RIC 2020

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Review of Advanced Manufacturing for Reactor Materials & Components

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Background and Motivation

- Advanced manufacturing technologies (AMTs) of interest to the NRC include those that have not traditionally been used in the U.S. nuclear industry and have yet to be formally standardized (such as those in Table 1).
- These technologies have the potential to allow flexible production of limited quantities of specific nuclear power plant (NPP) components. (NUREG/CP-0310, ADAMS #ML19214A205)
- The NRC has been informed that AMT parts (Fig. 1) are being considered for applications in the operating fleet.
- Studies being conducted by industry, the U.S. Department of Energy (DOE), and the NRC will provide more insight into assuring the reliability of specific AMT-produced components.
- Technical issues include component design, precursor materials, finished material properties, structural integrity, nondestructive examination, and qualification/certification.

ADDITIVE MANUFACTURING
Laser Powder Bed Fusion (L-PBF)
Directed Energy Deposition (DED)
NEAR NET SHAPE MANUFACTURING
Powder Metallurgy-Hot Isostatic Pressing (PM-HIP)
JOINING/CLADDING
Electron Beam Welding (EBW)
SURFACE MODIFICATION/COATING
Cold Spray

Table 1. Examples of AMTs pertinent to NPPs (excerpted from the Nuclear Energy Institute's "Roadmap for Regulatory Acceptance of Advanced Manufacturing Methods in the Nuclear Energy Industry," 5/13/2019).

ADAMS: Agencywide Documents Access and Management System

Current Activities

The NRC is revising its agency AMT action plan (ADAMS #ML19029B355) to address the use of advanced manufacturing for reactor materials and components. The purpose of both the initial AMT action plan and its revision is to develop a strategy that will enable the NRC staff to effectively, efficiently, and transparently regulate components manufactured using AMTs (Fig. 2). The NRC plans to leverage ongoing research with evaluations being performed by Federal and industry counterparts. The revised AMT action plan targets issues such as the following:

- regulatory infrastructure
- codes and standards development for AMTs
- properties of AMT materials and components for NPPs
- service performance

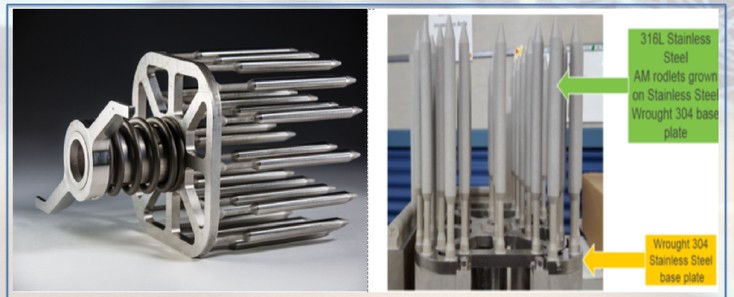

Fig 1. The NRC identified the L-PBF Westinghouse Thimble Plugging Device to be its first "candidate AMT application."

One of the tasks in the NRC AMT action plan was to identify a "candidate AMT application" to better understand which specific AMTs are of the greatest interest to the industry so that the NRC is proactively prepared for effective regulatory reviews.

Path Forward

- Continue to interact with the Nuclear Energy Institute, the Electric Power Institute, the National Institute of Standards and Technology, DOE, and industry groups to monitor relevant developments.
- Resolve fundamental questions, such as: How will AMTs be used in NPPs, and when? What regulatory infrastructure is necessary to provide a reasonable assurance of safety? What are the unique aspects for particular AMTs and what are the significant differences with conventional materials/processes?
- In the near term, assess differences between conventional and AMT-fabricated components to identify gaps in performance.
- In the mid term, work towards developing NRC guidance for AMT applications, data packages, and industry specifications and standards.

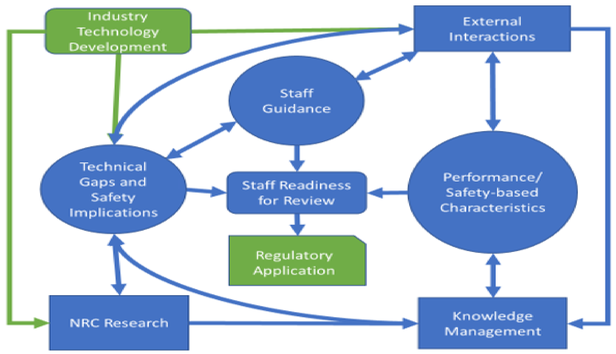

Fig 2. Interactive nature of AMT action plan tasks.