

CNST Teams Kickoff Two New Welding Projects

The Center for Naval Shipbuilding Technology recently kicked off two new projects, the Bath Iron Works-led Portable Weld Inspection Management System and the Pennsylvania State University Applied Research Laboratory (ARL)-led Hybrid Laser/Gas Metal Arc Pipe Welding System. Both projects were recently awarded to support the CNST mission to identify, develop and deploy advanced manufacturing technologies that will reduce the cost and time to build and repair Navy ships.

Portable Weld Inspection Management System

Welding is the primary means of joining structural components in naval vessels. All structural welds are visually inspected for compliance with workmanship and geometric (i.e., weld size) requirements. Acceptance criteria for shipyard visual weld inspections specify minimum requirements and the tendency in shipbuilding is to be over-conservative on weld size. The result is a culture of over-welding; welders may deposit two to three times more weld metal than is needed for structural integrity. In addition, visual inspections are somewhat subjective, as welds that pass one inspection may fail subsequent inspections, leading to redundant and unnecessary inspection and repair cycles.

The Portable Weld Inspection Management System (PWIMS) seeks to correct this problem by performing quantitative, non-subjective quality measurements and recording the results in an easily accessible format. PWIMS will be based on commercially-available, technically-proven components that are integrated and customized to meet shipyard inspection needs, including portable hand-held laser profile sensors, portable computers for data collection, a central database repository for inspection data and software tools for inspection approval and statistical process control. By eliminating redundant inspections and unnecessary repair cycles, shipyard efficiency will improve dramatically. Further, by recording actual weld size, the system will track weld quality and enable the use of statistical analysis to help identify/reduce over-welding.

Hybrid Laser/Gas Metal Arc Pipe Welding System

The Hybrid Laser/Gas Metal Arc System will generate significant cost savings by eliminating the multiple weld passes required when using beveled joints and more traditional welding processes (e.g., flux-core, gas metal arc or gas tungsten arc welding). With appropriate joint configuration and preparation, deep keyhole penetration provided by the laser and additional filler metal and heat input provided by the gas metal arc torch will permit single-pass, butt-welding of pipes. This decreases weld processing time and reduces the number of weld defects caused by repeated starts and stops. The system integrates off-the-shelf technology, including a laser seam tracking sensor, torch head manipulation and adjustment of weld schedule in response to gap fluctuations and post-weld inspection. Travel velocity is closely controlled using a clamping and pipe manipulation/rotation system.

Phase I will design a complete hybrid laser/GMA pipe welding system, including edge preparation and fixturing. Phase II involves procuring, assembling, testing and demonstrating the system at Penn State using ARL's 6 kW Nd:YAG laser system. Phase III is a three month pre-production demonstration with actual NASSCO pipe welding personnel. The entire pre-production system will be installed on a portable 40 foot transportation platform. This will permit transportation from Penn State ARL to NASSCO without disassembly and will provide an opportunity to easily transport the system to other shipyards for additional demonstrations.



The project team tours NASSCO's pipe welding shop as part of the project kickoff meeting.

Penn State ARL and NASSCO also will work with appropriate weld qualification bodies (i.e., the American Bureau of Shipping and NAVSEA) to ensure that the project will result in an approved weld procedure. The qualification process will include a qualified test plan, including the necessary metallography and mechanical testing requirements. Successful implementation will serve as a stepping stone toward eventual development of hybrid laser/GMA orbital pipe welding systems, further broadening the applicability, usefulness and cost savings of this system.

About CNST

CNST is a Navy ManTech Center of Excellence, chartered by the Office of Naval Research (ONR) to identify, develop and deploy, in U.S. shipyards, advanced manufacturing technologies that will reduce the cost and time to build and repair Navy ships. For additional information on this and other CNST projects, please visit www.cnst.us.