artificial intelligence and machine vision to identify defects.
3. Eliminate the metallization process that is currently required to pre-tin the dewar window prior to automated brazing.

Payoff

Implementation of a new automated, cluster machine for contact metal and hardmask deposition will avoid excess handling and improve throughput and cycle-time. In addition, this project will explore changing the hardmask material used to improve etch selectivity, further reducing material consumption and process time via reduced film thickness.

The first priority for visual inspection automation of dewar parts will be the dewar pre-weld cleaning inspection. The process of record method requires the technician to have specialized knowledge about the part, creating a single point of vulnerability since only limited operators are capable of inspecting these parts. This also creates a production bottleneck and limits the maximum throughput in this process step. Automating the visual inspection using machine vision will reduce touch time, ensure repeatability, improve traceability and prevent these single points of failure.

Similarly, for dewar window brazing, the goal is to completely remove all manual operations for window-to-window ring assembly. Currently, the window edge does not promote adequate solder wet-ability to the window ring, which is critical to maintaining vacuum, thus requiring manual pre-tining of the dewar window prior to brazing.

Together, these tasks are expected to save over \$3.0M for Navy acquisitions.

Implementation

These producibility improvements will follow a rolling implementation process — processes will be implemented as they are completed, validated, approved and cut into production prior to completion of this project. These process-level changes are required to be reviewed and approved by the manufacturer's Process Control Review Board. This EOC project will implement multiple, industry-approved process changes in FY2026 impacting Lots 18 and beyond.

Artificial Intelligence and Multiphysics Models to Optimize Yield and Performance for Infrared Detectors

T3048 — Process Modeling for Improved Performance of nBn FPAs

Objective

Focal plane arrays (FPAs) are primarily used in infrared imaging systems that require detection of light across a wide variety of wavelengths. In recent years, new detectors using nBn (n-type/Barrier/n-type) structures have been developed to increase operating temperature, with resulting efficiencies in weight and power consumption. By implementing an advanced detector model and test structure, material defects and process anomalies will be quickly and accurately identified for noise equivalent irradiance (NEI) yield improvement. NEI failure modes can occur at many development stages. An advanced model informs better statistical process control tolerances with vendors and manufacturing facilities to improve the detector material and processes. This Electro-Optics Center (EOC) project is aimed at fully understanding the manufacturing variability in nBn epitaxy, such that sensor performance can be optimized through a physics-based modeling approach.

Payoff

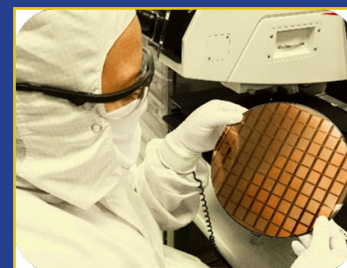
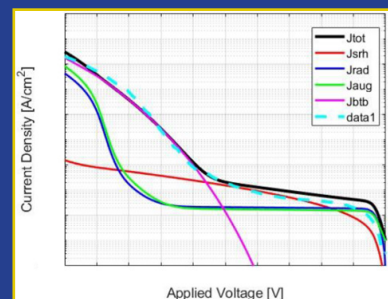
The use of nBn-type materials in infrared focal plane arrays are relatively new in production. Process models are needed to quickly and accurately identify material defects and process anomalies for NEI yield improvements.

NEI is inversely proportional to the square root of quantum efficiency for background-limited infrared photodetection detectors. A small improvement in quantum efficiency could lead to a significant yield improvement for infrared wafers. Neither the root cause nor the exact quantity of FPAs affected by low flux NEI have been identified. The analysis proposed in this project is intended to inform and enable these yield improvements.

The models produced from this project will be a Physics Informed Neural Network / artificial intelligence model and a COMSOL model, training through a combination of physics-based relations as well as by empirical data garnered from specifically designed test structures. Neural networks are fast-to-fit data, can handle complex geometries and nonlinear relationships, as well as capture unknown physics while respecting known physics. The intent is to identify the key processing parameters for monitoring and controlling the nBn fabrication process. It will also streamline the data analysis to build detector models that accurately predict the electro-optic behaviors of detector materials for design upgrades and cost reductions.

Implementation

This project will culminate with a modeled demonstration of the ability to improve NEI performance through nBn substrate growth optimization and predictions for the associated yield impact, cost reduction and performance improvements. Conceptual follow-on efforts would then validate these predictions through detector building and testing and subsequent implementation into production.



PERIOD OF PERFORMANCE:
March FY2025 to September FY2026

PLATFORM:
Airborne and Surface Sensors

CENTER OF EXCELLENCE:
Electro-Optics Center (EOC)

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F-35 Lightning II Joint Program Office



Energetics Projects

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The aircraft carrier USS Theodore Roosevelt (CVN 71) launches a Rolling Airframe Missile (RAM).
U.S. Navy image.

New CONUS Manufacturing Source for the Critical Chemical HNS

A2776 — Development of HNS Manufacturing Process

Objective

Many of the currently fielded air- and surface-launched Navy missile programs were developed decades ago. These programs are experiencing material obsolescence, discontinued products, inconsistent quality of material from the manufacturers and diminished manufacturing sources.

Hexanitrostilbene (HNS) is a thermally stable explosive and is identified as a critical chemical by the Department of War (DOW). It has applications in 47 weapon systems, such as Advanced Medium Range Air-to-Air Missile (AMRAAM), Hellfire, Guided Multiple Launch Rocket System (GMLRS), Sidewinder, Cartridge Actuated Device (CAD) / Propellant Actuated Device (PAD) Air Crew Escape System, etc. Currently, there is no consistent Continental United States (CONUS) source of HNS to meet the projected needs of the DOW. The material is currently procured from a single CONUS source, which leads to significant logistical challenges and long lead times for delivery.

The established process to produce HNS is the one-step Shipp procedure. This process produces a crude yield of 30%-50% that requires further purification and results in substantially lower overall yield. The modified Shipp process, a two-step process for small-scale synthesis of HNS is also reported in open literature. The first step is the synthesis of the intermediate hexanitrobibenzyl (HNBB) and the second step is the oxidation of HNBB to HNS. Following crude HNS production, the material undergoes crystallization to remove residual impurities and improve purity. This process first yields HNS-I, characterized by larger, well-defined crystals. Subsequent recrystallization of HNS-I yields HNS-II, which exhibits finer crystal morphology and higher sensitivity.

The objective of this Energetics Manufacturing Technology Center (EMTC) work was to develop and optimize a scalable, cost-effective process to produce HNS-I and HNS-II that meets specification PRF-WS-5003K, "HNS Explosive." This will enable large-scale production and establish a reliable CONUS supply for the Navy and DOW.

Payoff

Successful production of HNS at Naval Surface Warfare Center Indian Head Division (NSWC IHD) will provide the DOW with a reliable and cost-effective CONUS source of this critical chemical. This reliable production process ensures a supply of high-quality material, utilizing easily accessible and domestically produced starting materials. This reduces the risk of shortages or supply chain delays that could disrupt mission readiness. In addition, the newly developed process at NSWC IHD generates HNS at a higher yield than the current methods applied in industry. This results in greater quantities of HNS available to the DOW and the defense industrial base at a lower cost. Lastly, establishing a CONUS source of HNS shortens lead times from ordering overseas, supports DOW reshoring efforts for critical chemicals and eliminates foreign dependence.

Implementation

The successful results of this Navy ManTech project will be used to provide kilogram-scale quantities of HNS-I and HNS-II. These quantities will be used to validate the material utility in final (type) qualification studies for existing and future applications.

A two-step synthesis of HNS at multi-liter scale has been developed at NSWC IHD, Production Process Realization Branch. Each step was optimized for high yield, safety and ease of production. The first step of the process (i.e., production of HNBB) has been performed in multi-pound scales and has been optimized. The second step of the process (i.e., production of HNS) on kilogram-scale is scheduled to be completed in the fall of 2025. Once multipound quantities of HNS is produced, the crystallization to HNS-I and HNS-II will be performed.

The details of the optimized process will be documented in an internal NSWC IHD technical report after the successful manufacture of three 20-liter and 50-liter batches of HNS that meet specification requirements. Using the methods outlined in this report, NSWC IHD will be positioned to conduct manufacturing campaigns to support the transition of HNS-I and HNS-II for use in CAD / PAD (linear charges).



PERIOD OF PERFORMANCE:

November 2017 to December 2024

PLATFORM:

Energetics / CAD / PAD Devices

CENTER OF EXCELLENCE:

Energetics Manufacturing Technology Center (EMTC)

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STAKEHOLDERS:

PEO (U&W) PMA-201 CAD / PAD
JPO

Naval Surface Warfare Center
Indian Head Division



Novel Initiating Explosive Provides Warfighter with Safe, Lightweight and Reliable Weapon System initiation



PERIOD OF PERFORMANCE:
January 2021 to December 2024

PLATFORM:
Energetics / Special Purpose Munitions
Initiation System

CENTER OF EXCELLENCE:
Energetics Manufacturing Technology
Center (EMTC)

POINTS OF CONTACT:
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STAKEHOLDER:
Naval Surface Warfare Center –
Crane Division

S2920 — Industrialization of Submicron Explosive for Ultra-Low Energy Initiator (μ LEEFI)

Objective

The objectives of this Energetics Manufacturing Technology Center (EMTC) project were to demonstrate and qualify a novel initiating explosive for use in ultra-low energy exploding foil initiators (μ LEEFI) and then demonstrate and qualify the first μ LEEFI. The warfighter needs lightweight, safe and reliable initiation systems. This technology is an enabler for future smart weapons when employed in multi-point configurations that facilitate directional, deformable and tailorable effects warheads, as well as inclusion in smaller smart munitions that may employ out-of-line devices and hot wire detonators. Future in-line safe initiation systems must consume less energy, volume and weight. This state-of-the-art explosive technology can meet the requirement for smaller, less energy-intensive systems.

The low energy exploding foil initiator (LEEFI) is a qualified in-line initiator (ILI) permitted for use without interruption. Advancements in ILI technology are required to enable much smaller initiation systems with lower energy demands.

Payoff

Successful completion of this project will provide important benefits to the U.S. Navy in several areas, including improved cycle time, reduced cost and improved reliability.

In addition to the substantial reduction in process steps, handling and material movement, it is highly probable that this project will result in improved reliability by eliminating the current requirement for wetting and drying small particle size nitramines. Finely ground nitramines, typically agglomerate to some degree during drying. Eliminating the need for drying after shipment will result in a more consistent starting material for a mixing process.

The first programs to receive this technology are unable to achieve reliable firing or consistent lot-to-lot performance using the state-of-the-art LEEFI. The new μ LEEFI technology is an enabler that increases firing margin, allows the use of smaller and lower cost components and reduces supply chain risks. At a minimum, it is expected to save approximately \$2.0M over the next five years through the use of less expensive components and by guaranteeing a consistent supply of enhanced explosives. This Continental United States source will produce the required enhanced explosives using industrial processes with increased repeatability of quality, thereby decreasing the material cost.

Implementation

After successful demonstration of the novel μ LEEFI, Naval Surface Warfare Center Crane Division (NSA Crane) will assess the performance of the parts produced in the EMTC project in the end application. The measures of performance include an acceptable reliability at tactical all-fire based on both threshold testing and functional testing after exposure to tactically representative environments. If the device demonstrates reliable performance across those environments, the data will be compiled and submitted to the program manager for review and approval for immediate implementation into the production pipeline.



Resonant Acoustic Mixing Technology for Continuous Energetics Synthesis and Crystallization

S+2993 — CACR / CAC Manufacturing Technology Scale-Up

Objective

The objective of this Energetics Manufacturing Technology Center (EMTC) project is to create a modular, agile system for the continuous synthesis and crystallization of energetic materials using Resonant Acoustic Mixing (RAM). The design of the synthesis system is predicated on 2,6 diaminopyrazine-1-oxide (DAPO), which is a precursor to the molecule LLM-105, from n-nitrosodi (cyanomethyl) amine (IDAN-NO). However, the ultimate objective is to design, build and install a system capable of producing a variety of energetic materials, both liquid and solid. The design of the crystallization system is predicated on idoxuridine (IDOX).

Payoff

Naval Surface Warfare Center Indian Head Division (NSWC IHD) currently uses RAM technology for batch mixing of solid or powdered energetic materials. This project will provide for a continuous synthesis of energetics by feeding liquid feed streams to a Continuous Acoustic Chemical Reactor (CACR). The RAM technology employed in this manner will provide several advantages over currently available equipment. For example, the project will allow for the feed vessels to be reused for other raw materials. Also, the design will be such that taps and fittings are provided to add additional materials or to replace downstream components (e.g., filters) with other equipment simply by disconnecting hoses and installing the new equipment. This will allow for the rapid reconfiguration of the system for the production of a variety of materials. Similarly, the reactor product stream can be routed to a filter or future liquid-liquid extraction hardware easily and quickly. Also, multiple energetic materials may be synthesized and/or crystallized. Another significant advantage of the use of RAM technology is the ability to process solid materials up to 200 microns in size. This feature is an improvement over alternatives such as an Advanced Flow Reactor (AFR). Solid precipitates formed during energetics synthesis would plug the narrow channels comprising the flow path of an AFR.

A second application of RAM technology in this project is the Continuous Acoustic Crystallizer (CAC). As with the CACR, multiple continuous liquid streams are fed to the crystallizer. This CAC will provide tunable crystallization, which will allow control of particle size and distribution to desired parameters.

Implementation

Delivery and commissioning for both the CACR and CAC at NSWC IHD is targeted for the first quarter of FY2028. The commissioning will be performed starting with Facility Acceptance Tests at the Resodyn Butte, MT, facility. These tests will verify the ability of the CACR to produce DAPO at the required rate and quality and that the CAC can successfully crystallize the surrogate IDOX material. When the CACR and CAC are delivered to NSWC IHD, Resodyn will support installation and verification of the system components and will provide a checklist for these activities. When NSWC IHD begins DAPO synthesis and / or crystallization efforts, Resodyn will offer technical support. The original equipment manufacturer, Resodyn, will assist in the installation of the equipment and also provide initial start-up / operational verification of the equipment and training of NSWC IHD personnel.



