Advanced Metalworking Solutions For Naval Systems That Go In Harm's Way

2013 Annual Report

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The Navy Metalworking Center (NMC) was established in 1988 as one of the Centers of Excellence of the Office of Naval Research's Manufacturing Technology (ManTech) program.

NMC supports the Navy's need to reduce acquisition and total ownership costs by developing and transitioning innovative metalworking and manufacturing solutions. Working with its government and industry partners, NMC drives technologies from research and development to application on Navy and other military weapon systems.

NMC is operated by Concurrent Technologies Corporation, an independent, nonprofit, applied scientific research and development professional services organization located in Johnstown, Pennsylvania. For more information on NMC, visit www.nmc.ctc.com.

John U. Carney
Director, Manufacturing Technology Program
Office of Naval Research

Federal budget issues demand that the Navy Manufacturing Technology (ManTech) Program make every dollar count. That means developing creative technology solutions and ensuring that those improvements are implemented, because our work helps the Navy meet its affordability goals.

As you'll read in this annual report, the Navy Metalworking Center (NMC) is focused on providing innovative yet practical solutions for the weapon systems in the ManTech investment strategy: the Virginia Class Submarine and Ohio Replacement Program, Littoral Combat Ship, DDG 51 Class destroyer, CVN 78 Class carrier, and Joint Strike Fighter.

NMC has been very effective in promoting implementation of advanced technology by fostering strong relationships with shipyards, Program Offices and other relevant partners. In the case of NMC's Plate Edge Preparation Improvements project, Bath Iron Works has implemented both plate edge and surface preparation tools in DDG 51 and DDG 1000 construction. The tools are expected to increase production rates and save a potential $2 million to $4 million per hull on future surface combatants. The technology could also reduce shipyard injury claims across a multi-ship construction effort. This project is an excellent example of how NMC engages project partners throughout the process, ensuring that the technology sees real-world use.

Congratulations to NMC on all of the achievements that highlight the center's first 25 years. I'm confident that Dan Winterscheidt and his team will continue to advance metalworking and manufacturing solutions to reduce total ownership cost and implement results to benefit the warfighter.

John Carney

Daniel L. Winterscheidt, Ph.D.
Senior Program Director, Navy Metalworking Center

Our efforts to advance metalworking and manufacturing technology for Navy weapon systems have us constantly looking toward the future. This year, however, offered us a special opportunity to reflect on the past as well. Throughout 2013, we celebrated 25 years of operating an Office of Naval Research ManTech center of excellence.

Of course, much has changed since 1988, when the National Center of Excellence in Metalworking Technology (now known as the Navy Metalworking Center) was established. Several constants have also come to light: advancing and transitioning technology, remaining adaptable to address the Navy's evolving needs, and building strong partnerships are at the top of the list.

Those principles are evident throughout a quarter century of projects, including early research and development of technologies such as semi-solid metalworking; powder metallurgy; and process modeling and simulation. More recent projects have focused on friction stir welding, hybrid laser-arc welded metallic sandwich panels, and improved shipyard tools and processes, just to name a few.

Where do we go from here? Franklin D. Roosevelt said, "The only limit to our realization of tomorrow will be our doubts of today. Let us move forward with strong and active faith." At the Navy Metalworking Center we will continue to meet any current challenges and forge ahead, building on our many years of experience.

I extend my heartfelt appreciation to everyone who played a role in allowing us to enjoy a fruitful past, to successfully negotiate the present, and to realize an even more positive future.

Daniel L. Winterscheidt

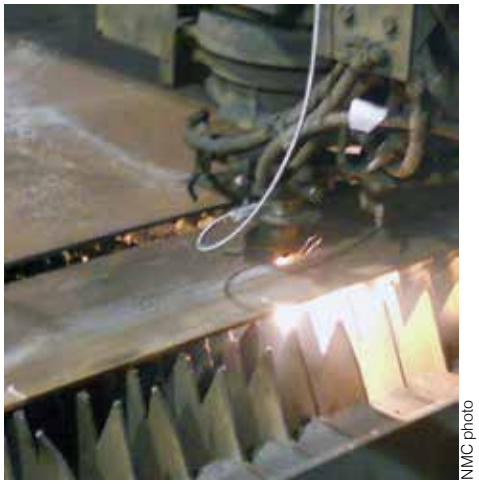
Lockheed Martin photo

Advanced Metalworking

Secretary of the Navy Ray Mabus, speaking at Marinette Marine Corporation in September 2013, said, "The cost of the 10th LCS (Littoral Combat Ship) out of here is going to be about half of the first, and what that means is that you are doing your job really well." He went on to say that he's going to do everything he can to protect Navy shipbuilding and make sure we get the ships the Navy needs.

His words underscore the vital work being done by the Navy ManTech Program to improve the affordability of naval platforms critical to the future force. This report outlines the current efforts of the Navy Metalworking Center (NMC), a Navy Manufacturing Technology Center of Excellence, which is singularly focused on transitioning project results that reduce costs for Navy weapon systems within its areas of expertise.

