ORNL/TM-2023/3058

Oak Ridge National Laboratory Compilation of AMMT Quality Assurance Procedures

Michael Russell

September 2023

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OAK RIDGE National Laboratory

ORNL IS MANAGED BY UT-BATTELLE LLC FOR THE US DEPARTMENT OF ENERGY

ORNL/TM-2023/3058

Advanced Materials and Manufacturing Technologies Program

OAK RIDGE NATIONAL LABORATORY
COMPILATION OF AMMT QUALITY ASSURANCE PROCEDURES

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DOE Milestone #M3CT-23OR1307051

Prepared by
OAK RIDGE NATIONAL LABORATORY
Oak Ridge, TN 37831
managed by
UT-BATTELLE LLC
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ABSTRACT

The Advanced Materials and Manufacturing Technologies (AMMT) Program was formed in FY 2022 by the combination of three previous US Department of Energy Office of Nuclear Energy programs:

- Advanced Methods for Manufacturing
- Nuclear Materials Discover and Qualification Initiative
- Transformational Challenge Reactor (TCR)

This milestone report focuses on converting the former TCR nuclear procedures at the Oak Ridge National Laboratory for use under the continuing AMMT Program. Additional procedures will be developed as the program matures or new processes are initiated, but these procedures serve as a primary framework to maintain the quality assurance established as part of TCR.

1. INTRODUCTION

The former Transformational Challenge Reactor (TCR) Program had a robust set of quality assurance (QA) procedures, which have been critical to the industrial implementation successes of the program [1][2]. This framework, adopted by the Advanced Materials and Manufacturing Technologies (AMMT) Program, will continue to follow the American Society of Mechanical Engineers Nuclear Quality Assurance NQA-1-2008, Part 1 standard, *Quality Assurance Requirements for Nuclear Facility Applications*, including the NQA-1a-2009 Addendum [3], and the current version of the US Nuclear Regulatory Commission 10 *Code of Federal Regulations* Part 50 Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants" [4]. These quality standards are applied in conjunction with US Department of Energy (DOE) Order 414.1D, *Quality Assurance* [5]. The AMMT Program's overarching QA program control is AMMT-QA-PLAN-001, *AMMT Quality Assurance Plan* [6], which describes the requirements and controls applied to Oak Ridge National Laboratory's (ORNL's) AMMT Program and the interactions with other standards and applicable ORNL processes. This program requires that select NQA-1 requirements and the 10 criteria of DOE Order 414.1D be addressed by program procedures, which is applied with the AMMT-QA-PROC-001 *AMMT Technical Procedure* [7] and other related procedures and processes in conjunction with ORNL's QA and other procedures maintained in the Standards Based Management System.

1.1 REPORT ORGANIZATION

The *AMMT Quality Assurance Plan* [6] and primary *AMMT Technical Procedure* [7] are attached in their entirety to this report as appendices), and other procedures attached as an appendix (some of which are export controlled) only show the cover page. These reports are available to the public upon request (as appropriate for individual releases). Appendix A provides a complete listing of the procedures contained in this report.

2. ADVANCED MANUFACTURING CONTROL AND QA STRATEGY

2.1 APPLICATION OF QUALITY

As part of NQA-1 [3], Part 1, "Requirements," advanced manufacturing–specific processes and related procedures are usually controlled as part of Requirement 9, "Control Special Processes." This criteria references that "Special processes that control or verify quality, such as those used in welding, heat treating, and nondestructive examination, shall be performed by qualified personnel using qualified procedures in accordance with specified requirements" [8].

This area is often applied to processes—such as welding, heat treatment, fabrication, destructive and nondestructive testing, and machining—that include the advanced manufacturing of metal or ceramic components, such as those at TCR. As such, a series of procedures, forms, templates, and plans was developed to address the special processes that encompass metal and nonmetal advanced manufacturing and related tasks at TCR. Each of these procedures applies the requirements outlined in AMMT-QA-PLAN-001, *AMMT Quality Assurance Plan* [6], and AMMT-QA-PROC-001, *AMMT Technical Procedure* [7], which include the applicable standards, QA references, roles and responsibilities, safety, training, records, and data disposition for each process, as well as the specific procedure steps to address the special process. These procedures are referenced only as part of this report and are available per request of the ORNL AMMT technical manager.

3. REFERENCES

[1] Oak Ridge National Laboratory, "Additively Manufactured Components by ORNL headed for TVA Nuclear Reactor," Press Release, Dated: October 19, 2020. (October 2020) https://www.ornl.gov/news/additively-manufactured-components-ornl-headed-tva-nuclear-reactor

[2] US Department of Energy, Nuclear Energy Office, *"National Lab 3D Prints Key Component for Kairos Power's New Molten Salt Reactor,"* Press Release, Dated: August 11, 2020. https://www.energy.gov/ne/articles/national-lab-3d-prints-key-component-kairos-powers-new-molten-salt-reactor

[3] ASME. 2008. *Quality Assurance Requirements for Nuclear Facility Applications*. NQA-1-2008/9a standard, including the NQA-1a-2009 Addendum.