PERIOD OF PERFORMANCE:

October 2021 to December 2026

PLATFORMS:

Low sensitivity mortar propellant charges used by the U.S. Marine Corps
Potential replacement for TATB in Trident II Nuclear Warheads

CENTER OF EXCELLENCE:

Energetics Manufacturing Technology Center (EMTC)

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STAKEHOLDER:

USMC PM AMMO



Post-processor Enables Continuous Purification of Liquid Energetic Materials



PERIOD OF PERFORMANCE:
October 2021 to November 2026

PLATFORMS:
5-inch HVP / GLGP projectile
HELM7 mortar propellant

CENTER OF EXCELLENCE:
Energetics Manufacturing Technology
Center (EMTC)

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STAKEHOLDERS:
Naval Surface Warfare Center –
Indian Head Division
PEO IWS 3C

S2995 — Continuous Post Processing for Methyl / Ethyl NENA

Objective

This Energetics Manufacturing Technology Center (EMTC) project is creating a system for continuous post-synthesis treatment of energetic materials from a Corning G1 Advanced Flow Reactor (AFR). The system design is predicated on the quenching and purification of a blend of N-methyl-N-(2-nitroxyethyl) nitramine and N-ethyl-N-(2-nitroxyethyl) nitramine (referred to as methyl / ethyl [Me / Et] NENA) but is suitable for use with a variety of liquid energetic materials.

Payoff

The project will provide on-demand capability for the production and purification of liquid energetic plasticizers (NENAs) that are more stable and less sensitive than nitroglycerin (NG). The upstream Corning G1 AFR will allow for continuous production of material while providing improved heat transfer and a smaller energetics footprint (less energetic material in one physical processing unit) as compared to a Continuously-Stirred Tank Reactor. The downstream post-processor will be a state-of-the-art, flexible and agile skid capable of handling multiple kinds of liquid-liquid extractions, not just NENAs. This post-processor will be comprised of gravity separators, extraction columns and in-line process control equipment that will ultimately pull off the waste stream to make a neat, final product stream. Continual post-processing only enhances the benefits of continuous flow production further by reducing production time and increasing throughput even more.

Implementation

Delivery of the post-processing unit by original equipment manufacturer, Synthio Chemicals, Inc., to Naval Surface Warfare Center Indian Head Division (NSWC IHD) is targeted for the fourth quarter of FY2027. Onsite support for initial commissioning and support / training is targeted for completion in the first quarter of FY2028. The Corning G1 AFR and related pumps and vessels are currently on site at NSWC IHD.



Optimized CONUS Manufacturing Source for the Critical Chemical DNPDP

A3002 — DNPDP Optimized Scale-up

Objective

Many Navy missile programs are encountering material obsolescence issues due to lack of a primary or secondary Continental United States (CONUS) manufacturing source. A secondary CONUS source for critical materials and critical chemicals becomes especially important during times of world conflict to ensure that these impacted programs experience no interruptions to their preparedness to defend the nation. N,N'-(di-2-naphthyl)-para-phenylenediamine (DNPDP) is an antioxidant in the MG-844 propellant formulation used in the AIM-120 Advanced Medium-Range Air-to-Air Missile (AMRAAM) program. DNPDP is one critical propellant component encountering obsolescence issues due to lack of a CONUS manufacturing source, and the current stockpile maintained by the AMRAAM program can support only two to three years of production at anticipated rates.

This Energetics Manufacturing Technology Center (EMTC) project optimized the DNPDP manufacturing process at Naval Surface Warfare Center Indian Head Division (NSWC IHD) through manufacturing technology as well as validated that NSWC IHD can produce DNPDP that meets customer material specification HS 6-0089A and can serve as a CONUS source of DNPDP. Previous projects have developed a small-scale process for the synthesis and purification of DNPDP that meets the required specifications; this project took that knowledge and sought to implement and optimize this process at a scale large enough to fulfill the AMRAAM program's estimated demand. Successful development and optimization of this capability would establish NSWC IHD as a qualified source for this critical chemical.

Payoff

Successful completion of this project will establish a reliable CONUS source of DNPDP product to support the Navy's AIM-120 AMRAAM program. DNPDP is a conventional antioxidant and is a proven material already qualified in several important formulations. This facilitates DNPDP's use in the qualification of other propellant formulations and could be beneficial to other programs and energetic formulators in the future. In addition, this process is reliable as the Department of War (DOW) and the defense industrial base can count on NSWC IHD to continue DNPDP production. Lastly, establishing a CONUS source of DNPDP shortens lead times from ordering overseas, supports DOW reshoring efforts for critical chemicals and strategically eliminates foreign dependence.

Implementation

This large-scale manufacturing process utilizes a 50-gallon reactor to make quantities sufficient to meet estimated weapon system demand. To ensure seamless, efficient and safe transition to such a large scale, a new state-of-the-art facility at NSWC IHD has been outfitted and commissioned to house this process as part of this project. This facility provides a flexible, modular-style manufacturing space for inert (non-energetic) critical chemical production. A walk-in fume hood limits operator exposure to hazardous vapors and a new control system monitors key process variables and initiates shutoff interlocks if unsafe values are detected. A specialized high-temperature TCU has been procured to allow for the required process temperatures without using a heating device (such as a heating jacket), which could present additional electrical hazard classification concerns. The details of the optimized process will be outlined in an internal NSWC IHD technical report once three 50-gallon batches of DNPDP that pass specification have been manufactured successfully. Through use of the methods in this report, NSWC IHD will be able to stand up full-scale manufacturing campaigns to transition material for use in the production of AMRAAM systems.



PERIOD OF PERFORMANCE:

December 2021 to December 2024

PLATFORM:

AIM-120 Advanced Medium-Range Air-to-Air Missile

CENTER OF EXCELLENCE:

Energetics Manufacturing Technology Center (EMTC)

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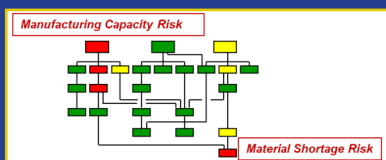
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STAKEHOLDERS:

Naval Air Systems Command Air-to-Air Missiles Program
Naval Surface Warfare Center – Indian Head Division



Defending the Supply Chain – Energetics Vulnerabilities Uncovered



PERIOD OF PERFORMANCE:
February 2024 to December 2026

PLATFORM:
Relevant to All Naval Weapons Systems

CENTER OF EXCELLENCE:
Energetics Manufacturing Technology Center (EMTC)

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STAKEHOLDERS:
ASN RD&A
DASN Sustainment
OASD for Industrial Base Policy, OUSD (A&S)

S+3026 — Navy Industrial Base Assessment Tool (IBAT) for Critical Chemicals

Objective

Energetic materials (EMs) are among the longest lead items for munitions production, which significantly delays their delivery to the warfighter. Lack of supply chain transparency from materials procurement interferes with the Navy ManTech program's ability to mitigate critical EM issues. This Energetics Manufacturing Technology Center (EMTC) project is refining and expanding a proof-of-concept Navy Industrial Base Assessment Tool (N-IBAT) into a functional prototype and demonstrating its capabilities. This will help Navy ManTech, the Department of the Navy (DoN) and the Department of War (DOW) improve acquisition readiness, meet sustainment requirements and meet emerging performance requirements for PEO / PM / prime transition.

Iterative testing of the N-IBAT will be done in close collaboration with Decision Sciences Incorporated, Inc. to develop it into a functional tool with data storage, analysis, retention, update and retrieval capabilities for tracking Navy energetic supply chains. The data will continue to be organized and added into the N-IBAT database so that periodic updates can be performed to monitor changes in the supply chain and to identify future needed mitigation efforts.

Payoff

The N-IBAT has benefactors across several levels. It will aid Navy ManTech in tracking manufacturing data and developing investment strategies for critical chemicals. Stakeholders such as Assistant Secretary of the Navy for Research, Development and Acquisition, Deputy Assistant Secretary of Sustainment (DASN-S) and Navy Program Executive Offices (PEOs) and Program Managers (PMs) will benefit from the database because it will improve their supply chain risk planning and provide increased awareness of Navy supply chain issues. By implementing the N-IBAT through integration with other DOW supply chain management systems, the DOW can then use the joint IBAT to perform supply chain risk planning across all DOW weapons acquisitions. The N-IBAT can improve the effectiveness of leveraging DOW investments, including Innovation Capability and Modernization, Defense Production Act Title III and Manufacturing Science and Technology. This tool can maintain a more robust industrial base to support future EM requirements because it can provide insights that will help suppliers better address government needs and facilitate planning for efficient incorporation of novel manufacturing technologies into the supply chain.

Implementation

Transition and implementation of the prototype N-IBAT will help improve acquisition readiness and meet sustainment and emerging performance requirements for PEO / PO / PM transition. Transition will occur when DOW and Navy leadership adopt and maintain N-IBAT for monitoring Navy energetics supply chains. Accurate, detailed supply chain mapping of EM will be implemented by various Navy and DOW stakeholders to provide insight on EM acquisition, performance requirements and supply chain risk mitigation efforts.



Production of L-series Materials for New CONUS Explosive Fills

S3027 — L-Series Process Development and Scale-up

Objective

Many of the currently fielded Naval Underwater Explosive (UNDEX) programs require materials that do not have reliable Continental United States (CONUS) sources. The formulations for those systems needs to be updated. As such, these programs are continually faced with material-related issues due to 1) material obsolescence – current qualified supplier(s) have discontinued products or product lines; 2) the quality or characteristics of materials coming from current manufacturers is inconsistent; and / or 3) critical chemicals only have a sole-source point of domestic manufacture. In many instances the materials that are discontinued are no longer available from alternate domestic manufacturers. In some instances, a modification of a formulation may be necessary to allow systems to continue to be manufactured without interruption. Any formulation modification needs to be evaluated in advance so that the necessary changes can be made without program interruption. Updating these formulations will be aided by the production of these L-series materials at Naval Surface Warfare Center Indian Head Division (NSWC IHD).

Payoff

This effort will establish a reliable CONUS source for the production of selective L-series materials for use in naval underwater systems. These materials will be fully sourced from CONUS feedstock products with a robust customer base (one of many customers). The L725 product was tested to be a 1.4 explosive by itself; in formulation, it was demonstrated by the Moby Dick test to perform on par with PBXN-111. Additionally, this Energetics Manufacturing Technology Center (EMTC) work will provide key gateway materials (L-721 & L-725) to an extensive line of other L-series materials (L-421, L-425, L335) that have potential application in insensitive munitions and enhanced performance (e.g., range, lethality) munitions applications.

Implementation

This effort benefits the Navy and defense industries by establishing a CONUS source of a critical energetic material used in naval underwater systems. Due to a limited source of material, NSWC IHD has demonstrated a method to scale L-series products that are highly significant and can potentially resolve an ongoing issue related to product sourcing. Under this effort, NWSC IHD will work with DTRA and OPNAV N957 for PMS 495 to establish a process of producing reliable L721, L725 and M1L721 (both 6H₂O and 4NH₃).



PERIOD OF PERFORMANCE:
February 2024 to December 2024

PLATFORMS:
Clandestine Delivered Mine MK 68 MOD 2
Long Range Aerial Delivered Maritime Mine

CENTER OF EXCELLENCE:
Energetics Manufacturing Technology Center (EMTC)

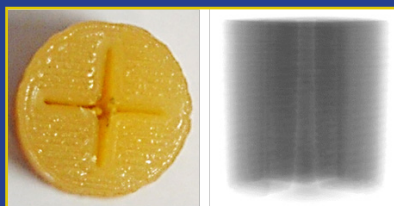
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STAKEHOLDER:
PMS 495



Industrialization of Printed Propellant: Improving Industrial Base Efficiency, Flexibility and Adaptability



Basic Igniter Grain
3D-printed by China Lake

PERIOD OF PERFORMANCE:

January 2025 to March 2028

PLATFORMS:

Pyrogen Igniters, D5, SM6, PAC3, MPBD, OpFires, MRBM

CENTER OF EXCELLENCE:

Energetics Manufacturing Technology Center (EMTC)

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STAKEHOLDER:

Navy Strategic Systems Program Office

S3028 — Additive Manufacturing of Igniter Grains

Objective

This Energetics Manufacturing Technology Center (EMTC) effort will demonstrate and qualify a printable composite propellant and its use as a pyrogen igniter. Igniter grains, small propellant grains with complex geometries, have long lead times contributing to schedule delays and cost overruns. During development, lead times for casting tooling are often several months, including for each rework necessary. In production, many cast grains are rejected due to defects introduced during removal from tooling. The 3D-printing of grains eliminates these issues as the propellant may be mixed in the morning and printed in the afternoon without the need for any tooling. This results in reduced development time, which helps systems reach the fleet sooner, reduced part rejection, which improves manufacturing reliability, and reduced resource demand, which enables industry to react more quickly during production surges.

Payoff

Igniter grain manufacturing issues are a classic tech-pull and justification for an additive manufacturing (AM) business case supporting critical path schedule compression, more rapid fleet availability and system sustainment. Printing igniter grains are expected to eliminate the typical lead-time of one year associated with tooling, \$100K-\$200K reduction in recurring tooling costs during development and the need to retool between production runs. Production yield is also anticipated to increase through a reduction of rejected parts while simultaneously eliminating machining requirements and associated energetic waste, thereby reducing component acquisition cost. With the ability to produce multiple assets or designs concurrently, the technology supports a more agile industrial base by freeing plant labor for other needs. Importantly, the technology may be utilized by any tri-service solid rocket motor or missile system for additional applications such as launch motor grains or solid divert and attitude control grains. In the long term, AM is expected to support the testing and production of functionally graded propellant grains targeting range goals.

Implementation

Composite propellant AM technology will be industrialized by transitioning materials and methods developed by the Navy to industry. An acrylated polybutadiene will be commercialized to supply production plants, government labs and igniter grain articles. The performance of the igniter grains will be assessed and a qualification plan implemented. Upon completion of the qualification plan, the igniter grain will be implemented in FY2028 into the production pipeline, and the basic technology will be utilized in other programs of record moving forward. The Navy will qualify the propellant composition in parallel.



Continuous Flow Enables Safe Direct-to-Lacquer BTTN Production

S3051 — BTTN Direct-to-Lacquer Flow Process Development

Objective

The objective of this Energetics Manufacturing Technology Center (EMTC) effort is to develop a continuous flow process for 1,2,4-butanetrioltrinitrate (BTTN) lacquer. This process would be inherently scalable to a Corning G1 Advanced Flow Reactor (AFR), which will provide enhanced safety in its design to avoid neat BTTN stream formation in the flow reactor. Downstream process development will also be conducted for continuous acid neutralization and solvent swap such that BTTN can be continuously produced as a lacquer that can be delivered directly into the mixer for cast cure formulations.

As part of this effort, under a cost shared NISE 219 effort, Naval Surface Warfare Center Indian Head Division (NSWC IHD) is using its experience in continuous flow process development of energetics to develop, optimize and demonstrate the inherent scalability of a flow process to BTTN. This process will by design avoid neat BTTN stream generation in the nitrating acids. This demonstration will begin with proof-of-concept validation using Little Things Factory microreactors that integrate with a Mettler-Toledo EasyMax reactor. Throughout these studies, in-situ Raman, in-situ infrared and in-situ nuclear magnetic resonance (NMR) (new flow NMR acquisition in this effort) will be used to enable rapid, data-rich optimization and trackable quality metrics for further scale-up. BTTN material quality will be tracked and calibrated methods for BTTN concentration at steady-state operation will be established to determine projected per-hour BTTN production.