The Navy Metalworking Center has optimized a wide variety of manufacturing technologies throughout its 25-year history, including powder metallurgy processing, semi-solid metalworking, metalworking process modeling, and much more. The center's current work is categorized in this report into advanced metalworking; coatings application and removal; shipyard processes; design for manufacturability; and advanced metrology and inspection technologies. The advanced metalworking projects address challenges with manufacturing processes such as joining, surface treatment, techniques to reduce distortion, and others.


NMC photo

Ingalls Using Thin Plate Guidelines to Reduce Distortion and Improve Part Accuracy in DDG 51 Construction

Ingalls Shipbuilding (Ingalls) is expected to save $5.2 million over five years from improvements in thin plate manufacturing that an NMC project team developed. Thin plates (<3/8 inch) make up almost half of the DDG 51 Class hull panels and will be used heavily in future ship classes. Those thin plates, while lighter, are subject to excessive distortion during handling, storage, plasma cutting and welding. The project team included the DDG 51 Program Office; Ingalls; ArcelorMittal Burns Harbor; ESAB Cutting Systems; the University of New Orleans; and the Naval Surface Warfare Center, Carderock Division (NSWCCD). Team members evaluated the distortion present in thin plate at Ingalls; identified alternative commercial plate manufacturing processes and sources that possess better flatness; identified factors affecting cut part accuracy; and developed rules and guidelines for improved cut part accuracy, reduced cut part distortion, increased productivity, and reduced costs. Ingalls incorporated the plate specification and plasma cutting guidelines into its DDG 51 construction programs in the third quarter of FY13 in support of DDG 114.


NMC photo

Reducing Distortion in DDG 51 Class Thin Plates Will Avoid Significant Rework

A related NMC project is expected to save Ingalls an additional $2.6 million over five years by mitigating the significant distortion associated with the welding of inserts into thin panel plates in DDG 51 Class production. Both the shape of the cut-out opening for the insert and the shape of the insert deviate from drawing specifications due to plate movements from residual stress and thermal cutting distortion. The resulting mismatch between the plate opening and insert results in insert weld joints with poor fit-up and excessive weld root gaps. These oversized weld root openings require large welds and excessive heat input, which can cause significant weld distortion. The project team is developing a controlled method to measure inserts and trim panel openings to fit together with a precise weld root gap. In addition, the team is developing techniques and tooling to minimize distortion during the welding process. Improved trimming and welding methods are undergoing prototype testing and evaluation Implementation of the project results will reduce fit-up time and enhance quality, avoid costs associated with mitigating panel distortion, and enhance panel line capability for DDG 51 Class thin panels. The results of the project will be integrated into DDG 117 panel lines at Ingalls in the first quarter of FY14. The project team includes the DDG 51 Program Office, NWSCCD, Ingalls, the University of New Orleans, and NMC.


NMC photo

Improved Material Properties for CVN Aircraft Elevators to Save Costs

In an effort to address life-cycle cost issues, an NMC Rapid Response project team compared several treatment methods to mitigate cracking that had been found in support structures made of a thick aluminum alloy on several CVN aircraft elevators. The project results will lead to the issuance of repair instructions by Naval Sea Systems Command (NAVSEA) 05P, NAVSEA 05V3 and PEO Carriers for treatment of affected in-service and new construction CVN aircraft elevator structural members. Initial implementation is expected in the first quarter of FY14 on CVN 76. Effective methods to improve the material's resistance to cracking propagation in the elevator support structures will save an estimated $15 million in repair costs for CVN 74, 76 and 77 throughout their service lives. Future repairs for CVN 78 and CVN 79 are also likely. The project team consisted of PEO Carriers (PMS 312 and 378), NSWCCD Code 612, NSWCCD Code 611, Newport News Shipbuilding (NNS), NAVSEA 05P, NAVSEA 05V3, and NMC.

Silver Anniversary Look Back 1991

The Navy Metalworking Center (formerly named the National Center of Excellence for Metalworking Technology or NCEMT) evaluated and analyzed the use of tungsten heavy alloys to replace depleted uranium penetrators in the Phalanx Close-In Weapons Systems. The U.S. Navy implemented the Phalanx penetrator made from the NCEMT's recommended alloy, which has a 50 percent improved ballistic performance compared to the existing penetrators and more than 100 percent improvement in remnant mass retention over depleted uranium.

A timeline of milestones in NMC's 25-year history is on www.nmc.ctc.com.

NMC photo

Solutions to Mitigate Wear on VCS Main Propulsion Shafts to Save Costs

The Navy is conducting a series of coordinated efforts to increase the service life of the main propulsion shafts on the Virginia Class Submarine (VCS) and the Ohio Replacement Program. Part of this overall effort is an NMC project that is investigating options to resolve the abnormal bearing journal wear observed on in-service VCS main propulsion shafts. NMC has designed and fabricated a shaft and bearing test stand to evaluate alternative journal and bearing insert material options for the Navy and is assessing the wear and grooving resistance of various journal and bearing material combinations. An estimated $4 million cost savings can be realized through both the increase in shaft change-out periodicity (from 72 to 96 months) and the need for fewer spare shafts. An Integrated Project Team (IPT) consisting of the VCS Program Office, NSWCCD, NAVSEA, iMAST, and General Dynamics Electric Boat (EB), is taking part in this effort.