[4] 10 CFR Part 50. 2006. "Domestic Licensing of Production and Utilization Facilities." *Code of Federal Regulations*, Title 10, *Energy*, Part 50, Washington, DC.

[5] DOE Order 414.1D. 2011. *Quality Assurance*, Washington, DC: US Department of Energy.

[6] AMMT Program. 2023. *AMMT Quality Assurance Plan*. AMMT-QA-PLAN-001. Oak Ridge: Oak Ridge National Laboratory. Draft.

[7] AMMT Program. 2023. *AMMT Technical Procedure*. AMMT-QA-PROC-001. Oak Ridge: Oak Ridge National Laboratory. Draft.

[8] Oak Ridge National Laboratory, "Transformational Challenge Reactor Quality Procedures for TCR Metal Core Structure Advanced Manufacturing Processes Report", ORNL/TM02020/1736 (September 2020)

APPENDIX A. LISTING OF PROCEDURES

Appendix B: AMMT-QA-PLAN-001, *AMMT Quality Assurance Plan*
Appendix C: AMMT-QA-PROC-001, *AMMT Technical Procedure*
Appendix D: Additional Procedures
- AMMT-AM-FORM-001, *AM Job Traveler Form*
- AMMT-AM-PROC-001, *AM Job Control*
- AMMT-AM-PROC-002, *AM Powder Sampling and Recycling*
- AMMT-AM-PROC-004, *AM Part Separation, EDM, and Machining*
- AMMT-AM-PROC-005, *AM Part Characterization*
- AMMT-AM-PROC-006, *AM Metallography Specimen Preparation*
- AMMT-AM-PROC-200, *AM Concept Laser M2 Cusing Setup*
- AMMT-AM-PROC-201, *AM Concept Laser Job Design and Slicing*
- AMMT-AM-PROC-400, *AM Renishaw AM250 and AM400 Setup and Build Start*
- AMMT-AM-PROC-401, *AM Renishaw AM250 and AM400 Job Design and Slicing*
- AMMT-MT-TEST-001, *Uniaxial Tensile Test Plan*

APPENDIX B. AMMT-QA-PLAN-001, *AMMT Quality Assurance Plan*

Advanced Materials and Manufacturing Technology Program Quality Assurance Plan

Michael Russell

October 2023

OAK RIDGE National Laboratory

ORNL IS MANAGED BY UT-BATTELLE LLC FOR THE US DEPARTMENT OF ENERGY

Advanced Materials and Manufacturing Technology Program

AMMT QUALITY ASSURANCE PLAN

Michael Russell

October 2023

Prepared by
OAK RIDGE NATIONAL LABORATORY
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Document Owner: Michael Russell, Quality Representative **Author:** Michael Russell, Quality Representative **Point of Contact**: Michael Russell, Quality Representative	**Approved by:** Ryan Dehoff, AMMT Technical Manager Valentino Jefferson, Performance Analysis and Quality, QA Plan SME **Reviewed by:** LaTravia Harmon, Quality Manager, FFESD Thomas Butcher, AMMT Project Manager
This document has been electronically approved. Electronic signatures of approvers are listed on the EDRM properties page associated with the EDRM Record # above.	
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This Quality Assurance Plan (QAP) provides a statement of the quality policy for the ORNL Advanced Materials and Manufacturing Technology (AMMT) Program and an overview of the quality management system. It is intended to provide employees, users, and sponsors with an understanding of AMMT's commitment to quality and explain how that commitment is manifested in operations.

REVISION LOG

Rev.	Date	Affected Pages	Revision Description
0	10/01/2023	All	Initial release

TABLE OF CONTENTS

ABBREVIATONS

AMMT	Advanced Materials and Manufacturing Technology Program
ASME	American Society of Mechanical Engineers
CFR	*Code of Federal Regulations*
DOE	US Department of Energy
EDRM	Enterprise Document and Records Management
HFIR	High Flux Isotope Reactor
M&TE	measuring and test equipment
NARA	National Archives and Record Administration
NDE	nondestructive examination
NNFD	Nonreactor Nuclear Facilities Division
NQA	Nuclear Quality Assurance
NR&D	nuclear research and development
NRC	US Nuclear Regulatory Commission
ORNL	Oak Ridge National Laboratory
PAQ	Performance Analysis and Quality organization
PI	principal investigator
QA	quality assurance
QAP	quality assurance program plan
QAPD	Quality Assurance Program Description
QR	quality representative/manager
R&D	research and development
SBMS	Standards Based Management System
S/CI	suspect/counterfeit item
SME	subject matter expert
WBS	work breakdown structure

1. INTRODUCTION

1.1 BACKGROUND

As the US Department of Energy's (DOE's) largest science and energy national laboratory, Oak Ridge National Laboratory (ORNL) applies its many assets in materials, neutron science, energy, and high-performance computing to address the national goal of developing and advancing nuclear technology as a viable component of the nation's energy strategy.