Payoff

With the advent of continuous flow processing and inline analytics, the synthesis of BTTN can be optimized for increased safety and efficiency. Generating BTTN in microfluidic modules instead of larger stirred tank reactors substantially reduces the severity of a worst-case mishap during operation from a plant explosion and loss of facility down to a process plate rupture. Improved efficiency benefits are anticipated to be improved yield and purity of BTTN with less processing and labor time needed to generate BTTN lacquer for formulation.

Additionally, de-risking BTTN sources from a single-point failure while the Agile Chemical Facility is being redesigned and restarted will strengthen supply chain resiliency and allow for continued Navy support for IH143 production.

Implementation

This process development to pilot scale conducted under this effort will enable the Navy to mitigate risk for the Mk48 HWT, Mk54 LWT, Quickstrike Mine, CENCAP and CDM. A local continuous flow direct-to-lacquer process for BTTN will be the deliverable of this effort at NSWC IHD. Improved safety, efficiency and reproducible quality of material produced will significantly improve the process of BTTN production by enabling a process that directly provides BTTN lacquer. Transition is expected in first quarter of FY2027 with full implementation in FY2028 at NSWC IHD.



PERIOD OF PERFORMANCE:

November 2023 to December 2026

PLATFORMS:

Mk48 HWT, Mk54 LWT, Quickstrike Mine, CENCAP and CDM

CENTER OF EXCELLENCE:

Energetics Manufacturing Technology Center (EMTC)

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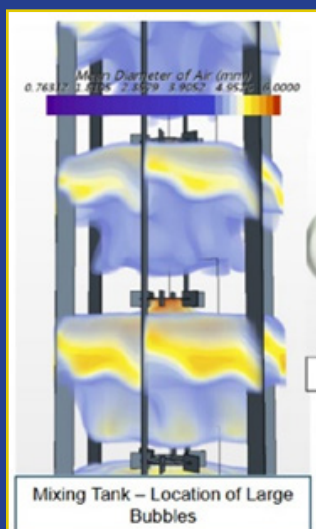
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STAKEHOLDERS:

Naval Surface Warfare Center – Indian Head Division



New Simulation Tool Enables Energetic Liquid-Powder Mixing Modeling



PERIOD OF PERFORMANCE:
October 2023 to September 2025

PLATFORMS:
Mk152 Warhead for Hydra 70
M72A10 Warheads

CENTER OF EXCELLENCE:
Energetics Manufacturing Technology
Center (EMTC)

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JSTAKEHOLDER:
PMA 242



A+3053 — Energetic Liquid-Powder Mixing Simulation Tool

Objective

This Energetics Manufacturing Technology Center (EMTC) project developed and delivered a modeling tool and platform for Resonant Acoustic Mixing (RAM) that continues to support the demonstration of RAM technology for energetics materials (EMs) manufacturing. This platform for energetics manufacturing includes generation of a laboratory information management system (LIMS) for the RAM mixers, development and analysis of laboratory- and production-scale methods for liquid-powder mixing and demonstration of modeling tool and platform for energetics mixing at Naval Surface Warfare Center Indian Head Division (NSWC IHD).

Payoff

The development of this explosives manufacturing software platform allows for better understanding of RAM of EMs and fills in the gap in the current knowledge of variations across RAM scales. In RAM EM manufacturing, there are many complex physicochemical processes such as multiphase and particle flows, chemical reactions, heat and mass transfer, laminar and turbulent flows and highly viscous non-Newtonian fluids. The behavior of each of these systems is unique and often difficult to predict or determine experimentally due to the connected nature of the governing physical phenomena, which results in extensive cost to develop and standup new manufacturing processes for energetics. This software platform drastically reduces the labor needed to develop new mixing processes and ensures that there is less batch-to-batch variation for materials manufactured at production scale. Having a RAM simulation like this ultimately reduces costs and ensures that materials manufactured at the production scale pass product requirements. Furthermore, this tool helps with implementation of RAM processes at current and future manufacturing sites without expensive standup costs to optimize mixing process parameters across variable products.

Implementation

Over the course of FY2025, Siemens Government Technologies, Inc. (Siemens) will develop a tool for simulating the mixing of liquids and solids in RAM, as well as an accompanying LIMS. These technologies will provide NSWC IHD with information that will streamline their process and formulation development in RAM. With current technologies, this development is heavily dependent on lengthy experimentation which results in higher project costs. Upon successful development of the LIMS and validation of the simulation tool, Siemens will transfer the platforms to NSWC IHD for use in future projects. These platforms will interface with modern records management and has potential to transition to other DOW laboratories and the organic industrial base. NSWC IHD and Siemens will collaboratively write a technical report detailing the work done to develop and validate the model upon conclusion of the effort.

RAM Enables PFAS and Plasticizer-Free Explosives Manufacturing

A+3054 — Manufacturing of PDMS and p-LMA Binders for Pressed PFAS and Plasticizer-free Explosives

Objective

This Energetics Manufacturing Technology Center (EMTC) project matured the manufacturing process of two new PFAS and plasticizer-free novel binder systems for pressed explosive (molding powder) applications. The goal was to develop a manufacturing process for these binder systems at the pilot-scale to optimize and advance their Technology Readiness Level (TRL) / Manufacturing Readiness Level (MRL) and make these binder systems readily available for explosive formulations.

First, end Modified-Polydimethylsiloxane (EM-PDMS) and Polymerized-Lauryl Methacrylate (p-LMA) are two novel binder systems that are free of PFAS within the polymer and the manufacturing process. They show great promise for lead, booster and main charge explosive applications.

Next, in addition to being PFAS-free, both EM-PDMS and p-LMA polymers have additional desired attributes in that they require no plasticizer to generate binder properties acceptable for use in pressed explosive applications. Currently, several pressed explosives use plasticizers with polymers to improve the mechanical and sensitivity of these energetic materials. These plasticizers are extremely effective in reducing the sensitivity of pressed explosives along with improving the density of end items using the pressing manufacturing process; however, they also migrate out of the explosive and cause changes to the sensitivity of the explosive and the initiation reliability upon aging. The fact that the new EM-PDMS and p-LMA do not need plasticizers expands their potential applicability into main charge explosives.

Lastly, both EM-PDMS and p-LMA can be manufactured using a simple synthesis process from common off-the-shelf ingredients without using extremely toxic or restricted materials, such as PFAS. Both binders can be synthesized at Naval Surface Warfare Center Indian Head Division (NSWC IHD) or other Department of War (DOW) sites and the organic industrial base to ensure that the manufacturing supply of these binders stays available.

Payoff

These two binder systems were matured and characterized as replacements for current Per- and polyfluoroalkyl substance (PFAS) binders, such as VDF-HFP, that are used in PBXN-5, PBXN-7 and PBXN-12 formulations as a potential direct replacement in the event that VDF-HFP is no longer available due to PFAS restrictions. Additionally, these new binders are potential replacements for plasticizer-containing formulations, such as PBXN-9, to eliminate potential for plasticizer migration in the weapon systems. At the conclusion of the effort, an initial cost evaluation was completed for these two binder systems and compared to the cost of currently used PFAS binders and plasticizer container binder systems.

Implementation

In order to maintain the Navy's ability to produce lead and booster explosives, such as PBXN-5, PBXN-7 and PBXN-12, new PFAS- and plasticizer-free binder synthesis processes need to be matured and characterized. The synthesis process for manufacturing p-LMA and EM-PDMS will be transitioned to a Naval Ordnance Safety and Security Activity (NOSSA) Insensitive Munitions Advanced Development High Explosive (IMAD-HE) program in FY26 for maturation and characterization of two novel pressed explosives utilizing these two binder systems. The synthesis processes will be utilized at NSWC IHD in the future to support this ongoing IMAD-HE process and potentially the qualification of the explosives. These two novel binder synthesis processes can be transitioned to the organic industrial base for future manufacturing or further scaled up at NSWC IHD as additional material is needed. Once the IMAD-HE program is completed, NSWC IHD will seek funding from IMAD-HE in order to qualify these new explosive formulations manufactured with p-LMA and / or EM-PDMS.



PERIOD OF PERFORMANCE:

October 2023 to September 2025

PLATFORMS:

AIM-9X, 2.75" Rocket / APKWS, AGM-114, Other Systems Utilizing Pressed Plastic-Bonded Explosives

CENTER OF EXCELLENCE:

Energetics Manufacturing Technology Center (EMTC)

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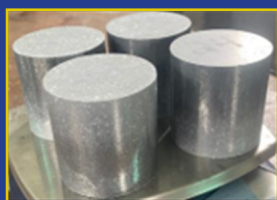
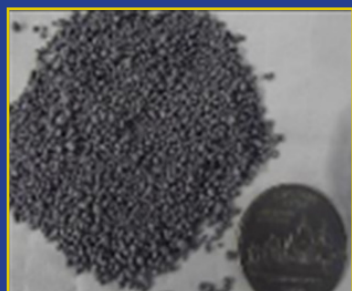
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STAKEHOLDERS:

Naval Ordnance Safety and Security Activity (NOSSA) Insensitive Munitions Advanced Development (IMAD) High Explosives (HE)



RAM Provides New Route to Pressed Explosives Manufacturing



PERIOD OF PERFORMANCE:
December 2023 to December 2028

PLATFORMS:
M72A10 Warheads, W80, other systems utilizing pressed plastic-bonded explosives

CENTER OF EXCELLENCE:
Energetics Manufacturing Technology Center (EMTC)

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STAKEHOLDER:
PM Ammo for M72 FFE



A3055 — Resonant Acoustic Mixing (RAM) Manufacturing Process for Pressed Explosives

Objective

The 3M Fluorinert™ FC-3283 is the sole process fluid utilized by the Department of War (DOW) and the defense industrial base for the non-aqueous slurry manufacturing process of pressed explosive formulations containing aluminum and water-soluble ingredients. FC-3283 is a perfluoroalkyl substance (PFAS), a family of chemicals heavily monitored by the Environmental Protection Agency. In January 2023, 3M announced it would be phasing out all PFAS products, leading to FC-3283's complete discontinuation by 2025. The ban on PFAS fluids has put all research and development, qualification and production efforts for pressed explosive formulations containing aluminum or water-soluble ingredients at risk because they cannot be processed with the conventional method, a water-based slurry process.

Naval Surface Warfare Center Indian Head Division (NSWC IHD) uses FC-3283 to manufacture PBXN-13, which is used as the M72A10 FFE warhead and is undergoing evaluation for integration in other weapon systems, e.g., HYDRA-70/APKWS family, Anti-Surface Warfare (ASuW) and anti-structural munition (ASM) weapon systems. PBXN-13 can't be manufactured using the conventional water slurry process due to the reactivity of aluminum with water, and with the imminent ban of FC-3283, PBXN-13 production could halt in 2025.

Currently, there are no other qualified manufacturing processes for PBXN-13, leaving the M72A10 system at risk. The development of a RAM process to manufacture PBXN-13 will introduce a new method to produce the material at a lower cost and a higher rate while eliminating the afflicting supply chain issue. The objective of this project is to scale up, optimize and qualify such a process at the five-gallon RAM (RAM5) scale.

Payoff

This Energetics Manufacturing Technology Center (EMTC) effort will reduce the overall cost per pound of PBXN-13 by eliminating the need for FC-3283 process fluid and reducing overall waste disposal, labor and batch processing time. A lower production cost will enable the Navy and DOW to supply more units for weapon systems to the warfighter. NSWC IHD is currently the only entity qualified to produce PBXN-13 in any capacity due to the incompatibility between FC-3283 and the processes established by other molding powder production facilities. Establishing this process maintains the ability of NSWC IHD to produce PBXN-13 post-FC-3283 discontinuation and enables technology transfer to industry as well. In addition, this RAM technology enables the quality of the material to be controlled via a reliable and repeatable recipe that virtually any operator familiar with the technology could execute, regardless of his / her experience level. The lack of reliance on process experience greatly reduces the risk associated with employee turnover. Also, RAM5 batch sizes are less than those via the industry standard process, but the time required to produce a batch of material is significantly lower. Since the RAM process will include the removal of solvent during the mix cycles, the need for filtration is eliminated entirely. It is currently projected that the RAM process will reduce the total labor cost by more than 68% and cut the cost to produce PBXN-13 by 50%. Lastly, the removal of an oven-drying step in the molding powder production process can drastically increase PBXN-13 throughput. An efficient RAM5 process to manufacture PBXN-13 can produce up to 1,600 lbs. per week, which more than doubles the current throughput at NSWC IHD with traditional manufacturing methods.

Implementation

The implementation of this technology will be performed using the RAM5 system at NSWC IHD. A proposal will be submitted to the Insensitive Munitions Advanced Development program to complete a delta qualification of PBXN-13 manufactured via RAM5, which will include the cost of all testing required by the Navy Configuration Control Board. Implementation at the RAM5 scale will be documented extensively to aid in the potential future transition of the process to the 55-gallon RAM scale at the McAlester Army Ammunition Plant which will further increase process throughput and efficiency.

Artificial Intelligence and Machine Learning Enable Rapid Energetics Manufacturing Scale-Up

S+3056 — Industry 5.0 for Energetics Manufacturing

Objective

Statistical Design of Experiments (DoEs) has been used for over a hundred years to increase the information-per-unit-experiment at all stages in chemical and materials discovery and manufacturing process development. However, it lacks some key features. Traditional polynomial models and factorial designs are insufficient for many highly complex systems, such as chemical processes with multiple kinetically significant steps or pathways. In addition, such models do not naturally provide mechanistic insight, which should be a key component of discussions when developing a manufacturing process. While it is possible to develop a DoE around physical models, doing so typically requires apprehension of physical nuances that are not often present at the outset of a development life-cycle.

The rapid rise in artificial intelligence (AI) models has opened one route to address both concerns. Machine learning algorithms, such as neural networks, are designed specifically for flexibility to data and numerous architectures have been developed to handle chemical processes within the federal government, including at the Air Force Research Lab and multiple National Labs, such as Oak Ridge, Sandia and Lawrence Livermore. However, many of these efforts are used primarily at the chemical lab scale, whereas process scale-up sits at the complex interface of chemistry, physics, engineering and surface science. AI models are a natural tool for use in handling the physical complexity of the systems involved, shortening the scale-up life-cycle and bringing energetics manufacturing to production scale faster.