NMC photo

Fabrication Process Assessment to Address Noticeable Wear on VCS Propulsion Shafts

Another project in this overall Navy effort investigated the cause of noticeable wear in the VCS main propulsion shafts, which are clad with INCONEL® Alloy 625 (Alloy 625) using an electroslag weld strip surfacing cladding process. The objective of this test program was to investigate the effects of variables in the shot-peening process on VCS propulsor shaft journals and to determine if there was any correlation to the grooving patterns observed on the in-service VCS propulsion shafts. The results of this work show that, regardless of the overlap-scheme for the shot peening nozzle, a uniform distribution of shot-peen indentations was achieved at all peening intensities. While this project was unable to conclusively show that the shot peening process is a driving factor in the grooving observed on in-service VCS shafts, several recommendations were provided to more properly evaluate the effects of the shot peening process on the hardening behavior of clad Alloy 625. Project team members included the VCS Program Office, NWSCCD, and Booz Allen Hamilton.

United Engineering photo

New Machining Technologies for VCS Propulsor Components Will Improve Production Rate and Cost

While manufacturing VCS propulsor components from the highly corrosion-resistant Alloy 625 will help reduce total ownership cost, the nickel-based alloy is difficult to machine. To mitigate the anticipated cost and schedule impact of fabricating these components, NMC is leading a project that is investigating new machining technologies. The project team, which includes the VCS Program Office, NSWCCD, National Center for Defense Manufacturing and Machining, BAE Systems Louisville, and NMC, is working to optimize the existing machining capability, as well as to investigate alternative processes. Estimates for machining Alloy 625 are roughly three times the cost and duration of HY steel. This project will reduce both the cost and the time required for machining in order to meet program requirements. A large-scale demonstration at the BAE production center in Louisville, Kentucky, is planned in the fourth quarter of FY14.

NMC photo

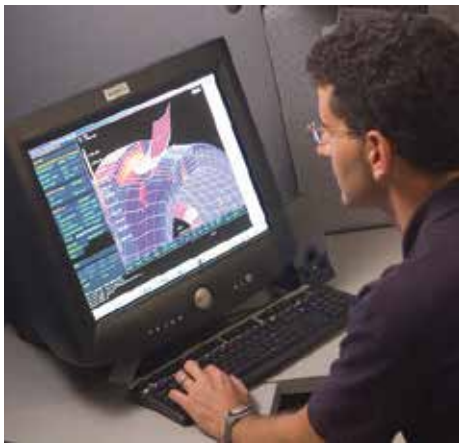
Improved Abrasives Reduce VCS Construction Labor Costs

The VCS program will also realize cost benefits when EB uses improved bonded abrasives in the construction of VCS, starting with SSN 785 by the fourth quarter of FY14. While abrasive technologies have improved greatly in many industries, those advancements have not transferred to nuclear shipbuilding because of stringent regulations. An NMC-led project team, consisting of the Virginia Class Program Office, NSWCCD, EB, and NMC, established requirements, identified candidate abrasives, performed technical evaluations, and conducted production evaluations of the selected abrasives. Segregation of abrasive products for general construction and certain nuclear components will allow EB to implement 3M™ Cubitron™ II bonded abrasives, resulting in a 62 percent increase in material removal rate and a four-fold increase in expected abrasive life over the legacy abrasive. These improvements are estimated to save $7.5 million over five years for VCS; additional benefits may be realized for overhaul activities.

Silver Anniversary Look Back 1996

In the early 1990s, NCEMT developed computer models to define the relationship between weldment properties and service loading conditions. NCEMT's developments in optimized welding technologies led the NAVSEA technical community to certify the use of undermatched weldments for the HY-100 pressure hull of the Virginia Class Submarine (VCS). In 1997, undermatched welding was certified for the Seawolf and VCS pressure hulls. Implementation of this technology provided superior weld performance and saved an estimated $7 million per VCS.

A timeline of milestones in NMC's 25-year history is on www.nmc.ctc.com.



U.S. Navy photo

Coatings Application and Removal

In addition to the metals themselves, how materials are coated is a critical factor, especially considering the harsh sea environment in which they operate. NMC is developing processes for both coatings application and removal that will improve life-cycle costs on several ship systems.

Kestrel Partners Inc. photo

Additively Applied Isolation Coatings for Navy Fasteners to Improve Galvanic Corrosion Protection

Another project team is leveraging a commercially available method to protect dissimilar metals from galvanic corrosion in Navy shipbuilding. This NMC Rapid Response project will validate the use of a durable isolation material applied directly to Navy specified fastener alloys during procurement, as opposed to the current isolation sleeves, which are prone to damage during assembly. If successful, the results of this project will address galvanic corrosion issues in flange assemblies on the LPD 17 titanium seawater piping system and potentially benefit other similar applications. The use of additively applied isolation material is expected to save at least 30 percent of the LPD 17 titanium piping system repair costs, which are currently estimated to be no less than $1.2 million over the next five years and grow to $4.1 million over the subsequent five years. The project team, consisting of NAVSEA 05P2, NSWCCD, PMS 470, and NMC, will develop the manufacturing process for producing representative fasteners and evaluate their performance in various laboratory and shipboard tests. Pending acceptable performance, the results will be compiled and provided to NAVSEA 05P2 to develop the Materials Selection Information (MSI) documentation and procurement specifications. Implementation will occur within the LPD maintenance cycle, initially in the second quarter of FY15 at Sasebo, Japan.

