Advanced Manufacturing Technologies Action Plan Subtask 2B: Assessment of Regulatory Guidance for Advanced Manufacturing Technologies

Purpose:

The staff assessed whether any regulatory guidance (e.g., Regulatory Guides, NUREG-0800 Standard Review Plan [SRP] sections) needs to be updated or created to clarify the process and procedure for reviewing submittals with advanced manufacturing technologies (AMT) components[1].

Two goals were identified for the staff review:

1) Identification of aspects of the regulations or staff guidance that could potentially impede or restrict the staff's ability to perform an efficient and thorough review of licensee submittals utilizing AMT components.

2) Determination of whether the regulations or regulatory guidance need to be updated to support efficient staff review of submittals with AMT components.

Process:

The staff performed a limited review of U.S. Nuclear Regulatory Commission (NRC) regulations and related NRC documents to determine whether updates were necessary or new guidance was needed to support efficient staff review of submittals incorporating AMT components. Guidance and regulations exist in the form of Title 10 of the *Code of Federal Regulations* (10 CFR) sections, regulatory guides, branch technical positions, etc. Based on the Nuclear Energy Institute (NEI) AMT Roadmap and industry discussion of potential AMT applications, this review focused on regulations and guidance related to material properties and functions with respect to the current operating fleet and new reactors. This included all relevant SRP sections and applicable regulatory guides. This review was limited to materials engineering issues and did not include other technical disciplines (e.g., electrical, structural, nuclear fuels).

Results:

In its limited review of NRC regulations, the staff did not identify any impediments that would preclude a licensee's use of AMTs or restrict the staff's ability to conduct an efficient and thorough review of such use. In general, the regulations in 10 CFR Part 50 that were examined are defined in terms of component function, without specifying or restricting manufacturing processes. Like traditionally-fabricated components, AMT-fabricated components must be capable of performing their intended functions. Initial use of AMTs is being implemented through the current regulations in Part 50. Industry plans for demonstrating the capabilities for AMT-fabricated components are being pursued through the development of American Society of Mechanical Engineers (ASME) Code Cases, which could be incorporated through 10 CFR 50.55a. Also, as part of the AMT Action Plan, the staff is developing a document regarding the application of the 10 CFR 50.59 process for an AMT component. It is expected that this will be completed in May 2020. Industry has recently utilized the 50.59 process for the installation of a thimble plugging device (TPD) that was fabricated by additive manufacturing.

[1] The term "component" is broadly meant to include new and replacement components, repair activities of existing components, and specific fabrication elements (i.e., welds, coatings, etc.) of a component.

The staff's review of regulatory guidance also did not identify any impediments. Such documents typically pertain to specific methodologies or processes to meet NRC regulations. The staff's review was particularly focused on the SRP because it provides regulatory guidance to NRC technical reviewers regarding a large range of core regulatory areas. The SRP is often utilized by applicants to develop their submittals. The staff conducted a review of SRP sections that are used for material engineering reviews, which are listed in Appendix A of this communication. The staff reviewed these SRP sections as well as regulatory guides that are applicable to material reviews and found that they did not contain guidance related to manufacturing processes that would preclude implementation of AMTs.

As stated above, the staff concluded that there were no impediments in current regulations or regulatory guidance. However, the staff's review indicated that either updating existing regulatory guidance or developing additional regulatory guidance may help improve the efficiency and effectiveness of the staff's review and provide clearer expectations to the applicants for AMT submittals with regards to material properties and functions. This revised or new guidance may address the range of safety-significant differences that AMTs may introduce compared to traditional manufacturing methods, including microstructure, defect populations, and aging performance. The exact form of any new or updated guidance (e.g., new SRP section, new regulatory guide) will be determined in conjunction with Subtask 2C of the AMT Action Plan Revision 1.