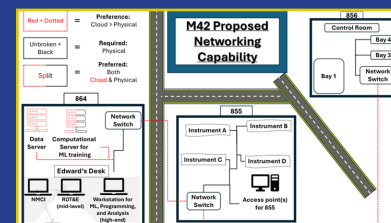
Currently Naval Surface Warfare Center Indian Head Division (NSWC IHD) is developing these AI capabilities by creating a cloud-based app for continuous, real-time monitoring of active chemical processes using automated reactors and process analytical technology. The data collected will be used for training cloud-based AI models that will, in turn, analyze and recommend new experiments to the scientists and engineers and act to build digital representations, or digital twins, of the processes under study. These digital twins will allow for advanced analysis and planning of reaction scale-up.

Payoff

By providing accurate digital twins of chemical processes, this Energetics Manufacturing Technology Center (EMTC) effort will allow NSWC IHD to more rapidly bring energetics production to scale. One key benefit gained is a significant reduction in labor time associated with data management, data processing and data analysis to arrive at models to inform chemical process development as well as changes to at-scale chemical manufacturing processes. In addition, it will provide a template and platform for the Navy and other services to follow in building their own data management and processing frameworks for digital twin development.

Implementation

The AI / machine learning model developed and demonstrated during this project will transition to NSWC IHD to be used to develop, produce and scale additional chemicals in the future. The model will be demonstrated to aid in the development of 1,3,5-triamino-2,4,6-trinitrobenzene, but the model will also be applied to all energetics development and could be expanded to other processes as well. This system will streamline chemical process development by combatting suboptimal development strategies (e.g., one-factor-at-a-time, physically uninformed statistical models) and supplying chemical predictions to the user, leading to shorter development life-cycles and more quickly bringing new energetics processes to the fleet and wider military.



PERIOD OF PERFORMANCE:

December 2023 to September 2027

PLATFORMS:

Relevant to All Naval Weapons Systems

CENTER OF EXCELLENCE:

Energetics Manufacturing Technology Center (EMTC)

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STAKEHOLDERS:

Naval Surface Warfare Center – Indian Head Division



RepTech Projects

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Hull Maintenance Technician 3rd Class Jesse Belfi Strikes a Welding Rod to Mend the Hinge of a Quick-Acting Watertight Door Handle Aboard the USS Bonhomme Richard (LHD 6). *U.S. Navy image*

Optimized Ceramic Coating Improves Wear and Prevents Calcareous Deposit on Large Diameter Submarine Ball Valves

RT2837 — Submarine Large Diameter Ball Valve Improvement

Objective

The coatings on large diameter submarine seawater valve balls fail prematurely resulting in emergent repairs at significant cost. Causes of increased torque are attributed to: 1) swelling of valve seats, 2) loss of lubricity between the surface of the valve ball and seat due to the loss of the green coating, and 3) calcareous deposits from marine growth. Damage to the surface finish of the valve ball coatings requires a full restoration. The objective of this Institute for Manufacturing and Sustainment Technologies (iMAST) Repair Technology (RepTech) project was to identify, test /evaluate and implement potential coating manufacturing system and/or process that improves the performance and life-cycle of seawater-system ball valves.

iMAST evaluated ceramic coatings with an overcoat for hydraulically actuated valves with high torque output. The project identified the contributing coating system deficiencies (porosity, density, uniformity, adhesion, microstructure, friction, etc.) and the failure mechanism of the ceramic / coated and Teflon™-coated titanium valve balls and their repair processing parameters. The ceramic coating application process, deposition parameters and coating microstructure was evaluated and optimized in order to provide the ultimate ceramic coating solution. Initial testing of a coated large diameter valve ball, tested to the anticipated total number of lifetime cycles in a dry condition (i.e., friction test), indicated no failures to the ceramic / xylan coating system, indicating potential life-of-boat reliability. Full-scale durability testing was conducted at General Dynamics Electric Boat (GDEB) without encountering a single coating failure over life-of-boat representative service conditions. This Navy-owned coating process can be applied to both in-service submarines, including LOS ANGELES Class, VIRGINIA Class and OHIO Class submarines, as well as new submarine construction, including both VIRGINIA and COLUMBIA Class submarines.

Payoff

An improved ceramic coated valve ball would eliminate a month-long honing operation and result in significant cost savings and increased mean-time-between-overhaul, providing improved availability, less rework and reduced delays in complex repairs. The coating may also be applied to large and small diameter seawater valve balls further increasing the cost savings. Total life-cycle cost savings for the VIRGINIA Class submarine are approximately \$80.6M. Additional cost savings would be realized with the COLUMBIA Class submarine at a minimum of \$22.4M depending on the number of seawater ball valves. This also represents a five-year return on investment of 6.4:1 for both VIRGINIA and COLUMBIA Class submarines.

Implementation

The seminal transition event was considered to be the satisfactory completion of a laboratory validation testing of a 12-inch seawater ball valve assembly coated with an effective ceramic coating that improves wear and prevents calcareous deposit. This project was completed in the third quarter of FY2025 and the results are available for implementation at GDEB within one to two years on new construction submarines utilizing qualified private vendors such as A&A coatings, pending drawing updates funded by the associated Program Offices.



PERIOD OF PERFORMANCE:

April 2020 to June 2025

PLATFORMS:

COLUMBIA Class Submarine
VIRGINIA Class Submarine

CENTER OF EXCELLENCE:

Institute for Manufacturing and
Sustainment Technologies (iMAST)

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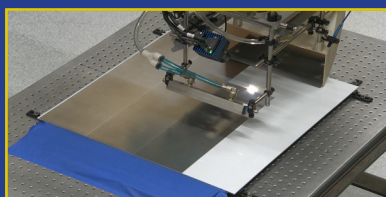
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STAKEHOLDERS:

PMS 397
PMS 450



Improving Coatings Removal Operations for Off-Aircraft Parts



PERIOD OF PERFORMANCE:
April 2021 to December 2024

PLATFORM:
T-6 Texan II Aircraft

CENTER OF EXCELLENCE:
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Sustainment Technologies (iMAST)

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STAKEHOLDERS:
Naval Air Systems Command
Commander, Fleet Readiness Centers
Fleet Readiness Center Southeast



RT2923 — Laser Ablation for NAVAIR Applications

Objective

Aircraft coatings removal at Naval Air Systems Command (NAVAIR) Fleet Readiness Centers (FRCs) is performed using chemical, manual (hand sanding) and blasting methods. Many coatings contain hexavalent chromium or other hazardous chemicals targeted for elimination by DOW; these create occupational exposure and hazardous waste disposal issues. The objective of this Institute for Manufacturing and Sustainment Technologies (iMAST) Repair Technology (RepTech) project was to test and transition a laser ablation (LA) process to remove coatings from Navy aircraft parts in order to 1) reduce costs associated with blast media and coatings removal labor, 2) reduce handling hazardous stripping chemicals, 3) eliminate occupational exposure to hazardous chemicals and airborne dust, and 4) reduce damage to substrates and/or rework as a result of legacy processes.

iMAST, working with FRC Southeast (FRCSE), developed and executed a comprehensive test matrix to evaluate LA for complete paint removal from thin aluminum aircraft. iMAST identified several candidate LA technologies, developed suitable process parameters and optimized settings on the selected 1kW, pulsed, Nd:YAG LA system from Adapt Lasers. LA samples have passed most critical tests, including de-paint efficiency, hardness, conductivity, surface roughness, cadmium embrittlement, adhesion and tensile testing. Corrosion testing showed slight reduced protection and fatigue testing showed mixed results, requiring a greater data set that will be completed outside this project.

Payoff

The business case was based on cost avoidance for the sustainment of T-6 Trainer Aircraft. FY2021 production data (hazardous waste costs, material costs and depaint labor costs) was extrapolated to FY2022 / FY2023 production quantities and labor rates were updated to establish baseline coatings removal costs. The Navy estimated LA reduces labor depaint time by 70% and materials usage and hazardous waste generation by 90%, as compared to conventional coatings removal technologies for the T-6 Trainer Aircraft alone (flight controls and fuselage body). This enabling technology also resulted in five-year savings of just under \$9.0M for this single aircraft platform. NAVAIR estimates that expansion to another yet to be identified aircraft platform, where 50% of production workload can be stripped using LA, will result in an additional five-year savings of \$6.0M, representing a final return on investment (ROI) of 1.41:1.

Implementation

FRCSE intends to pursue additional qualification testing to support implementation in sustainment operations. FRCSE's initial focus is planned for T-6 aircraft parts and associated 2024-T3 (clad and bare) and 7075-T73 (bare) aircraft systems; expansion to other NAVAIR aircraft is also anticipated. Data will be provided to the Air Force to pursue joint service applications and will be reviewed for wider applications in aerospace maintenance, repair and overhaul operations. Implementation is expected to be funded by Command Fleet Readiness Center (COMFRC) / FRCSE and is anticipated in FY2027 – FY2028.

Optimizing Motor Generator Remanufacturing Tooling and Processes

RT2964-2 — Motor Generator Rewind Optimization, Phase 2

Objective

The Puget Sound Naval Shipyard (PSNS) Shop 51 (S51) plays a crucial role in rewinding alternator components for a wide range of motors, motor generators and fire pumps used across most naval platforms. Previously, the process of rewinding these generators was predominantly manual, resulting in an alarming 80% failure rate during qualification testing. This high failure rate necessitates an average of 3.1 rebuilds per motor / motor generator before they can be deployed back to the fleet. These frequent failures and repetitive work have led to significant cost overruns and availability issues.

During the exploratory phase of this project, the Institute for Manufacturing and Sustainment Technologies (iMAST) identified that excessive manipulation of the windings due to challenging installation requirements was the primary cause of motor rewind failures. The objective of this Phase 2 iMAST Repair Technology (RepTech) project was to address these failure issues by developing processes and tooling that reduce the time and failure rate associated with the rewinding process. The goal was to minimize manipulation and the risk of component damage during installation.

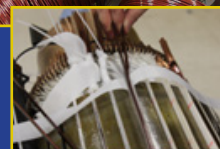
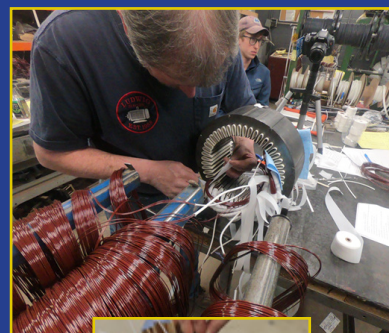
iMAST identified and tested various process improvements, including winding material replacement, alternative Dacron™ slot filling, coil protection using Mylar™ and new tooling for custom winding forming. A new rewinding process using industry best practices and modern, application-optimized materials was developed by iMAST that significantly reduced the failure rate of rewinding operations. To ensure successful implementation of the refined process, iMAST conducted an onsite training at PSNS and then hosted an in-person motor rewinding training course for PSNS artisans at the Penn State Applied Research Laboratory.

Payoff

Based on data provided by S51, the initial business case estimates a conservative reduction in failures of over 20% due to the improved process and training conducted through this effort. This translates to a direct reduction in labor hours resulting in five-year savings of approximately \$2.0M and a return on investment (ROI) of 2.3:1. Implementation of these process improvements are also expected to reduce the high failure rates for motor rewinding by 50%, thus improving availability of these critical items in ship maintenance.

Implementation

Process and material modifications have been reviewed and approved by Code 270. The implementation of new solutions was executed in a progressive, phased approach, with each solution evaluated and adopted at the floor-level workmanship practices prior to full adoption. Full implementation was completed at PSNS in the second quarter of FY2025.



PERIOD OF PERFORMANCE:
September 2023 to October 2024

PLATFORMS:
CVN 78 Class Aircraft Carrier
OHIO Class Submarine
LOS ANGELES Class Submarine
VIRGINIA Class Submarine

CENTER OF EXCELLENCE:
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STAKEHOLDERS:
NAVSEA 04
Puget Sound Naval Shipyard



Additive Manufacturing Repair for Critical Engine Components Reduces Fleet Maintenance Costs and Improves Operational Availability



PERIOD OF PERFORMANCE:
May 2023 to October 2024

PLATFORMS:
T-64 Engine (CH53-E)
T408 Engine (CH53-K)

CENTER OF EXCELLENCE:
Institute for Manufacturing and
Sustainment Technologies (iMAST)

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STAKEHOLDER:
Naval Air Warfare Center – Aircraft
Division
Fleet Readiness Center East

RT2992 — Powder Blown Laser Directed Energy Deposition (L-DED) Repair

Objective

Knife-edge seal features on multiple engine platforms experience wear over their service life and require periodic maintenance to restore these worn seal features. As an example, the T64 (CH-53E) Rear Air Seal experiences excessive in-service wear on the knife-edge seal teeth features resulting in a loss in engine performance. Traditionally, these components are scrapped and replaced, but for some legacy systems, there is not a sufficient supply for full part replacement due to the aging fleet and a decreased vendor base. Arc welding and thermal spray have been used to rebuild feature geometries on some components such as the T64 Rear Air Seal, but these processes are not suitable for many parts that are sensitive to excessive heat input. Repairing with a powder blown laser directed energy deposition (L-DED) process has many functional benefits that make this process a leading contender for developing a qualified repair method on knife-edge seal features. Powder blown L-DED repairs have been demonstrated to significantly decrease heat affected zones of the repaired region and decrease thermal distortion of the repaired component when compared to traditional welding processes.

The objective of this Institute for Manufacturing and Sustainment Technologies (iMAST) project was to develop a qualified repair process for a family of rotating engine components using powder blown L-DED.

iMAST worked with Naval Air Warfare Center Aircraft Division (NAWCAD) and Fleet Readiness Center East (FRCE) to develop and test the powder blown L-DED process, as well as build and transition advanced in-situ monitoring / control capabilities to assess weld repairs in real time to drive deposition standoff and path planning on a layer-by-layer basis. The project team's initial demonstrations have been successful in restoring part geometry and have conducted full metallurgical and mechanical testing to provide the objective quality evidence needed for a qualified repair process. Furthermore, the preliminary transition of the monitoring / control software has taken place at NAWCAD and plans to move this capability to FRCE are underway.

Payoff

The primary benefit is cost savings associated with approval of a repair process that can restore traditionally scrapped components in lieu of full part replacement. The repair process is estimated to cost approximately 20% of a component replacement. Assuming 30 repairs per year for a single engine platform (T-64), implementation of this technology will result in five-year savings of approximately \$3.0M, resulting in a return on investment (ROI) of 2.4:1. Additional ROI is expected as Naval Air Systems Command (NAVAIR) expands this repair capability to other engine platforms, such as the T-408. In addition, the repair process is expected to reduce lead time for component availability by about 75%, thus increasing mission capability. Finally, the combination of L-DED hardware with the LiveSCAN Repair Process Control, an in-situ monitoring and control software developed in this project, not only increases quality but also reduces touch time during final machine operations, further reducing lead time and increasing production capacity.