NMC photo

Durability Coating Improves Life of GTC Tile

Another NMC project team is developing a better way to protect the Gradual Transition Coating SONAR baffle tiles on Seawolf and Virginia Class Submarines. During recent Extended Drydocking Selected Restricted Availabilities (EDSRA), several of the tiles required replacement due to cracks and delamination. The project team is evaluating several materials and installation process parameters to select a durability coating that can be applied to the tile to improve service life. This involves working with industry to determine which materials can meet the harsh service environment requirements and conducting testing to verify performance. The anticipated cost benefits for in-service VCS and Seawolf hulls, along with new construction VCS, will total $13.4 million. Implementation will occur on in-service hulls during EDSRA at the appropriate Naval Shipyard & Intermediate Maintenance Facility (IMF); the first application is expected on SSN 777 in the fourth quarter of FY15. Implementation on new construction of VCS will also occur in mid-2015. NSWCCD; the VCS Program Office; the Strategic and Attack Submarines Program Office; Globe Composite Solutions; Pearl Harbor Naval Shipyard and Intermediate Maintenance Facility; and NMC are contributing to this effort.

International Climbing Machines photo

Remotely Operated Machine to Save Costs in Ship Maintenance

Performing surface maintenance on submarine and aircraft carrier bilges and tanks is often done in hazardous environments, possibly exposing workers to multiple safety hazards. In addition to challenges posed by potentially toxic atmospheres, some of the surfaces are physically inaccessible to the average shipyard worker. In order to reach these locations, shipyards must remove a significant amount of piping or equipment, causing additional work and cost. In a project funded by the NAVSEA Paint Center of Excellence, NMC is working with Norfolk Naval Shipyard (NNSY), International Climbing Machines, NAVSEA 04, NAVSEA 05, and the other naval shipyards on a solution that will reduce costs and improve worker safety. The project is modifying an existing, remotely operated crawler to perform a wide variety of inspection, de-coating, and preservation tasks in hazardous or inaccessible shipboard areas. Use of a remotely operated crawler can reduce labor and personnel exposure by 80 percent and can eliminate the labor needed to remove interference to allow human access to the surfaces to be maintained. Total five-year cost savings from the use of this system on two Moored Training Ships maintained by NNSY is expected to be $2.67 million. The modified crawler will be implemented at NNSY in third quarter of FY14.

Silver Anniversary Look Back 2003

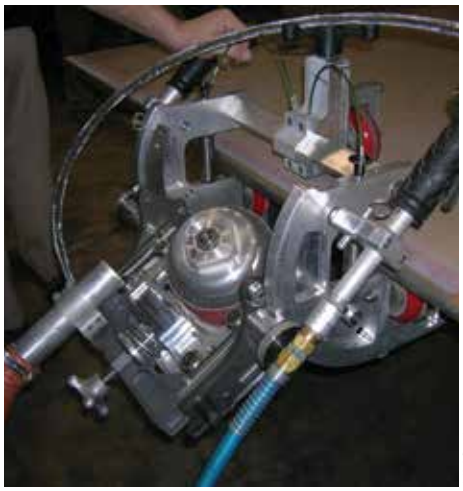
NCEMT received a letter of commendation from the DoD ManTech Program for improving the manufacturing process and reducing the high cost of thermal batteries used to power sonobuoys, guided artillery, missiles, guidance systems, and countermeasure devices. The new process has saved $30 million over five years for the sonobuoys program alone; and 7,400 more batteries can be produced per month.

A timeline of milestones in NMC's 25-year history is on www.nmc.ctc.com.

U.S. Navy photo courtesy of General Dynamics

Shipyard Processes

NMC has developed several mechanized process solutions that save labor costs for the shipyards and provide ergonomic and environmental benefits to the workforce.



NMC photo

Mechanized Plate Surface Preparation Tools Will Save Shipbuilding Costs

General Dynamics Bath Iron Works (BIW) has implemented two new, mechanized tools to replace manual grinding of large plates for weld preparation. Developed by an NMC-led project team, the tools demonstrated that they can significantly increase production rates and save between $2 million and $4 million on the cost of future surface combatants. The project team, consisting of the DDG 1000 Program Office, NSWCCD, BIW, Ingalls and NMC, developed several prototype concepts for mechanized abrasive tools to remove light surface rust and primer from the edges and surfaces of large plates. BIW implemented the prototype edge preparation tool in the fourth quarter of FY12 to process at least 2,000 linear feet of plate edges on DDG 51 and DDG 1000 Class hulls. BIW also implemented the surface preparation tool in the second quarter of FY13 on the same classes. Full implementation with commercially produced tools on DDG 1000 and DDG 51 Class hulls is anticipated in FY14. This technology can readily be implemented on virtually any ship type, and is not limited to surface combatants.

