3D Printer Solves Engineering Challenges Onboard USS Somerset

Hull Technician 3rd Class Mario EnriquezSanchez, a Denver native, cuts the baseplate of a 3D printed component aboard the San Antonio-class amphibious transport dock ship USS Somerset (LPD 25) during Exercise Rim of the Pacific (RIMPAC) 2024 while underway in the Pacific Ocean, July 15. (U.S. Navy photo by MC2 Evan Diaz)

By Lt. Zachary Anderson

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photo by MC2 Evan Diaz)

When the team of engineers from the Consortium for Advanced Manufacturing Research and Education (CAMRE) loaded their 3D hybrid-metal printer onboard Somerset as part of the experimentation sector of Exercise Rim of the Pacific 2024, they had no idea that they would soon be asked to solve a real-world engineering casualty.

Hours after being loaded on board, a critical component of the reverse osmosis pump, which generates clean water for the crew – an absolute necessity for ships spending long periods at sea – shattered.

“What we didn’t expect was that we would have the opportunity to directly help ship readiness so soon,” said Lt. Charles Wallace, a mechanical engineer from the Naval Postgraduate School, and one of the team members onboard. “Especially for something as mission-essential as a reverse osmosis pump, where if you run out of water you’re going to be coming home pretty quick.”

3D printing, or additive manufacturing (AM), has been a major area of interest for Department of Defense in recent years. In January 2021, the DoD published its first-ever Additive Manufacturing Strategy to “provide a shared set of guiding principles and a framework for AM technology development and transition to support modernization and warfighter readiness,” across the military.

“For Trident Warrior, CAMRE organized the largest distributed advanced manufacturing demonstration the Department of Defense has ever conducted to date,” explains Lt. Col. Michael Radigan with the Marine Innovation Unit, and government lead on the CAMRE team. “This was accomplished by linking advanced manufacturing equipment, joint subject matter experts, and commercial partners to tackle real-life readiness solutions.”

The benefits of successfully implementing additive manufacturing on ships include saving time, money, space, and increasing overall warfighting readiness by allowing for repair and replacement of equipment in a contested environment. In the case of Somerset, had the reverse osmosis pump failed during their 6-month deployment, it would have reduced their ability to produce drinking water for the Sailors and Marines.

“If the crew had to rely on a replacement part without using additive manufacturing, it would have taken weeks or months,” said Staff Sgt. Jordan Blake, a member of the Marine Innovation Unit, and tasked with technical oversight of the project aboard ship. “With this technology, we’ll have the new component printed and ready for installation before the order for a replacement would be completed.”

While 3D printing on Navy ships is still in its infancy, Somerset is not the first ship to utilize AM. In April, 2024, the amphibious transport dock USS San Diego (LPD 22) piloted a liquid metal jetting additive manufacturing process fielded by the CAMRE team, operationally showcasing this novel technology’s capabilities at sea.

What makes the Somerset demonstration unique, is that the machine is a metal hybrid design, combining subtractive and additive manufacturing in one machine. Subtractive manufacturing is an umbrella term for the process by which solid blocks of material are shaped into the desired object via cutting, boring, drilling, and grinding. This is in contrast to additive manufacturing, which builds something by adding material one layer at a time – hence additive.
Oftentimes, constructing a replacement part involves both additive and subtractive manufacturing. Before they tested the model on Somerset, this meant alternating between different machines, however by combining the two processes it

effectively streamlines the overall workflow.

“The benefit of a system like this is that you’re able to computerize , send the code, then once you’ve printed something, it becomes replicable,” said Wallace when asked how the hybrid machine represents a step forward for the military.

Not only is 3D printing faster and safer than traditional machinery repair, but the replacement parts are often stronger as well. The weld is nearly as strong, or stronger, than the parent metal. AM is essentially building through welding, which means the replacement pump will potentially surpass the strength of the previous version.

The project builds upon a unique cross-sectional effort from the DoD and industry partners to provide hands-on experience for military students. The printer test itself falls under the umbrella of CAMRE, which funded the project and sent four NPS students to study advanced manufacturing capabilities in an operational scenario. Two soldiers on the team operate the printer and three Marines operate the polymer printers which help augment the capabilities of the metal printer.

A project engineer and representative for the industrial printer’s parent company, is also on hand to teach the Somerset crew to operate the printer independe