Implementation

To date, iMAST has transitioned LiveSACN Repair Process Control to NAWCAD, and they have demonstrated the capability. The iMAST project team, along with their NAVAIR partners are planning to transition all processes and controls to FRCE in the third to fourth quarter of FY2026. FRCE has already acquired a powder blown L-DED machine. Therefore, implementation costs should be modest and limited to final repair process approval, procedure development and operator and equipment training along with a maintenance contract.



Cold Spray Additive Manufacturing Can Support Rapid Component Fabrication to Support Navy Sustainment Needs

RT2998 — SPEE3D for Rapid, Low Cost Additive Manufacturing of Navy Components

Objective

The casting supply chain continues to shrink, which increases the lead time and cost for castings used by the Navy and other Department of War (DOW) organizations. Long lead times can cause delays in meeting tight refurbishment schedules when replacement components are required. Cold Spray Additive Manufacturing (CSAM), a process capability of the SPEE3D systems, can quickly and economically produce near-net shape parts from aluminum alloys, brass, bronze and stainless steel. Other alloys, such as 70 / 30 copper nickel (CuNi) and nickel aluminum bronze (NAB), that are of particular interest to the Navy, need to be developed for use on the SPEE3D system. In addition, there is a potential need to produce replacement components in the field or at forward maintenance facilities to maintain readiness. However, a qualified process, proven in use in Continental United States (CONUS) repair and fabrication sites is first needed to justify that forward-based capability. The objective of this Institute for Manufacturing and Sustainment Technologies (iMAST) project is to develop the additive manufacturing process for three different material / components using the SPEE3D cold spray system and transition the process to the Navy or supporting industry to cost for both U.S. Navy submarine repair and new construction.

iMAST, working closely with Naval Sea Systems Command (NAVSEA) 05T1 and SPEE3D, is selecting candidate NAB and CuNi components, developing and optimizing process parameters not only for component build. Additional testing on post-heat treatment, conducting extensive material characterization and testing is being conducted in order to provide the Navy with the objective quality evidence for more accelerated repair approval. Finally, there is work on developing technical data packages for specific components and material systems. Once SPEE3D-fabricated components meet the performance requirements, they will be delivered to NAVSEA, Portsmouth Naval Shipyard and / or Norfolk Naval Shipyard for additional evaluation and potential installation onto active Navy vessels.

Payoff

The primary benefits are time and cost savings associated with the approved CSAM process as a replacement for castings procurement. In the case where castings are not readily available, CSAM parts may provide an adequate replacement. CSAM can produce parts at orders of magnitude faster than conventional casting procurement, days versus months of lead time, therefore, improving weapon system availability and potentially reducing costly dry-docking times. Implementation of this technology is expected to result in five-year savings of approximately \$4.3M and return on investment (ROI) of 2.4:1.

Implementation

Implementation of the CSAM process is expected to occur at industrial facilities that already have the organic capability (e.g., HAMR Industries and Solvus Global), therefore, reducing implementation cost. Post-project implementation may require Navy investment in full process qualification; however, it is anticipated that the processes developed in this project will be applicable to a range of components of similar alloys, specifications, etc. The data set produced for materials in this study can be leveraged for future components though some additional tests, and part-specific qualifications may be required. Implementation is expected to occur in late FY2026 or early FY2027.



PERIOD OF PERFORMANCE:
May 2023 to December 2025

PLATFORMS:
CVN 78 Class Aircraft Carrier
COLUMBIA Class Submarine
VIRGINIA Class Submarine

CENTER OF EXCELLENCE:
Institute for Manufacturing and
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STAKEHOLDERS:
NAVSEA 05T1
PMS 312
PMS 392
PMS 396



Advanced, Automated Paint Removal Process for USMC to Enhance Repair and Overhaul Activity



PERIOD OF PERFORMANCE:
April 2024 to April 2026

PLATFORMS:
Shipping containers, JLTV Comm Shelters, possibly doors LAV, JLTV, ACV

CENTER OF EXCELLENCE:
Institute for Manufacturing and Sustainment Technologies (iMAST)

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STAKEHOLDER:
Marine Depot Maintenance Command
Production Plant Albany

RT3025 — Laser Ablation of Armored Vehicles

Objective

Marine Depot Maintenance Command, Production Plant Albany (MDMC Albany) has worked with Titan Robotics to integrate the Adapt Laser System into an automated laser coating removal system to replace conventional paint removal processes at MDMC Albany (e.g., manual garnet blasting). Manual garnet blasting is labor-intensive, causes worker fatigue and exposure to hazardous materials, results in significant blast media consumption and disposal costs and cannot be used for sensitive or fragile substrates. U.S. Marine Corps (USMC) requires objective, quality evidence that the laser stripping process does not result in candidate substrate degradation but meets coating removal requirements. The objectives of this Institute for Manufacturing and Sustainment Technologies (iMAST) project are to develop and optimize laser stripping process parameters to be used on the Titan Robotics system, obtain approval to use the process through testing and ease transition to MDMC Albany operations.

iMAST is executing Phase 1, which focused on developing a test matrix for the Light Armored Vehicle (LAV) and Joint Light Tactical Vehicle (JLTV), initiating parameter development and working with the system manufacturer to optimize use. However, iMAST found that robotic laser decoating of the vehicles would not easily permit coating removal on the inside of the vehicle, and coating removal on the outside was prohibitively long. Therefore, the team pivoted focus to large shipping containers that are used as workspaces in the field; they are currently scrapped because the fragile, thin aluminum cannot be blasted using conventional methods / media available at MDMC Albany. Suitable parameters are being developed to allow these containers to be reused. Once found that they may be reused, a go / no-go meeting will take place to continue onto demonstration and trials / testing for JLTV communication shelters, also fabricated from thin aluminum. Phase 2 of this project will leverage the results from Phase 1 to modify processing parameters from the shipping containers to meet the communication / shelter needs. The results from the combined phases will be used to support USMC in funding any additional testing that may be required to use the system on these targeted assets.

Payoff

The primary benefit for this project has shifted to using the laser de-coating system on shipping containers to avoid replacement costs. The anticipated five-year savings in using this technology to de-coat these containers and retain their service life is \$47.6M, resulting in a return on investment (ROI) of 70.2:1. Additional returns may be yielded for use on the communications shelters and possibly off-vehicle parts, such as doors, if proven to be a more effective means than conventional grit blasting.

Implementation

MDMC has procured and installed a 1 kW Titan Robotics pulsed laser decoating system, capable of robotic and hand-held operation, at Production Plant Albany in the fourth quarter of FY2025. For full implementation to occur, process development is required. Once applicability is demonstrated, MDMC intends to use the process. Full implementation for laser stripping of containers and / or communication shelters is anticipated in mid-FY2026.



Integrated 3D Spatial Software Solution Provides Broad Access to 3D Reality Capture Datasets and Digital Twins for Maintenance Planning

RT3049 — Modernizing Shipchecks to Enable the Digital Twin

Objective

The shipcheck process for naval vessels involves capturing as-built and/or as-maintained conditions of ship compartments and machinery. Currently, more than 12,000 hours per shipcheck are required to generate this content, and the resulting work packages are still issued as 2D drawing packages that require multiple in-person / manual verifications once work has started on the availability. Light Detection and Ranging (LiDAR) scanning has supplemented / replaced the paper and clipboard approach and results in high-resolution point cloud representations of the current conditions. Naval Sea Systems Command (NAVSEA) shipyards lack a fully integrated capability to organize and centralize 3D reality capture data for use in maintenance planning.

The objective of this Institute for Manufacturing and Sustainment Technologies (iMAST) project is to develop a federated, integrated system that organizes and centralizes 3D reality capture datasets. Such a capability enables Navy shipyards to create and distribute digital twins, facilitating asynchronous planning and design processes. As a result, the workforce is provided access to accurate, real-time digital representations of ships that support efficient ship inspection, workload planning and design efforts. An integrated, 3D spatial software solution that meets NAVSEA security and access control requirements will enhance collaboration, reduce downtime, and improve the overall speed and accuracy of the ship repair process.

Payoff

Adoption of an integrated, 3D spatial shipyard refurbishment digital twin process for ship checks is expected to result in 10% labor savings compared to conventional, paper-based shipchecks for all classes and ships and shipyards – five-year savings of \$4.4M – equating to a return on investment (ROI) of 4.6:1. Additional labor savings during refurbishment (not captured in the above ROI) are expected as a result of improved shipyard refurbishment planning enabled by the 3D spatial technology. Finally, refurbishment time is also expected to decrease with improved planning and increased probability of required material availability.

Implementation

Upon successful completion of this project, it is anticipated that the Navy maintenance, repair and overhaul community will have access to an integrated, cyber-secure 3D spatial system to manage shipcheck digital data and enable improved planning. Initial implementation will occur at Puget Sound Naval Shipyard in FY2027. Implementation requirements include procurement of 3D spatial technology software, user training and procedure revision and is expected to be funded by NAVSEA 04XT.



PERIOD OF PERFORMANCE:
February 2025 to January 2027

PLATFORMS:
CVN 78 Class Aircraft Carrier
COLUMBIA Class Submarine
VIRGINIA Class Submarine

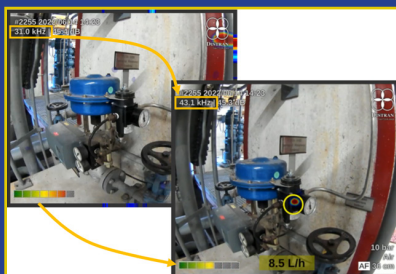
CENTER OF EXCELLENCE:
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STAKEHOLDER:
NAVSEA 04XT



Health Management Technologies to Reduce Maintenance / Repair Delays



PERIOD OF PERFORMANCE:
February 2025 to January 2027

PLATFORMS:
CVN 78 Class Aircraft Carrier
COLUMBIA Class Submarine
SEAWOLF Class Submarine

CENTER OF EXCELLENCE:
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STAKEHOLDERS:
NAVSEA 04XT
Puget Sound Naval Shipyard

RT3050 — Health Management Technology (HMT) Enabled POTs / PATs

Objective

Preparing the schedule and repair / maintenance bill of material for submarine and aircraft carrier availabilities is a challenging process, primarily because the required availability work is based on engineering estimates of equipment condition and not actually known machinery condition. Though the shipyards conduct Pre-Overhaul Tests (POTS) / Pre-Availability Tests (PATs) inspections before availabilities, the primarily visual-based inspections do not reveal all the machinery / equipment deterioration that needs to be fixed during the availability. The top factors that contribute most to maintenance period delays are unplanned work and workforce factors such as a limited quantity of skilled labor. One of the primary causes for the unplanned work delays is attributed to not knowing the equipment health condition of the carriers / submarines when they arrive in the shipyard for the maintenance / repair availabilities, thus impacting material and resource planning.

The objective of this Institute for Manufacturing and Sustainment Technologies (iMAST) Repair Technology project is to identify the submarine and aircraft carrier equipment applications where the most appropriate health management technologies (HMT) can be tested and demonstrated to detect equipment health issues during the POTS / PATs inspections to enable more accurate planning / scheduling of maintenance availability activities and reduce maintenance / repair delays. A critical aspect to this project is to train the shipyard POTS / PATs inspection teams to use advanced HMT on the critical submarine and aircraft carriers components / systems to accurately interpret their health condition to enable effective repair and maintenance scheduling.

Payoff

The main benefits of this project are in the areas of reduced labor and refurbishment scheduling through established quality levels of material after conducting a POTS / PATs for refurbishment planning. The HMT will directly diagnose and prognose existing quality status of materials and systems being evaluated much better than the current POTS / PATs manual processes. This tool could also provide for better planning for all future naval ship refurbishment work. An estimate of 2% savings per maintenance availability using HMT results in expected five-year savings of \$5.8M and a return on investment (ROI) of 4.6:1.

Implementation

Upon successful completion of this project, the POTS / PATs process conducted by Puget Sound Naval Shipyard personnel will provide actionable health assessment data to develop time efficient maintenance availability schedules and associated repair bill of materials for submarines and aircraft carriers that will reduce availability delays. Full implementation of the HMT in the POTS / PATs process is anticipated in FY2027.



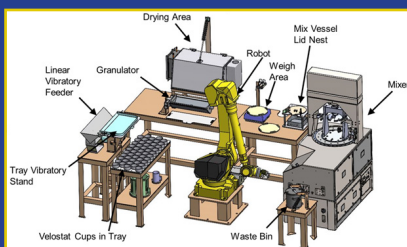
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Sailors and Boeing team members prepare to move a Boeing unmanned MQ-25 aircraft into the hangar bay aboard the aircraft carrier USS *George H.W. Bush* (CVN 77). U.S. Navy image.

Advanced Mixing Method for Infrared Countermeasures to Improve Safety and Reduce Costs



PERIOD OF PERFORMANCE:
May 2020 to December 2023

PLATFORM:
F-35 Lightning II Aircraft

CENTER OF EXCELLENCE:
Composites Manufacturing
Technology Center (CMTC)

POINT OF CONTACT:
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STAKEHOLDERS:
Hill AFB, USAF AECM Acquisition
Program Office
PMA-272J, USN AECM Acquisition
Program Office



J2777-A — Advanced Mixing Method for Infrared Countermeasures

Objective

The current method for mixing magnesium, Teflon™ and Viton™ (MTV)-based infrared countermeasure energetics relies on legacy mixing technologies, such as Mix Muller and Cowles systems. These methods, while effective, are labor-intensive, expose operators to hazardous conditions and lack automation capabilities. This Composites Manufacturing Technology Center (CMTC) project developed and validated a Resonant Acoustic Mixing (RAM) process for MTV ignition compositions. RAM technology demonstrated the capability for full automation, improved safety, reduced mixing times and enhanced mix quality. The project also included the development of a fully automated system for material handling, mixing and bowl clean-up procedures.

Payoff

Upon implementation, the RAM technology and automation is expected to deliver a number of benefits, including:

- **Improved Safety:** Automating will reduce personnel exposure to hazardous environments by nearly 90%, significantly reducing the risk of injuries and fatalities.
- **Cost Savings:** Reducing mixing times and labor requirements are projected to save as much as \$150K in costs at Chemring Countermeasures' Kilgore facility.
- **Enhanced Efficiency:** Reducing solvent usage by up to 80%, improves mix consistency and enables compatibility with downstream automated processes.
- **Scalability:** Increasing production capacity suitable for ignition compositions, with potential for broader application across MTV-based flares used by nearly every combat aircraft in the Department of War inventory.

Savings

- By reducing mixing times and labor requirements, Chemring Countermeasures estimates cost savings to be as much as \$150K per year.