Ingalls Shipbuilding photo

Optimized Panel Line Processes Will Improve Panel Quality and Reduce Production Schedule and Costs

While BIW has implemented the prototype plate edge preparation tool, Ingalls has begun to implement the improvements developed in an NMC-led project that optimized equipment, processes, and procedures in its panel line for DDG 51 construction. The project team, consisting of Ingalls, the DDG 51 Program Office, NSWCCD, and NMC, addressed panel line challenges such as excessive distortion, wide weld joint gaps, suboptimal welding performance, excessive weld repairs, and low throughput rates. The project team developed more than 20 recommendations to improve processes on Ingalls' panel line. Ingalls is implementing six of these recommendations and has long-range plans to implement an additional eight recommendations. Incremental implementation began in the third quarter of FY13 for DDG 114. Five-year savings of more than $2.1 million is expected. The project's solutions will also benefit other Navy programs, such as the LPD and LHA amphibious platforms, and the U.S. Coast Guard's National Security Cutter.

NMC photo

Improved Tooling Will Reduce Costs When Installing and Repairing VCS Pipe Assemblies

NMC is working on several shipyard process improvement projects for VCS. One project reduced the labor hours required to install piping assemblies, which involves extensive manual preparation, fitting, aligning, and welding. The IPT generated and tested candidate tooling concepts and fabricated prototype tools to improve methods for pipe assembly installation fit-up, fixturing and positioning, and/or to allow for the use of automation techniques. Final project activities focused on commercialization of these prototype tools for shipyard use. This project leveraged the success of the recent Pipe Preparation and Welding Methods (S2224) and Large Diameter Pipe Process Improvements (S2326) projects. Implementation of the project results is expected at both EB and NNS for use in the construction of SSN 788 and 789 in early FY14. The project is expected to save $6 million over five years for the VCS program. The IPT consisted of the VCS Program Office, NSWCCD, EB, NNS, and NMC.

General Dynamics Electric Boat photo

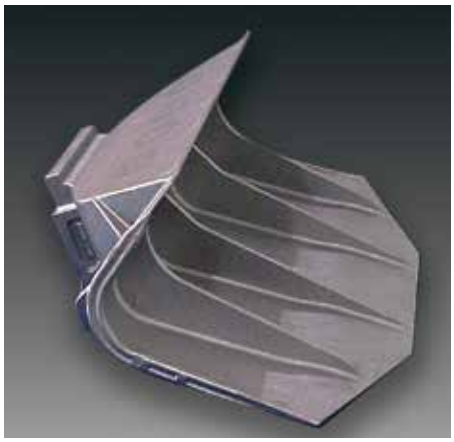
Innovative Solutions Will Improve Cable Pulling Operations on VCS

Another labor-intensive and injury-prone process in VCS construction is the installation of electrical cable, or cable pulling. EB researched commercially available equipment to assist with cable installation, but found that it was not conducive for VCS due to the cable routing configuration and confined areas aboard ships. An NMC-led project developed innovative solutions to reduce labor costs and injury claims. The IPT, including the VCS Program Office, EB, and NMC, developed tooling concepts to help workers manipulate and guide the cables, as well as to reduce friction during routing operations. Candidate concepts were down-selected for prototype development, evaluation, and implementation. The project results will be implemented on SSN 789 in the first quarter of FY14 and later at both EB's Groton and Quonset Point facilities. The project's objective was to reduce the labor hours associated with routing cables on new VCS construction by at least 10 percent, which corresponds to a cost savings of $242,000 per hull. In addition to the labor reduction, the technology has the potential to reduce injury claims and medical costs.

Silver Anniversary Look Back 2005

NMC made the M777A2 155mm towed howitzer weapon system more affordable through several manufacturing improvements, most notably the conversion of a 60-part component to a single large, complex titanium casting incorporating a network of internal stiffeners. As of February 2013, a total of 1,000 M777 have been built, which brings this project savings to nearly $68M. NMC received a letter of commendation from the DoD ManTech Program in 2008 for its project efforts.

A timeline of milestones in NMC's 25-year history is on www.nmc.ctc.com.



General Dynamics Electric Boat photo

Robotic Plasma Backgouging System to Reduce Labor Costs for Joining VCS Hull Sections

Another VCS shipyard process improvement project is developing a portable, production-hardened, track-based plasma arc backgouging system for VCS hull butt joints. This system design will be an extension of the robotic welding technology that was successfully demonstrated in Phase II of a prior ManTech project (S2197) executed by the Navy Joining Center. This effort will use the same track from that mechanized welding system. Phase III is focusing on hardening the backgouging system components against electromagnetic noise and physical hazards and integrating these components with a simpler control system on a dedicated carriage. EB estimates a $2.2 million savings over five years from increased efficiency of the backgouging method. The consistent backgouge profile allows for more efficient welding, reduced grinding time, reduced set-up time, and a small compression in schedule. The prototype system is expected to be available for training, or as a back-up system, at EB Quonset Point by the second quarter of FY14. EB plans to procure two production backgouging systems from the commercialization partner, Servo-Robot, to prepare VCS hull butt joints after the prototype is demonstrated. The IPT consists of the VCS Program Office, NSWCCD, EWI, EB, Servo-Robot, and NMC.