The Advanced Materials and Manufacturing Technology (AMMT) Program is sponsored by DOE's Office of Nuclear Energy to develop the information, processes, and tools needed to lead additive manufacturing adoption into existing and advanced nuclear energy systems.

The scope of the AMMT is described in the DOE Office of Nuclear Energy *Advanced Materials and Manufacturing Technologies (AMMT) 2022 Roadmap* [1].

The AMMT Program will develop crosscutting technologies in support of current fleet and next-generation advanced nuclear reactor technologies and maintain US leadership in materials and manufacturing technologies for nuclear energy applications. The overarching vision of the AMMT Program is to accelerate the development, qualification, demonstration, and deployment of advanced materials and manufacturing technologies to enable reliable and economical nuclear energy. This road map identifies key research needs, challenges, and opportunities; outlines strategic research priorities; and provides a detailed 5-year plan to realize the mission and vision of the AMMT Program.

The major goals of the AMMT Program are to (1) develop advanced materials and manufacturing technologies that have cross-reactor significance, (2) establish a comprehensive framework for the rapid qualification of new materials made by advanced manufacturing, and (3) accelerate the commercialization of new materials and manufacturing technologies through demonstration and deployment. These goals will be achieved through three program elements:

- Development, qualification, and demonstration: This is the core program element, targeting big challenges and game-changing technologies with an emphasis on demonstration. Focus areas include developing advanced materials and manufacturing technologies, establishing a rapid qualification framework, evaluating materials performance in nuclear reactor environments, and technology demonstration and deployment.

- Capability development and transformative research: This program element supports the development of experimental and computational capabilities needed for the core program and innovations. It will also support transformative research that may result in significant advances in materials design, discovery, and processing.

- Collaborative research and development: This program element is intended for collaboration and partnership to support the diverse needs of the nuclear energy community. The team will work with other DOE programs, funding agencies, industry, and universities to investigate a broad range of advanced materials and manufacturing techniques, address reactor-specific issues, leverage and collaborate on capability development, and provide near-term material solutions to the nuclear industry through collaborative research and development (R&D).

The thematic execution strategy of the AMMT Program is integration and collaboration. The AMMT Program comprises three core technical areas—namely, materials development, advanced manufacturing,

and environmental effects. The technical areas mesh with the program elements in a matrix structure to facilitate integration and collaboration. An integrated approach, combining a set of tools including advanced characterization, high-throughput and accelerated testing, modeling and simulation, and machine learning and artificial intelligence, will be used across all the areas to support the accelerated development, qualification, demonstration, and deployment of advanced materials and manufacturing techniques.

The AMMT Program will directly affect the nuclear industry by developing high-performance radiation-, corrosion-, and high-temperature-resistant materials for advanced manufacturing and/or through advanced manufacturing, as well as accelerating the deployment of advanced materials and manufacturing technologies to enable reliable and economical nuclear energy.

ORNL's AMMT work scope uses multiple ORNL capabilities, including the additive manufacturing capabilities developed at the Energy Science and Technology Directorate's Manufacturing Demonstration Facility; the artificial intelligence and large data management capabilities of the Computing and Computational Sciences Directorate; the materials characterization and testing in the Physical Sciences Directorate; and the nuclear fuels and reactor performance in the Fusion and Fission Energy and Science Directorate. Much of ORNL's work under AMMT is derived from work previously performed for DOE under the Transformational Challenge Reactor (TCR) Program. This document supersedes the TCR Quality Assurance Program Plan and any remaining TCR related work scope activities can use this QAP and related documents to complete their tasks.

ORNL personnel and technical teams from other DOE national laboratories and academia will collaborate to develop AMMT deliverables under the leadership of an Argonne National Laboratory program office that will manage the overall risk mitigation, cost, and schedule. The teams include personnel from ORNL; Idaho National Laboratory; Argonne National Laboratory; Pacific Northwest National Laboratory; Los Alamos National Laboratory; the University of Tennessee, Knoxville; and other universities, partners, and subcontractors as the program scope continues to develop. The team members will use a combination of quality assurance (QA) programs to facilitate their individual and collective deliverables. In most cases, members will use their own QA programs to perform specifically contracted or partnered tasks per contractual agreement. In other cases, the members will work directly under this AMMT QA program controls. In all cases, this plan encompasses all the ORNL AMMT activities, tasks, deliverables, and QA programs as applied herein. Other ORNL and AMMT projects or programs can use this plan and associated documents to perform work with the approval of the AMMT Technical Manager.