Implementation

The mixing process and automation system developed under this project are anticipated to transition to small-scale production for ignition compositions in FY2026.

Enhanced Structural Efficiency for ORCA XLUUV Bulkheads and Control Surfaces

S2895 — ORCA XLUUV Bulkhead Fixed Control Surface Substructure Improvements

Objective

The ORCA XLUUV Bulkhead Fixed Control Surface Substructure Improvements project addressed manufacturing inefficiencies and long lead times associated with the production of large, monolithic metallic bulkheads and fixed control surface substructures. These components were critical to the structural integrity and performance of the ORCA XLUUV but posed challenges due to their size, material requirements and limited supply base.

This Center for Naval Metalworking (CNM) project developed alternative manufacturing approaches, including multipiece bolted metallic assemblies and thermoplastic hybrid bulkheads. The goal was to reduce lead times, improve manufacturing flexibility and lower costs while maintaining the structural integrity and performance requirements of the ORCA XLUUV.

Payoff

The ORCA XLUUV Bulkhead Fixed Control Surface Substructure Improvements project delivered significant benefits, including:

- **Lead Time Reduction:** Achieving a 33% reduction in bulkhead lead times by transitioning to multipiece assemblies and smaller raw material sizes.
- **Improved Manufacturing Flexibility:** Enabling the use of smaller, more readily available raw materials, reducing supply chain risks.
- **Innovative Advancements:** Paving the way for future use of thermoplastic hybrid bulkheads, offering additional weight and cost savings.

By implementing these improvements, the project enhanced the manufacturability of ORCA XLUUV bulkheads and control surfaces, reducing costs and accelerating production schedules.

Savings

- Return on Investment (ROI): 2.5:1

Implementation

Full implementation will be achieved with the improved bulkhead designs integrated into ORCA XLUUV production. This activity is planned for future orders beginning in FY2029.



PERIOD OF PERFORMANCE:
October 2022 to November 2024

PLATFORM:
ORCA Extra Large Unmanned Undersea Vehicle (XLUUV)

CENTER OF EXCELLENCE:
Center for Naval Metalworking (CNM)

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STAKEHOLDER:
PMS 406



Navy ManTech Increases MQ-25A Mission Capability



PERIOD OF PERFORMANCE:
June 2022 to December 2023

PLATFORM:
MQ-25A Unmanned Carrier-Based Aircraft

CENTER OF EXCELLENCE:
Composites Manufacturing Technology Center (CMTC)

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STAKEHOLDER:
Unmanned Carrier Aviation Program Office

A2896 — MQ-25A Lightweight Composite/Hybrid Nozzle

Objective

The MQ-25A unmanned flight vehicle enables extended combat range for deployed F/A-18 Super Hornet, EA-18G Growler and F-35C Lightning II fighters through its refueling capability, opening additional mission readiness opportunities for tactical aircraft. The current focus is on identifying and maturing manufacturing technologies and design concepts to reduce the MQ-25 airframe weight, enabling additional fuel available for offload to maximize this capability. One key structural component identified with significant weight-saving opportunities is the exhaust nozzle.

This Composites Manufacturing Technology Center (CMTC) project developed and validated a lightweight exhaust nozzle through investigation and analysis of alternate materials and designs, concluding with a full-scale demonstration. The full-scale demonstration focused on the most complex section to reduce risk for remaining design and implementation activity.

Key objectives included:

1. Developing a reliable and repeatable process to measure hole defects.
2. Enabling inspectors to collect 360° surface data for digital twin mapping and defect tracking.
3. Reducing inspection time per aircraft by up to 15%.

Payoff

The primary benefit of this project is airframe weight reduction, allowing for increased mission capability. Additional benefits include:

- Lead Time Reduction: Reducing procurement lead time, which was quantified during project execution.
- Enhanced Mission Capability: Increasing fuel offload capacity due to reduced airframe weight.

Savings

- Reduced cost over baseline nozzle by \$147K

Implementation

Implementation activities include detailed design of the remaining nozzle sections and testing. Design activity may occur in parallel with this Navy ManTech project to accelerate technology insertion. Key milestones include detailed design completion in FY2025 and production implementation with future production vehicles beginning in FY2029.



Composite Pressure Vessel Improvements for XLUUV to Reduce Weight and Cost

S2897 — XLUUV Pressure Vessel Improvements

Objective

The baseline Extra Large Unmanned Undersea Vehicle (XLUUV) configuration contains pressure vessels (PVs) distributed throughout the vehicle. These PVs account for a substantial portion of the vehicle's weight and cost. This Composites Manufacturing Technology Center (CMTc) project aims to develop composite PV designs and manufacturing processes to replace the existing metallic PVs, thereby reducing both weight and cost. The project will validate the technical feasibility of composite PVs through hydrostatic pressure testing and benefits analysis.

Payoff

The implementation of composite PVs is expected to deliver the following benefits:

- **Increased Vehicle Capacity:** Enabling additional available volume within the vehicle, enhancing payload capacity.
- **Cycle Time Benefits:** Improving manufacturing processes will reduce production time, further increasing affordability.

Savings

- Savings per Hull: \$1.9M

Implementation

The composite PV designs and manufacturing processes developed under this project will transition to production through an Engineering Change Request package. Implementation is expected to occur on future XLUUV hull orders to be determined by the Navy in future budget cycles.



PERIOD OF PERFORMANCE:
March 2025 to March 2027

PLATFORM:
ORCA Extra Large Unmanned Undersea Vehicle (XLUUV)

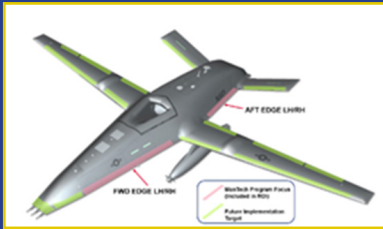
CENTER OF EXCELLENCE:
Composites Manufacturing Technology Center (CMTc)

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STAKEHOLDER:
PMS 406



Stronger, Lighter and Faster: Induction Welding for Composite Joining



PERIOD OF PERFORMANCE:
June 2022 to December 2023

PLATFORM:
MQ-25A Stingray Aircraft

CENTER OF EXCELLENCE:
Composites Manufacturing
Technology Center (CMTc)

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STAKEHOLDER:
Naval Air Warfare Center – Aircraft
Division

J2917 — Thermoplastic Composite Welded Assemblies

Objective

Structural composite assemblies require bonding or mechanical fastening to join individual components. Traditional methods, such as surface preparation for adhesive bonding or hole machining for fastener installation, are labor-intensive and costly. Thermoplastic composite components, due to their chemical nature, enable local re-melting and provide opportunities for “welding” as a means of joining. This Composites Manufacturing Technology Center (CMTc) project developed an induction welding process for thermoplastic composite assemblies, focusing on complex geometries such as aircraft fuselage chines and leading / trailing edges. The goals were to demonstrate the feasibility of induction welding for structural applications, reduce manufacturing costs and improve assembly efficiency.

Payoff

The implementation of induction welding technology offers the following benefits:

- **Cost Savings:** Reducing material handling, supply chain simplification and automation of assembly processes; additional savings are expected for other platforms.
- **Weight Reduction:** Eliminating fasteners reduces the weight of assemblies, contributing to improved aircraft performance and fuel efficiency.
- **Enhanced Manufacturing Efficiency:** Induction welding enabling faster assembly processes, reduces labor requirements and supports automation.
- **Scalability:** Applying to various thermoplastic composite structures, expanding its utility across multiple platforms.

Savings

Cost-savings for the MQ-25A Stingray are estimated at 30% reduction over the baseline cost for the forward and aft chine assemblies. Yields will increase up to 11% and reduce processing time by 10% for Navy acquisition programs.

Implementation

The induction welding process developed under this project is anticipated to transition to production for MQ-25A aircraft fuselage chines in future production buys in FY2028.



Revolutionizing Shipboard Power Distribution with Advanced IBP Manufacturing

S2951 — Insulated Bus Pipe (IBP) Manufacturing Improvements

Objective

The Insulated Bus Pipe (IBP) Manufacturing Improvements project is addressing inefficiencies in the legacy artisan manufacturing process for IBP, which involves manual hand-wrapping of insulating layers. This labor-intensive process results in high production costs, extended lead times and inconsistent quality.

This Center for Naval Metalworking (CNM) project is developing and demonstrating advanced manufacturing capabilities to improve IBP production. Key objectives include accelerating production time, improving yield, reducing costs and meeting future Navy requirements for shipboard power distribution systems. The effort is also exploring improved materials; automated manufacturing processes, including liquid silicone rubber injection; and enhanced quality assurance inspection methodologies.

Payoff

The IBP Manufacturing Improvements project will deliver significant benefits, including:

- **Cost Savings:** Reducing production costs through automation and improved materials.
- **Improved Quality:** Enhancing consistency and reliability of IBP products, reducing rework and inspection costs.
- **Accelerated Production:** Reducing lead times, enabling faster integration into shipbuilding schedules.
- **Scalability:** Establishing a foundation for future IBP production across Navy and commercial platforms.

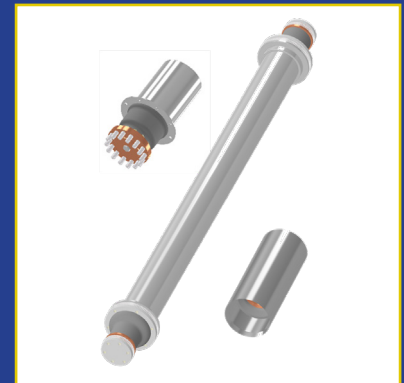
By transitioning from manual processes to advanced manufacturing methods, the project will improve efficiency, reduce costs and ensure the Navy's ability to meet future power distribution requirements.

Savings

- Savings per FFG 62 Hull: \$1.1M

Implementation

The project's improved process will be implemented at Stäubli's manufacturing facility, with prototype acceptance being conducted in the fourth quarter of FY2026. This project will deliver an IBP design and process that will be adopted by additional project efforts. These follow-on projects will be necessary for full implementation and deployment of IBP and its improved manufacturing process.



PERIOD OF PERFORMANCE:
April 2023 to September 2026

PLATFORM:
FFG 62 Class Frigate

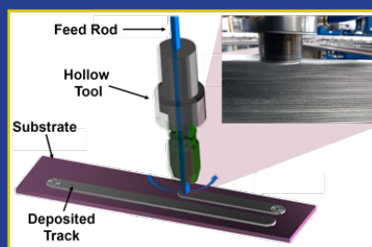
CENTER OF EXCELLENCE:
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STAKEHOLDER:
PMS 515



Advancing Mobile Fabrication and Repair with Friction Stir Welding Technology



PERIOD OF PERFORMANCE:
March 2024 to April 2027

PLATFORMS:
Various Army and Navy Platforms
and Army Infrastructure

CENTER OF EXCELLENCE:
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STAKEHOLDERS:
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Naval Surface Warfare Center
Carderock Division
DEVCOM Ground Vehicle Systems
Center
Engineer Research and Development
Center
Project Management for Mounted
Armored Vehicles (PM MAV)
Project Management for Next
Generation Combat Vehicles
Program Manager Sets, Kits, Outfits
and Tools (PM SKOT)



J2967 — Mobile Fabrication and Repair via Friction Stir Welding and Deposition

Objective

The Mobile Fabrication and Repair via Friction Stir Welding (FSW) and Deposition project is addressing the limitations of traditional welding and repair methods in shipyard environments. Current processes rely on fusion welding techniques that are labor-intensive, require extensive setup and are prone to defects when applied to highly sensitized aluminum alloys. These challenges result in increased costs, rework and schedule delays.

This Center for Naval Metalworking (CNM) project is developing portable solid-state additive / joining processes for in-theater repair for multiple Army and Navy platforms. Parallel paths will be followed for the development of: 1) a man-portable FSW system, and 2) a larger, containerized portable system with both additive friction stir deposition and FSW capabilities. These processes will provide new alternatives for sustainment and reduction of obsolescence issues for equipment and materials. Additionally, the project will create higher fidelity repairs of components for a variety of alloys and metals, wherein dissimilar joining / cladding can subsequently be achieved. This project will work to advance the current state and develop the required data for qualification of these two sustainment and repair capabilities.

Payoff

The project is expected to deliver significant benefits, including:

- **Improved Weld Quality:** Enhancing weld integrity and reduced defects, particularly for highly sensitized aluminum alloys.
- **Labor Savings:** Reducing labor hours required for setup and execution of welding and repair operations.
- **Enhanced Repair Capabilities:** Enabling additive repair of damaged components, reducing material waste and replacement costs.

By leveraging friction stir welding and deposition technologies, the project will improve efficiency, reduce costs and enhance the quality of shipyard fabrication and repair processes.

Implementation

The results will be leveraged for a full transition to PMS 443, Navy shipyards, Project Management for Mounted Armored Vehicles (PM MAV), Project Management for Next Generation Combat Vehicle (PM NGCV) and Program Manager Sets, Kits, Outfits and Tools (PM SKOT) for the development of a final prototype. Implementation is expected in FY2029.

Advanced Crashworthy Self-Sealing Fuel Bladder Enhances Aircraft Safety and Reduces Costs

A2971 — Advanced Crashworthy Self-Sealing Fuel Bladder

Objective

The Advanced Crashworthy Self-Sealing (ACWSS) Fuel Bladder project is developing new crashworthy, self-sealing fuel bladders using modern manufacturing methods. The focus is on material development of advanced composite construction to enhance low fuel permeability, structural toughness and self-sealing performance while reducing weight and susceptibility to damage during handling and installation. This Composites Manufacturing Technology Center (CMTC) project is also addressing manufacturing inefficiencies, such as high scrap rates and labor-intensive processes, by incorporating automated production techniques.

Payoff

The ACWSS Fuel Bladder project is expected to deliver the following benefits:

- **Improved Safety:** Enhancing crashworthiness and self-sealing capabilities will reduce the risk of fuel leakage and fire during aircraft incidents.
- **Cost Savings:** Reducing production costs, maintenance costs and fuel cell replacement costs.
- **Efficiency Gains:** Automating manufacturing will reduce scrap rates from 32% to an acceptable 11%, improve production output and reduce lead times.
- **Weight Reduction:** Improving aircraft performance and reducing fuel consumption with fuel bladders up to 40% lighter than current designs.
- **Ease of Installation:** Simplifying installation, reducing labor hours and minimizing damage during handling with lighter and more flexible bladders.

Savings

The total savings for V-22 Osprey in production and maintenance costs are anticipated to be \$22K per unit, which equates to \$87.0M in program savings.

Implementation

The ACWSS Fuel Bladder project is scheduled for implementation in FY2027 with full-scale production readiness and transition to fleet-wide implementation.