NMC photo

Improved FCAW Electrode Evaluated for High-Strength Steel Welding Applications

For CVN 78 Class ships, NMC evaluated and optimized several candidate MIL-101TM flux-cored arc welding electrodes in an effort to deliver an improved electrode that addressed inconsistent lot-to-lot notch toughness and lower fracture toughness values of the currently approved MIL-101TM electrode. While project test results on the down-selected electrode showed some improvement in several performance characteristics over the currently approved FCAW electrodes, the IPT decided not to pursue implementation for CVN 79 because an electrode that consistently met the specified weld performance could not be developed within the project's budget and schedule. The electrode manufacturer intends to pursue commercialization of the modified FCAW electrode evaluated under this project as a new product. The IPT included the CVN 79 Program Office, NNS, NSWCCD, NAVSEA, and NMC.

U.S. Navy photo

Design for Manufacturability

NMC uses a design for manufacturability approach, which concurrently addresses design and manufacturing considerations to improve the manufacturability of ship components and ultimately the cost.

NMC photo

Manufacturing Improvements Result in Reduced Cost and On-time Delivery of CVN 79 Weapons Elevator Doors

Manufacturing issues such as weld distortion can have a serious impact on ship production schedule and construction costs. For CVN 78, relatively thin steel plates are being used to produce the weapons elevator doors and, after welding and pressing operations, those doors did not consistently meet the required flatness and straightness tolerances. NMC and NNS employed a prioritized approach to address these challenges, while significantly reducing labor costs. The project focuses on incremental improvements (Interim Corrective Action [ICA] doors) as well as an improved balanced weld configuration (Permanent Corrective Action [PCA] doors). With the ICA doors, NMC and NNS applied several manufacturing enhancements, including elimination of the back sheet, use of purchased pre-fabricated stiffeners, vertical-down welding, improvements in weld sequencing, and introduction of flame straightening. The ICA door was implemented and is now in production for CVN 79. For the PCA design, the IPT further reduced labor and material costs by using a Design for Manufacturing and Assembly (DFMA) approach that incorporates a balanced weld and tubular frame construction. NNS and NMC each constructed trial doors that validated the cost and labor savings and proved the viability of the PCA design. Implementation of PCA doors is expected on CVN 80 in 2018. The producibility methods and improvements developed in this project can be applied to hatches, other ballistic and fragmentation doors and hull closures, or other applications or platforms. Compared to CVN 78 doors, this project will achieve cost savings of $1.1 million and cost avoidance of $22.9 million by avoiding late delivery of CVN 79 doors. Compared to ICA doors, implementation of PCA doors on CVN 80 is expected to provide an additional $1.1 million in cost savings after non-recurring engineering costs are factored in, with cost savings of $4.2 million for each follow-on hull. In addition to NNS and NMC, PEO Aircraft Carriers, NAVSEA 05V3, NSWCCD, and EWI are contributing to this effort.

Silver Anniversary Look Back 2008

NMC advanced the state of LAS-er-welded corrugated-CORe (LASCOR) metallic sandwich panel manufacturing technology for naval applications. LASCOR panels are stiff, lightweight steel structures that offer corrosion resistance, reduced weight, and less distortion. NMC optimized the LASCOR design for materials, manufacturability, joining, structural and protection performance, earning a 2008 Defense Manufacturing Technology Achievement Award for its efforts. In 2009, BIW implemented LASCOR panels for DDG 1000 berms and personnel safety barriers, which significantly reduced the overall acquisition cost.

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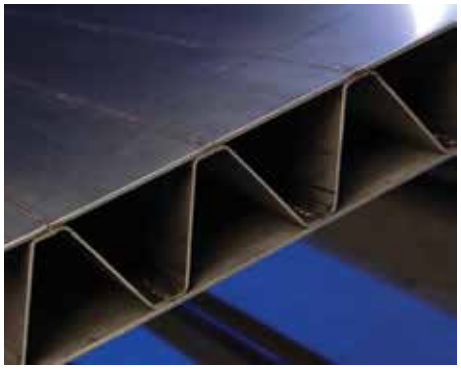


NMC image

Casting Solution for LCS Component to Save Construction Costs

In an effort to lower the cost on another Freedom-variant LCS component, NMC and project team members investigated an alternative manufacturing approach for the roller brackets that connect the launch, recovery, and handling system crane to the LCS hull. The current fabricated bracket design involves tight operational tolerances and requires precision fabrication, welding, and machining. This Rapid Response project developed a ready-to-machine cast bracket design that will save an estimated $61,000 and 2,000 pounds per LCS. The bracket manufacturer, Oldenburg Group Inc. (OGI), has committed to implementing the cast design on LCS 11, most likely in the fourth quarter of FY14, assuming that the prototypes are found to pass all physical validation tests. The project team included the LCS Program Office, OGI, Computer Sciences Corporation, Lockheed Martin, and NMC.

