Advanced Onsite Fabrication of Continuous Large-Scale Structures

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ABSTRACT:

We propose to conduct initial development work toward a novel method for onsite fabrication of continuous large-scale structures such as pressure or containment vessels for the nuclear, petrochemical, chemical processing, and other industries that use large process structures. This project will investigate techniques and additive manufacturing methods to construct large-scale structures onsite from smaller format raw materials.

The objectives of the research activities are to (1) determine the feasibility to precisely control deposition via thermal spray, material representative of pressure vessel steel and (2) determine the suitability of thermal spray and other arc-based additive manufacturing processes for a large-scale vessel or structure fabrication.

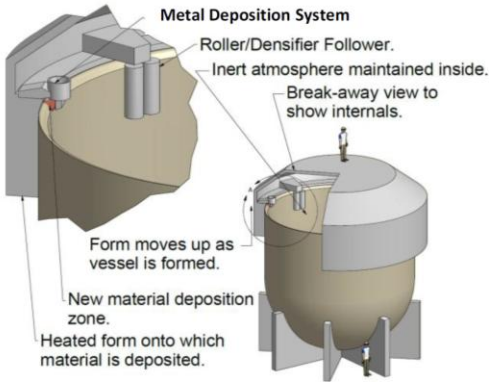

Figure 1. Concept of fabrication of large pressure vessel.

The ultimate goal of this research is to develop a method of producing large-scale structures onsite, as illustrated in **Error! Reference source not found.**.

Methods:

Spray forming and thermal spray involve entraining liquid metal droplets in a high-velocity gas stream from which it is deposited on a substrate form. This project will design a robotically controlled thermal spray deposition system (a HVOF process will be initially emphasized) and characterize the functionality of sn experimental apparatus and approach. Work will also be conducted to determine optimal additive manufacturing techniques for both bulk material deposition, and the addition of features via other additive manufacturing processes, such as arc-based additive manufacturing. This will also necessitate a substantial effort in sensors and process control to monitor and control deposition rates, geometry, and final residual stress state.

Potential Outcome/Impact:

This project has the potential to revolutionize the way large pressure vessels and containment structures are fabricated and will enable the domestic production of these structures at a much reduced cost with the potential of implementing advanced materials and composite structures.

The long-term vision of this project is to enable the fabrication of large structures in locations previously unattainable and to enable fabrication via methods previously not possible. This project supports the DOE mission to deploy small modular reactors in a variety of sites as part of a distributed power production portfolio. This project also enables the on-shore and local production of pressure vessels for a variety of chemical processing end uses. This project also furthers the state-of-the-art of large-scale additive manufacturing for the nuclear industry.