PERIOD OF PERFORMANCE:
July 2024 to January 2027

PLATFORM:
V-22 Osprey Aircraft

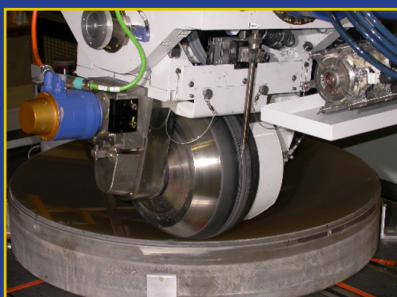
CENTER OF EXCELLENCE:
Composites Manufacturing
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STAKEHOLDER:
Naval Air Systems Command



Meeting Manufacturing Challenges for Large Integrated HEL Optics



PERIOD OF PERFORMANCE:
February 2023 to August 2025

PLATFORM:
DDG 51 Class Destroyer

CENTER OF EXCELLENCE:
Electro-Optics Center (EOC)

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STAKEHOLDER:
PEO IWS 11.0

S2989 — Manufacturing Integrated Large Optics

Objective

Laser weapon systems offer warfighters unique solutions to challenges. The large optics in the beam director assembly subsystem of the beam control system play an essential role in determining the combat mission performance of every high energy laser (HEL) weapon system. To date, the Navy has integrated prototype directed energy weapons and HEL into DDG 51 Class destroyers. Additional platforms will be considered as the technology evolves and fleet needs are established.

The integrated large optic of the beam director manufacturing presents several related manufacturing challenges. The optic itself requires special handling and precision tolerances to meet the demanding optical performance specification. This optic also must be integrated into a robust optical system to maintain performance across a wide variety of combat environments. Improper manufacturing integration of the optic into the optical system can significantly degrade the optical performance of the entire system. Achieving required high levels of integrated optic performance has proven to be a cost and schedule driver in beam director manufacturing. Furthermore, optimizing a single aspect of the manufacturing process may not yield the best result for the integrated optical performance, cost, or schedule. This Electro-Optics Center (EOC) project researched the manufacture of an integrated optic that meets performance and provided a flexible process to produce cost and schedule improvements over a range of laser weapon systems.

The Navy has made several successful investments to improve manufacture of the optical components, but future systems require manufacturing methods that scale to meet future requirements. This project complemented prior ManTech investments and built on these proven manufacturing advances, then addressed the manufacturing challenges of the large integrated optic by defining a process for the interface and build.

Payoff

This project is developing manufacturing aspects of the laser directed energy solutions concurrent with technology development, thereby compressing the delivery of the laser weapon systems to the warfighters. The project expects both manufacturing efficiency improvements up to 15% to drive an affordable cost and responsive delivery as well as technical innovations to meet more demanding performance requirements.

Implementation

The project transition point for this effort is a manufacturing package of an integrated optic produced with the novel manufacturing process. Project transition and implementation partners from Department of War (DOW) will participate in the demonstration event. The project final report captures manufacturing innovations and test results for the transition partners to employ on new projects. Program Offices that will benefit from this project include both Army and Navy.



Advancing Low-Cost Ceramic Matrix Composites for High-Temperature Navy Applications

T2990 — Low-Cost Ceramic Matrix Composite Materials and Processing Evaluation

Objective

The Navy requires materials capable of operating at elevated temperatures (300°C–1000°C) while meeting flame, smoke and toxicity (FST) requirements. Current material options include:

- Polymer Matrix Composites (PMC): Lightweight but unable to meet high-temperature requirements.
- Ceramic Matrix Composites (CMC): Excellent temperature resistance but expensive and complex to process.
- Metallics (Titanium / Inconel): High temperature resistance but heavy and costly.

This Composites Manufacturing Technology Center (CMTTC) project aims to identify, mature and demonstrate a low-cost composite material and associated processing methods that meet Navy requirements for high-temperature applications. The focus is on developing inorganic polymer-based composites derived from alumino-silicate geopolymers, which offer a lightweight and cost-effective alternative to traditional materials.

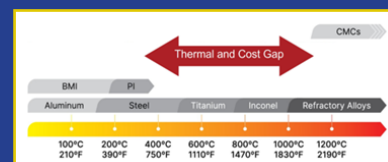
Payoff

The successful development of low-cost CMC materials and processes will deliver the following benefits:

- Cost Reduction: Lowering material and manufacturing costs compared to traditional CMCs and metallics.
- Weight Savings: Reducing platform weight, improving fuel efficiency and performance.
- Enhanced Capability: Materials capable of operating at temperatures up to 1000°C while meeting FST requirements.
- Scalability: Simplifying processing methods enable broader adoption across Navy systems, including hypersonic platforms, engine exhaust areas and heat-sensitive components.

Implementation

Materials are anticipated to be integrated into Navy platforms in FY2027.



PERIOD OF PERFORMANCE:
February 2024 to February 2026

PLATFORMS:
Conventional Prompt Strike
Navy Hypersonic Systems
Manned and Unmanned Rotary-
and Fixed-Wing Aircraft
Shipboard Heat-Sensitive Applications

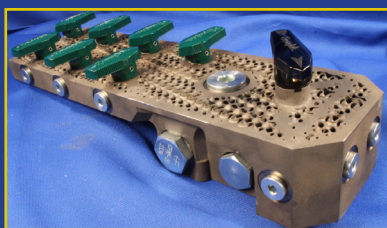
CENTER OF EXCELLENCE:
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STAKEHOLDERS:
Conventional Prompt Strike Program
Office
Naval Air Systems Command



Additive Manufacturing of Critical Component to Resolve Supply Chain Deficiencies



PERIOD OF PERFORMANCE:
November 2022 to June 2024

PLATFORM:
Submarine Rescue Diving and
Recompression System Pressurized
Rescue Module

CENTER OF EXCELLENCE:
Institute for Manufacturing and
Sustainment Technologies (iMAST)

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STAKEHOLDERS:
PMS 390
Naval Surface Warfare Command –
Carderock Division
Naval Undersea Warfare Command –
Keyport Division

S2996-2 — Additively Manufactured Submarine Rescue Vehicle Manifold

Objective

The U.S. Navy Submarine Rescue Diving and Recompression System (SRDRS) exists to perform rescue operations on submerged, disabled submarines. The SRDRS Pressurized Rescue Module (PRM) contains complex, application-specific components that are not readily available from established supply chains when replacement components are required. One example is the jettison-hatch control manifold, which enables control of several safety-critical functions. There are currently no spare manifold components and no readily available method of procuring additional components. Powder bed fusion (PBF) additive manufacturing (AM) has the potential to enable rapid production of this component by a qualified Navy-owned process and machine. The overall objective of this path-finder project was to exercise — for the first time — the entire AM development, qualification and deployment cycle for a safety-critical Scope of Certification (SOC) subsea component. This involved material substitution, redesign-for-AM, developing and coordinating process and part qualification and supporting transition to NUWC Keyport for production and PMS 390 for installation.

Institute for Manufacturing and Sustainment Technologies (iMAST), working closely with PMS 390, Portsmouth Naval Shipyard (PNSY), Naval Undersea Warfare Center-Keyport (NUWC KP) and Naval Surface Warfare Center-Carderock (NSWC CRD), supported PBF procedure qualification by coordinating and completing nondestructive and destructive testing and analysis of material properties, microstructure, mechanical properties and machining of test specimens and representative parts. iMAST and NUWC KP completed a series of part verification builds and follow-on post-process procedures and tests (including stress relief, heat treatment, electrical discharge machining, machining and hydrostatic testing) in support of qualification package 2 that will enable fully qualified production at NUWC KP.

Payoff

Inability to rapidly procure or fabricate these components can result in costly downtime or delays implementing on additional components and vehicles. This pathfinder project creates a qualified procedure and process to fabricate replacement parts for safety-criticality components, allowing the Navy to alleviate emergent replacement delays and costs and reduce lead times. Having a qualified procedure and system for material substitution and redesign for AM within the Navy will enable more rapid qualification for other SOC and safety-critical subsea components in the future.

Implementation

Full qualification and implementation is still in progress. In accordance with S9074-A2-GIB-010 / AM-PBF – Requirements for Metal Powder Bed Fusion Additive Manufacturing, both the Part Verification Procedure and Production Conformance Evaluation Plan were approved by the Tech Warrant Holder (TWH) in November FY2024 and the Procedure Qualification Test Report was approved in April FY2025. iMAST coordinated required destructive testing and conducted hydrostatic testing and corrosion testing on production parts in FY2026Q2. The Production Verification Test Report and the Production Conformance Test Report will then be submitted to the TWH to fulfill the final requirements for implementation in late FY2026.



Demonstrating High Operating Temperature Diodes for HEL Systems

S3000 — High Operating Temperature Pump Diodes

Objective

The primary objective of this Electro-Optics Center (EOC) project was to improve the manufacturing of high operating temperature (HOT) diodes and their packaging to enable a SWaP reduction in high energy laser (HEL) thermal management systems (TMS) without reducing amplifier beam quality or sacrificing system reliability / life expectancy. During the course of the project, diodes were characterized for their reliability and efficiency and compared against established benchmarks / metrics. By leveraging previous Department of War (DOW)-funded efforts and integrating their results, this project developed a scalable manufacturing process for HOT diode packages ready for future integration into full-scale systems.

Payoff

This project helped advanced the technical readiness level (TRL) and manufacturing readiness level (MRL) of HOT diodes for future incorporation into HEL systems. By leveraging previous Army ManTech and Joint Technology Office funding, rapid acceleration of the manufacturing capability and yield of HOT diodes will be realized for faster adoption by the fleet. While this project focused on advancing the TRL / MRL, utilization of these diodes will enable more widespread adoption of HEL systems on ground, air and sea platforms as the cooling requirements will be reduced. This benefit is especially important for installing HEL systems on legacy platforms since chilled water availability is often problematic.

For Navy sea platforms specifically, incorporation of a 50°C HOT diode allows a significant reduction in retrofit (pipe size changes) and TMS costs by utilizing readily available sea water through a heat exchanger as the cooling medium instead of conventional chilled water system. This saves power, weight and space on the platform, thus enabling the implementation of higher power systems.

Implementation

Demonstration at the end of the project was conducted on a prototype brass board amplifier. This demonstration showcased the ability of HOT diodes to meet the project's requirements for life expectancy, power and efficiency at elevated operating temperatures. Implementation of HOT diode packages is expected during future HEL system developments.



PERIOD OF PERFORMANCE:
June 2023 to December 2024

PLATFORMS:
High Energy Laser (HEL) Weapon Systems

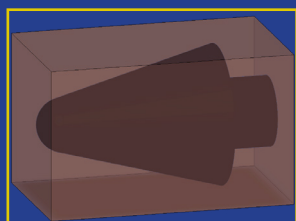
CENTER OF EXCELLENCE:
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STAKEHOLDER:
PEO IWS 2.0



Advancing High Yield Machining Techniques for Thermal Protection Systems



PERIOD OF PERFORMANCE:
May 2024 to May 2026

PLATFORM:
Conventional Prompt Strike

CENTER OF EXCELLENCE:
Composites Manufacturing
Technology Center (CMTC)

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STAKEHOLDERS:
Conventional Prompt Strike
Navy Strategic Systems Programs
Office

J3001 — High Yield Machining of Thermal Protection Systems

Objective

The High Yield Machining of Thermal Protection Systems (TPS) project focuses on developing advanced machining techniques to improve the manufacturability and cost-effectiveness of TPS components used in aerospace and defense applications. These components are critical for protecting high-performance systems from extreme thermal environments. This Composites Manufacturing Technology Center (CMTC) project aims to optimize machining processes, reduce material waste and enhance production efficiency while maintaining stringent quality standards.

Payoff

The implementation of high-yield machining techniques is expected to deliver the following benefits:

- **Cost Savings:** Reducing material waste is projected to reduce material cost by 30%.
- **Improved Efficiency:** Enhancing machining processes will reduce cycle times and increase throughput, enabling faster delivery of TPS components.
- **Quality Assurance:** Advancing machining methods will ensure consistent quality and precision, meeting the demanding requirements of aerospace and defense systems.
- **Scalability:** Optimizing processes are applicable to a wide range of TPS components, supporting both current and future platforms.

Savings

- **Total Program Savings:** \$20.8M
- **Life-of-Program Return on Investment (ROI):** 4.6:1

Implementation

The equipment developed under this project is anticipated to first be implemented in FY2027.



Enhancing Drop-Stitch Manufacturing and Inspection Processes to Improve Production Rates and Product Performance

C3017 — Drop-Stitch Manufacturing and Inspection Improvement

Objective

The Drop-Stitch Manufacturing and Inspection Improvement project is addressing critical challenges in the production of inflatable vessels used in military applications. Current manufacturing processes for drop-stitch panels are labor-intensive, prone to defects and result in high rework and scrap rates. This Composites Manufacturing Technology Center (CMTC) project focuses on developing a drop-stitch welder that will guide, position and apply heat and pressure to the materials to uniformly weld sidewall to the drop-stitch to increase production rates, reduce costs and improve product performance.

Payoff

Implementation of advanced manufacturing and inspection technologies is expected to deliver the following benefits:

- **Cost Reduction:** Fabrication costs for inflatable vessel bodies are projected to decrease by 45%, driven by reduced rework and scrap rates.
- **Defect Reduction:** Air-holding defects will be minimized by 25%, improving product reliability and reducing maintenance requirements.
- **Enhanced Durability:** Fatigue failures will be reduced by 25%, increasing the operational lifespan of inflatable vessels.
- **Improved Efficiency:** Automation will streamline production processes, reducing cycle times and labor requirements.

Savings

- Five-Year Savings: \$16.3M
- Five-Year Return on Investment (ROI): 3.1:1

Implementation

Following final technology and manufacturing facility inspections, the implementation of this equipment is expected to be in the third quarter of FY2027.