Recommendations:

The AMT Action Plan reflects the dynamic nature of the fast-paced evolution of these technologies. As such, the NRC anticipates periodic revisions of the AMT AP to reflect the evolving state of knowledge and potential industry utilization of AMT. As a result of the inter-related nature of the AMT Action Plan tasks, the information resulting from current tasks as they progress and are completed will be used to inform other tasks and to identify future tasks. The staff has two recommendations which may be considered for inclusion in a future revision of the AMT Action Plan:

1) Once Subtask 2C in Revision 1 of the AMT Action Plan has been completed, the staff will determine whether new regulatory guidance or updating current regulatory guidance would provide the staff with more efficient and effective processes and procedures for reviewing submittals with AMT components. If it is determined that new or updated guidance is recommended, the work will be initiated and then reflected through the addition of a new task in a future revision of the AMT Action Plan.

2) Based on industry communications and the initial industry implementation of AMT (the TPD), the staff, this review was focused on the materials engineering discipline. Further indications by industry for incorporating other AMT-fabricated components should be considered to assess whether expansion of this assessment of regulations and regulatory guidance to different disciplines based on expected AMT submittals may be warranted. As this information becomes available, the staff recommends that other technical disciplines consider whether similar reviews of their applicable guidance are necessary.

Appendix A:
NUREG-0800 SRP Sections Reviewed for Relevance to AMTs for Materials Properties

Title	Section
Seismic Classification	3.2.1
System Quality Group Classification	3.2.2
Turbine Missiles	3.5.1.3
Leak-Before-Break	3.6.3
Containment and Structures	3.8
Concrete Containment	3.8.1
Steel Containment	3.8.2
Internal Structures of Containments	3.8.3
Other Seismic Cat. I Structures	3.8.4
Foundations	3.8.5
ASME Code Class 1, 2, and 3 Components and Component Supports, and Core Support Structures	3.9.3
Reactor Pressure Vessel Internals	3.9.5
Function Design, Qualification, and Inservice Testing Programs for Pumps, Valves, and Dynamic Restraints	3.9.6/3.9.7
Risk-Informed Inservice Inspection of Piping	3.9.8
ASME Code Class 1, 2, and 3 Piping Systems, Piping Components and their Associated Supports	3.12
Threaded Fasteners	3.13
Control Rod Drive Structural Materials	4.5.1
Reactor Internals Materials	4.5.2
10 CFR 50.55a Codes	5.2.1.1
Code Cases	5.2.1.2
Overpressure Protection	5.2.2
Reactor Coolant Pressure Boundary Materials	5.2.3
Reactor Coolant Pressure Boundary Inservice Inspection and Testing	5.2.4
Reactor Vessel Materials	5.3.1
Pressure-Temperature Limits, Upper-Shelf Energy, and Pressurized Thermal Shock	5.3.2
Reactor Vessel Integrity	5.3.3
Pump Flywheel Integrity	5.4.1.1
Steam Generator Materials	5.4.2.1
Steam Generator Program	5.4.2.2
Engineered Safety Features Materials	6.1.1
Coatings	6.1.2
Containment Heat Removal Systems	6.2.2 (6.8)
Fracture Prevention of Containment Pressure Boundary	6.2.7
Containment Spray Function	6.5.2
Inservice Inspection and Testing of Class 2 and 3 Components	6.6
Spent Fuel Pool Criticality safety	9.1.1
Spent Fuel Pool Fuel Storage	9.1.2
Spent Fuel Pool Cooling System	9.1.3
Reactor Auxiliary Cooling Water System	9.2.2
Process and Post-Accident Sampling System	9.3.2
Chemical and Volume Control System	9.3.4

Emergency Diesel Generator Fuel Oil	9.5.4
Turbine Rotor Integrity	10.2.3
Steam and Feedwater System Materials	10.3.6
Condensate System	10.4.6/10.3.5
Steam Generator Blowdown System	10.4.8
Fracture Toughness Requirements	BTP 5-3