Office of Naval Research photo

Manufacturing Improvements Essential to Navy's Near-term Implementation of HTS Degaussing System

Improving the manufacturability of the High Temperature Superconducting Degaussing (HTSDG) system that will be implemented on a future surface combatant is the focus of a current NMC project. The HTSDG system, which is replacing the legacy copper cable degaussing system, neutralizes the ship's inherent magnetic field. One of the project goals is to develop a process for an efficient, robust, repeatable solder joint connection in key areas where joint visibility is restricted and minimal heat must be used. The IPT, which includes NSWCCD, AMSC, and NMC, will also develop a high-yield process for bundling the uniquely shaped High Temperature Superconducting wire that is more conducive to the production quantities that will be seen when the technology is transferred to future surface combatants. Initially, the IPT will optimize current manufacturing processes, and then investigate more efficient alternative processes. In addition to reduced labor-hours required to assemble an HTSDG cable, additional benefits include increased HTSDG system reliability, reduced lead times that will mitigate schedule risk to the Navy, and increased HTSDG cable capacity. Select manufacturing improvements will be implemented on a future surface combatant as they are proven over the course of the project.

Newport News Shipbuilding photo

Improved Manufacturability of the FI Track System to Reduce Lead Time and Save Costs

NMC is exploring ways to improve the manufacturability of the Flexible Infrastructure (FI) Track System at NNS to reduce acquisition costs. The FI Track System enables equipment to be mounted to certain Navy ships to facilitate rapid rearrangement of the space to meet changing missions. The IPT, consisting of the CVN 79 Program Office, NSWCCD, NNS, Gryphon Technologies, and NMC, evaluated the manufacturing design, developed two alternate concepts, and prototyped both concepts. Installation planning and testing, grounding and bonding validation, as well shock and vibration testing (sponsored by a related Small Business Innovation Research effort) are underway on the prototypes. The most promising concept will be selected for implementation. The improved FI Track System concepts will reduce the total ownership cost for CVN, LHA, and DDG platforms that use or may use the FI Track System. In addition to cost savings, the lead time to procure the components will be reduced because the optimized designs are simpler to manufacture and will allow more vendors to bid on and produce the components. The estimated cost savings over five years is $3.8 million for CVN 79, LHA 7/8, DDG 1001/1002 and CVN 73 overhaul. Implementation is expected in the first quarter of FY15 on CVN 79 construction and CVN 73 overhaul.

NMC photo

Changes in Manufacturing Processes Yield Significant Cost Savings for VCS Weapons Cradles

To improve producibility and reduce costs, an NMC project team applied lean manufacturing and DFMA principles to the complex design of the VCS weapons cradle. The anticipated five-year cost savings from the simplified design is $7.4 million. Enhancements include a 14-part reduction, higher quality, reduced rework, and reduced weldment fabrication times. The improved quality will result in fewer engineering waivers and reduced scrap costs. NNS is implementing some incremental cradle process improvement recommendations including single-piece end blocks and is using a balanced weld joint to attach the end blocks in 2013 on SSN 788 cradles. The remaining collective enhancements will be implemented on SSN 790 in 2015. The project team is comprised of the VCS Program Office, the Naval Undersea Warfare Center Division Newport, EB, NNS, and NMC.

Silver Anniversary Look Back 2009

NMC increased the performance and strength of HSLA-100 steel through improved thermal processing so that it could be used at reduced thickness, and thus, reduced weight. This project work led to the approval of a new material, HSLA-115, which designates its increased minimum yield strength of 115 ksi. HSLA-115 is being used in the construction of CVN 78 class aircraft carriers. This project earned a commendation letter from the DoD ManTech Program in 2009.

A timeline of milestones in NMC's 25-year history is on www.nmc.ctc.com.

Lockheed Martin photo

Advanced Metrology and Inspection Technologies

NMC is leading several projects improving the measurement (metrology) and inspection of weapon system components. Implementation of advanced metrology and inspection technologies significantly enhances the inspection fidelity and reduces weapon system cost.

NMC photo

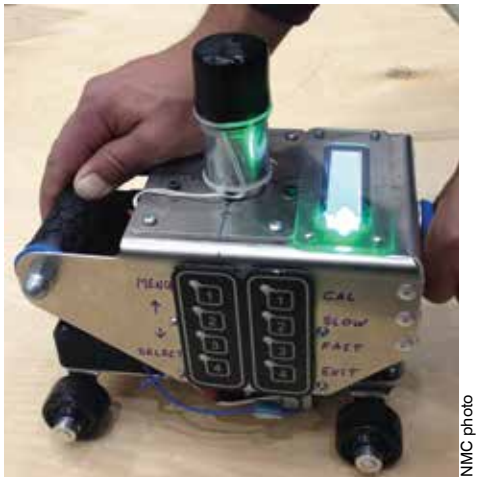
White Light Scanning Technology Expected to Save Costs in Inspection of Main Propulsion Shaft Tapers

An NMC project is evaluating and optimizing white light scanning technology for inspecting a key component on submarines and aircraft carriers – the tapers through which power is supplied from the inboard coupling to the main propulsion shafts. The project team is improving a commercially available white light scanning system by developing features that automatically measure the part, analyze the data, report results, and project the outline of out-of-specification areas onto the measured part. Implementation will occur in the third quarter of FY14 as Norfolk Naval Shipyard uses the prototype system delivered to them for evaluation. The other Navy shaft refurbishment facilities will also implement the results as the Navy removes the current gauge process. The Navy will save more than $6 million by doing away with the purchase of taper inspection gauges and an additional $830,000 per year by eliminating the need to maintain the existing taper gauges. The project team includes NAVSEA 05Z22, NAVSEA 04X, NSWCCD, Norfolk Naval Shipyard, Portsmouth Naval Shipyard, Pearl Harbor Naval Shipyard, Puget Sound Naval Shipyard, and NMC.