PERIOD OF PERFORMANCE:

November 2024 to November 2026

PLATFORMS:

Inflatable Vessels (IVs) for Expeditionary Advanced Base Operations (EABO)

CENTER OF EXCELLENCE:

Composites Manufacturing Technology Center (CMTC)

POINT OF CONTACT:

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STAKEHOLDER:

Marine Corps Systems Command



Low-Cost, Minimal-Use Tooling Supports NAVAIR Aviation Repair and Sustainment



PERIOD OF PERFORMANCE:
February 2024 to October 2024

PLATFORM:
CH-53K Helicopter

CENTER OF EXCELLENCE:
Institute for Manufacturing and
Sustainment Technologies (iMAST)

POINT OF CONTACT:
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STAKEHOLDERS:
Naval Air Systems Command –
Fleet Readiness Center East

RTR3029 — CFOAM Tooling for Aviation Composites

Objective

Naval Air Systems Command (NAVAIR) and other Department of War (DOW) organizations have a need to rapidly fabricate complex composite parts for repair of aircraft. Composite structures found in military aircraft consist of glass or carbon-fiber / epoxy-matrix or carbon / bismaleimide cured at 350°-450°. These elevated cure temperatures necessitate high-temperature molds or tooling, which also have a low coefficient of thermal expansion to closely match carbon fiber-reinforced parts and maintain dimensional accuracy. Typically, nickel-iron alloy (Invar™) or carbon composite tooling are used in these applications. However, Invar™ is expensive and heavy and carbon composite tooling is expensive and time-consuming to fabricate. Carbon foam, or CFOAM, is a relatively new tooling material derived from coal, which may offer advantages in schedule and cost saving compared to traditional Invar™ and composite tooling. CFOAM has not yet been adopted by NAVAIR, so fabrication procedures and best practices are not well understood. This project investigated the CFOAM material for tooling fabrication, developed the aforementioned procedures and documented best practices and presented a business case for broad adoption across the Fleet Readiness Center (FRC) community.

This Rapid Response, Navy Repair Technology (RepTech) project, led by the Institute for Manufacturing and Sustainment Technologies (iMAST), working with Fleet Readiness Center East (FRCE), conducted a study of carbon foam adhesives, surface sealants and application method and machinability of resultant tooling. iMAST delivered a Navy-owned process for temporary tooling fabrication that can withstand up to 10 thermal fabrication cycles.

Payoff

CFOAM is light-weight and reportedly easy to machine, bond and repair. Unlike Invar™, CFOAM requires no welding, forming or heat treatment. High-volume pricing on CFOAM is \$300/ft³, compared to \$4,000/ft³ for Invar™. Implementation of CFOAM tooling will help reduce repair backlog and repair costs for Navy aircraft.

Implementation

All findings, test results and procedures have been shared with FRCE, as the primary initial implementation organization, as well as the other NAVAIR FRCs. The new tooling material and process developed in this effort are viable to fabricate parts of simple-to-medium geometric complexity and low-to-medium tolerance requirements and are considered ready for implementation at FRCE. Further work is needed to refine the process to produce tight tolerance parts and to demonstrate with more complex and larger part geometries. FRCE implemented CFOAM tooling in the first quarter of FY2025 and additional implementation will follow. CFOAM is not seen as a universal solution for all tooling needs but as an additional option that will be used in select applications where it offers cost- and / or time-savings over existing metallic and composite tooling.



Standardizing Alignment of Multi-Aperture Electro-Optic and Infrared Systems

S3044 — Manufacturing for Low-Cost Sensor and LRF Alignment

Objective

Multi-aperture Electro-Optic Infrared (EOIR) systems are prevalent in many Navy applications, for example in fire control, intelligence, reconnaissance and intelligence (ISR) and directed energy (DE). Despite serving different Navy needs, the alignment requirements for multi-aperture systems have significant overlap. Each separate aperture must be co-aligned to a common field-of-view, often to tight tolerances driven by mission requirements. Both hardware failure and operation in extreme environments can compromise alignment retention, triggering costly hardware repair or replacement.

This Electro-Optics Center (EOC) project is developing a portable alignment tool and requisite practices for the efficient alignment of multi-aperture sensor assemblies, including the Shipboard Panoramic Electro-Optical Infrared (SPEIR) system. The hardware demonstrator designed and fabricated for this project will be capable of assuming primary or secondary, independent alignment responsibilities that result in high-accuracy boresight alignment without specialized technician skillsets. Commonality of alignment hardware and processes across multiple Navy applications and systems will result in increased efficiency when alignment is required during installation or as a result of hardware failure or environmental extremes.

Payoff

This project is developing common hardware and technician skillsets for efficient, high-accuracy boresight alignment of multi-aperture systems utilized by fire control, ISR and DE applications. The project expects both technical innovations to enable additional missions with more demanding performance requirements and to promote cost savings through efficiency improvements to system alignment procedures during installation and on-site work as well as reduced need for specialized hardware and technician skill sets.

Implementation

The project transition point for this effort is an alignment demonstration on a surrogate, multi-aperture platform using the portable boresight tool designed and fabricated for this effort. Project transition and implementation partners from Department of War (DOW) and industry will participate in the demonstration event. The project final report captures manufacturing innovations and test results for the transition partners to employ on new projects. Program Offices that will benefit from this project include both Army and Navy.



PERIOD OF PERFORMANCE:
March 2025 to August 2026

PLATFORM:
DDG 51 Class Destroyer

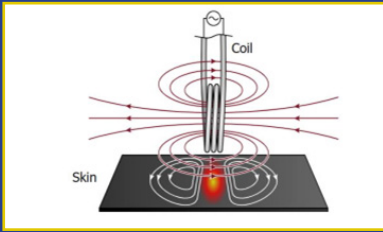
CENTER OF EXCELLENCE:
Electro-Optics Center (EOC)

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STAKEHOLDER:
PEO IWS 2.0



Advancing Repair Technology for Thermoplastic Components to Enhance Navy System Sustainment



PERIOD OF PERFORMANCE:
July 2025 to July 2027

PLATFORMS:
Naval aircraft platforms utilizing thermoplastic composite components
Future Navy systems incorporating thermoplastic materials

CENTER OF EXCELLENCE:
Composites Manufacturing Technology Center (CMTc)

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STAKEHOLDER:
Naval Air Warfare Center – Aircraft Division

T3045 — Repair Technology Development for Thermoplastic Components

Objective

The increasing use of thermoplastic composites in Navy systems offers significant performance and cost advantages over traditional thermoset composites. However, repair technologies for thermoplastic components are not yet mature, limiting their adoption in critical applications. This Composites Manufacturing Technology Center (CMTc) project aims to develop and demonstrate advanced repair technologies for thermoplastic composite components, focusing on induction welding techniques. The goal is to establish a reliable, repeatable and scalable repair process that meets Navy performance requirements while reducing sustainment costs.

Payoff

The successful development of repair technologies for thermoplastic components will provide the following benefits:

- **Enhanced Sustainment:** Enabling in-field and depot-level repairs of thermoplastic components, reducing downtime and improving system availability.
- **Cost Savings:** Reducing the need for full component replacement, leading to significant life-cycle cost savings.
- **Improved Performance:** Ensuring repaired components meet or exceed baseline mechanical properties, maintaining system integrity and performance.
- **Broader Adoption:** Facilitating the wider use of thermoplastic composites in Navy systems by addressing repairability concerns.

Implementation

This project is a 6.2 project with no current implementation planned. Upon successful demonstration, it is anticipated that a 6.3 ManTech project will be developed that has an implementation plan.



Machine Data Visibility to Enable Predictive Maintenance and Efficient Machine Usage

RTR3057 — Machine Data Visibility and Analysis

Objective

Marine Depot Maintenance Command (MDMC) is installing its operational technology (OT) network infrastructure to enable a data path to monitor machinery and production. MDMC needs assistance in defining and delivering a production system integrated into an OT network that shows the value of visibility into machine and production data. At the production facility, approximately 40 automated assets are used in daily production activities that are standalone and have no visibility into machine health, performance or maintenance issues, unless standing in front of the equipment. There is also an issue with aging equipment that is functional, but the current control systems are obsolete and no longer supported by the original equipment manufacturer. Lack of machine data and ability to support the equipment are leading to emergency, reactive maintenance and inability to even purchase replacement parts in some cases. The Institute for Manufacturing and Sustainment Technologies (iMAST) is performing a Rapid Response Repair Technology (RepTech) project that will create visibility on a local OT network for four high-value assets on a modern control system and implement live and historical data analysis to assist with maintenance and production planning.

The objective of this project is to upgrade production critical assets to show how machine visibility and data analysis lead to reductions in maintenance and downtime and improves efficiency. This project will also act as a model and framework to upgrade and improve additional assets across the production floor to enable future OT network improvements and access to machine data.

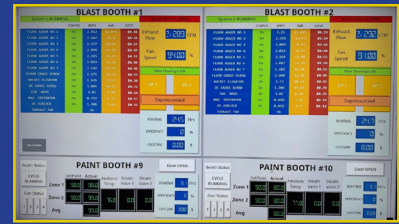
Payoff

The systems being upgraded to enable data visibility are the blast and paint booths that are critical to Albany MDMC production. A past project at Marine Corps Logistics Command identified the following benefits of enabling condition-based maintenance plus (CBM+) and production monitoring on similar critical equipment:

- Reducing maintenance costs by 25-30%.
- Reducing breakdowns by 70-75%.
- Reducing unplanned downtime by 35-45%.
- Increasing production efficiency by 20-25%.
- Transitioning condition- and predictive-based maintenance.

Implementation

This project will build a model and framework to implement an OT network and data visibility solutions to other systems that are identified as being candidates for upgrades due to obsolescence and / or return on investment. Furthermore, this solution can be part of a broader scale OT solution for future improvements. Implementation uses all commercial-off-the-shelf software and hardware, will be installed using known industry standards that will be fully supported into the future and is expected in the first quarter of FY2026.



PERIOD OF PERFORMANCE:
February 2025 to October 2025

PLATFORMS:
USMC Ground Vehicles

CENTER OF EXCELLENCE:
Institute for Manufacturing and Sustainment Technologies (iMAST)

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STAKEHOLDERS:
USMC Logistics Command
Marine Depot Maintenance Command



Demonstrating Feedback Loop for Smart Coating Removal



PERIOD OF PERFORMANCE:
October 2025 to June 2028

PLATFORMS:
F-35 Lightning II Aircraft
DDG 51 Class Destroyer

CENTER OF EXCELLENCE:
Electronics Manufacturing Center
(EMC)

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STAKEHOLDERS:
F-35 Lightning II Joint Program Office
PMS 400D



S3071 — Real-Time Terahertz Feedback for Smart Coating Removal

Objective

This Electronics Manufacturing Center (EMC) project will result in demonstration of an integrated, in-situ, line-scanning Terahertz (THz) coating thickness measurement system that can be integrated into future robotics procurements in systems requiring precise, on-demand feedback control based on thickness. This project will develop and validate the applicability of integrating the THz control system into robotic applications with a need for precise and on-demand coating thickness measurement during processing (e.g., laser stripping, sanding and painting). The project team will integrate laser processing / stripping systems by leveraging a previous Small Business Innovation Research (SBIR) program effort in which a THz system, complete with software, was demonstrated to showcase feasibility. While the one-off prototype system showcased feasibility, improvements are needed in both hardware and software for system manufacturability. A streamlined, agnostic control system is required for low-cost integration. This project aims to improve the TRL / MRL of the entire system such that it will be commercially available from the subcontractor(s) that will be active participants in this project.

Payoff

By achieving the project objectives, this project will reduce costs of both hardware / software systems by taking them from prototype, one-off, systems that require custom development and integration to a commercial-off-the-shelf product that can be readily acquired. This will, in-turn, allow for decreased implementation costs as redundant tasking / research will be eliminated. In order to capture this projected savings and illustrate the massive benefit of this project, a notional return on investment (ROI) has been developed to showcase the potential benefits of this effort. Estimated savings are \$2.5M per aircraft / hull. However, this includes implementation within just a few specific use cases / systems related to laser ablation, with further expected returns for inclusion in other systems like robotic sanding and painting.

Implementation

As a capability acceleration project, the team intends to develop a path that allows system integrators to readily implement scanning THz technology into future systems used for laser ablation and other processes that require coating thickness interrogation. As part of this project, EMC will develop a technology transfer and implementation plan that will reduce costs of future integrations, including both the hardware / software and knowledge required to integrate. EMC will coordinate the technology transfer activities and will include, at a minimum, an end of project demonstration for interested personnel and appropriate mechanisms for future distribution of resulting production improvements to government and industry organizations.

Advanced Coating System Development to Improve Corrosion Resistance of Underwater Connectors

Z3081 — Ultra Short Pulse Laser (USPL) Connector Backshell Surface Treatment

Objective

Underwater cables are plagued by corrosion, as improper coatings cause corrosion that leads to premature failure. While effort has been made to better protect these connectors through the development of alternative coating systems, these efforts have failed to deliver a consistent corrosion-resistant product due to unexpected porosity, incorrect coating application and overall lower quality assurance than anticipated. Recent efforts to use USPL surface treatments on these back shells has shown the ability to significantly improve their corrosion resistance while reducing or eliminating a complex stack up that is prone to different failure modes. As testing has indicated, significant reductions in corrosion and cathodic disbandment are substantial benefits that will be made possible by the use of USPL processing during cable manufacturing.

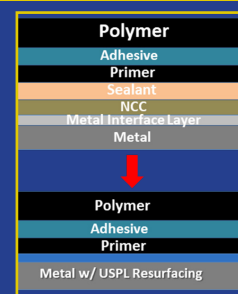
While the USPL process has been defined by the Office of the Secretary of War (OSW) effort, commercial vendors will eventually be required to use this treatment in compliance with technical specifications. The objective of this Electronics Manufacturing Center (EMC) project is to better define processing methods and outline system requirements. The team will work with appropriate technical warrant holders (TWH) and the Cable Working Group (CWG) to ensure continued buy in, and vet potential future industrial partners who could utilize this coating system, should it be made a requirement for future back shell procurement. While significant interest and buy-in has already been obtained, the project team continues to vet and answer potential concerns while developing a phased pathway to introduce USPLs as a required process during cable manufacturing. Industry will then phase out old coating systems / material stacks to secure improved performance.

Payoff

Implementation of USPL treatments on connector backshells has shown significant improvement over current practices that would extend system life, reduce unexpected failure and decrease unscheduled maintenance to underwater systems. Therefore, the return on investment (ROI) for this effort will be significant for both cost savings and cost avoidance, in addition to improved availability and reduced maintenance. While this project does not point to a specific ROI impact, significant work has been done to understand the cost benefit of using USPL treatment, as was noted in the business case analysis performed in FY2023.

Implementation

As a capability acceleration project, the team intends to develop a path toward transition through this project, by working with appropriate parties to gain continued buy-in for insertion into the required technical publications. It is a goal of this project to work closely with TWHs, CWG representatives and other key staff to answer any lingering questions, complete required testing and develop a robust network of potential commercial vendors that can be solicited for future procurements and will be made available for design of other forms of transducers, benefiting wider fleet applications in the future.



PERIOD OF PERFORMANCE:
August 2025 to October 2025

PLATFORMS:
COLUMBIA Class Submarine (CLB)
DDG 51 Class Destroyer
VIRGINIA Class Submarine (VCS)

CENTER OF EXCELLENCE:
Electronics Manufacturing Center (EMC)

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STAKEHOLDERS:
Submarine Maintenance Engineering,
Planning and Procurement
PMS 401



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