Sciaky photo

NDI Strategy Will Enable Inspection of EBDM Flight-critical Titanium Components

A joint Navy ManTech and Air Force Research Laboratory (ARFL) project is assessing the ability of several traditional and advanced non-destructive inspection (NDI) processes to detect internal defects in Electron Beam Direct Manufacturing (EBDM) parts to be used on the F-35 Joint Strike Fighter (JSF). While the use of EBDM is important to improving JSF affordability, an NDI procedure has not yet been developed for EBDM parts. The IPT is investigating methodologies, such as traditional radiography, standard and phased array ultrasonic inspection, and computed tomography, to develop NDI test methods and acceptance standards that will lead to approval of EBDM technology for fabrication of F-35 airframe components. Upon approval, the recommended NDI practices will be implemented by Sciaky, Inc., and Lockheed Martin Aeronautics - Advanced Development Program on all designated EBDM components for the F-35 program in the second quarter of FY15. This project is jointly funded by the Industrial Base Innovation Fund and Navy ManTech. The IPT includes the AFRL, Lockheed Martin Aeronautics, Sciaky, NMC, NAVAIR and the JSF Joint Program Office.



NMC photo

Inspecting Special Hull Treatment with Impulse Hammers Will Lead to Cost Avoidance for VCS

For VCS construction, inspection of the Special Hull Treatment (SHT) is a critical process that detects debonding or delamination, which can degrade durability and performance. Currently, the SHT is inspected manually. This NMC project developed a prototype impulse hammer tool that mimics the manual method, but measures the input force and response electronically instead of through human senses. A cost avoidance of $348,000 per hull may be realized by repairing SHT debonds during construction as opposed to after delivery by allowing repairs to be made while the processing equipment, staging and environmental controls are already in place. In addition, the impulse hammer could be used either during new construction or in dry dock. The project team, consisting of the VCS Program Office, NSWCCD, EB, NAVSEA 04X, Portsmouth Naval Shipyard, Puget Sound Naval Shipyard, Pearl Harbor Naval Shipyard, and NMC, has initiated testing of the prototype system with promising results to date. If successful, implementation is planned for the second quarter of FY14 at EB for SSN 786.

Newport News Shipbuilding photo

Geometric Accuracy of Castings Will Save Costs, Speed Up Production Time

Advanced metrology is the focus of an NMC project that will allow the NNS Foundry to rely less on manual measurements of patterns, molds, and castings using tape measures and calipers. While the manual methods are often sufficient for checking basic dimensions required for product delivery, they are generally inadequate to validate geometric features. The NNS Foundry has used photogrammetry and laser scanning to validate geometric features on more challenging patterns and castings, but these methods as currently configured require significant labor to collect and process the resulting data. This NMC-led project, which includes contributions from the VCS Program Office, NNS, NSWCCD, a metrology consultant, and NMC, will evaluate, develop, demonstrate, and recommend advanced foundry metrology technologies that extend the capabilities of commercially available systems for use in the foundry. The project results are expected to reduce labor-hours and inspection costs by 50 percent, with a $2.3 million cost avoidance for VCS and $3.8 million for the NNS Foundry over five years. Implementation is expected in the first quarter of FY16, after successful demonstration of the technology and finalization of the business case.

Projects Included in this Report:

Advanced Metalworking

S2400 Thin Plate Distortion Mitigation
S2468 Precision Panel Inserts
R2519 CVN Aircraft Elevator Cracking Remediation
R2521 VCS Propulsion Shaft Shot Peen Study
S2368-B Improved Shaft Cladding Materials and Processes
S2548 Machining Alloy 625 Propulsor Components
S2471 Improved Abrasive Technology

Coatings Application and Removal

R2549 Additive Isolation Coatings for Navy Fasteners
S2541 GTC Durability Coating
Z2528 NNSY Bilge and Tank Maintenance Platform

Shipyard Processes

S2373 Plate Edge Preparation Improvements
R2516 Panel Line Process Improvements
S2398 Pipe Assembly Installation Improvement Methods
S2472 Improved Cable Routing Tools
S2467 Hull Fabrication Improvements
S2372 FCAW Electrodes with Improved Toughness

Design for Manufacturability

S2469 Weapons and Stores Elevator Doors Manufacturing Cost Reduction
S2399 Sliding Door Manufacturing Improvements
R2515 Crane Roller Bracket Manufacturing Improvements
S2523 Degaussing System Manufacturing Improvements
S2517 Flexible Infrastructure Track System
S2319-2 Weapons Cradle Manufacturing Cost Reduction

Advanced Metrology and Inspection Technologies

S2365 Main Propulsion Shaft Taper Inspection
A2506 Non-Destructive Inspection for Electron-Beam Additive Manufacturing of Titanium
S2363 SHT Debond Detector
S2529 Advanced Foundry Metrology

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