1.2 RANGE OF AMMT WORK SCOPES

A 5-year road map and comprehensive list of the potential AMMT work scopes performed by ORNL for DOE and sponsors is outlined in the *AMMT Roadmap* [1], which includes, the following sections.

2. ORNL'S AMMT PROGRAMMATIC QUALITY DESCRIPTION

As a DOE national laboratory, ORNL has prime contract–imposed mandates and expectations for its overall QA program. For most activities, these expectations are contained in DOE Order 414.1D, *Quality Assurance* [2], and 10 *Code of Federal Regulations* (CFR) Part 830, Subpart A, "Nuclear Safety Quality Assurance Requirements" [3], which is imposed on the balance of ORNL activities associated with nuclear facilities, radiological areas, and programs and activities that could affect nuclear or radiological safety. To meet these requirements, ORNL implements its *QA Program Description* (QAPD) [4], which serves as the highest tier QA document for the site. The QAPD addresses sponsor requirements through the imposition of a QA program based on the ANSI/ISO/ASQ(E) Q9001:2015 standard [5]—which

serves as ORNL's baseline QA standard—or an alternate standard when it is advantageous or required to do so.

For DOE and commercial nuclear activities, the QA requirements are based on one of two US domestic nuclear quality standards: the American Society of Mechanical Engineers (ASME) Nuclear Quality Assurance (NQA)-1 standard, *Quality Assurance Requirements for Nuclear Facility Applications* [6], or the US Nuclear Regulatory Commission (NRC) QA requirements defined in 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants" [7]. Because of the strong similarity between the two documents, a comprehensive QA program was developed to address the NQA-1 requirements for AMMT and was deemed satisfactory to meet 10 CFR Part 50, Appendix B, requirements based on past NRC interpretations and pronouncements.

The AMMT Program, which is conducted under the auspices of this plan, invokes NQA-1-2008, *Quality Assurance Requirements for Nuclear Facility Applications*—including the NQA-1a-2009, Addendum (NQA-1-2008/9a) [6], which also meets the requirements of the current version of 10 CFR Part 50, Appendix B [7]. Additionally, the program implements NQA-1-2008, Part IV, Subpart 4.2, "Guidance on Graded Application of Quality Assurance for Nuclear Related Research and Development," as the guiding document to grade the application of quality requirements on a risk basis for nuclear research activities, future work phases as the program progresses, and the nature of the planned and potential uses of the milestone deliverables. In some cases, ORNL procedures developed under NQA-1-2000 [8] QA requirements (or other versions) can be used by AMMT (examples include ORNL's Nonreactor Nuclear Facilities Division [NNFD] and High-Flux Isotope Reactor [HFIR]), but where applicable, the differences between NQA-1-2000 (or other versions) and those requirements outlined in NQA-1-2008/9a will be specifically addressed in AMMT implementing procedures.

DOE Order 414.1D [2] and 10 CFR Part 830, Subpart A [3], mandate that departmental or subcontracted entities develop a basis for implementing a graded approach to

- describe how each invoked standard's criteria and requirements are met using the documented graded approach,
- flow down the applicable QA requirements and responsibilities throughout all levels of the organization, and
- wholly or partially use the appropriate national or international consensus standards that are consistent with regulatory requirements and DOE direction.

The ORNL QAPD [4] was partially developed to address these expected attributes. The ORNL QAPD section entitled "Graded Approach" addresses ORNL's methods for the graded application of quality requirements and the imposition of associated rigor based on work activities, their associated risks, and the nature of the resulting deliverables on a site level. The descriptions provided in this plan further define how NQA-1-2008/9a [6] and 10 CFR Part 50, Appendix B [7], requirements are met based on the range of work scopes undertaken by line managers and staff members performing the full range of nuclear research and development (NR&D) activities conducted for AMMT. Section 2.1 of this plan provides additional detailed, AMMT-specific information concerning how the graded approach is applied.

This plan is established, maintained, and executed in accordance with the stated DOE expectation that ORNL successfully integrates the applicable criteria of the ORNL QAPD into AMMT's scope of work. This plan serves as the enabling document for quality-related work to be conducted at ORNL for AMMT-related technical tasks and work scopes. This plan addresses the applicable requirements of the following documents and standards:

- 10 CFR Part 830, Subpart A, "Nuclear Safety Quality Assurance Requirements," and DOE Order 414.1D, *Quality Assurance*, as applicable
- 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants"
- NQA-1-2008, including Addendum NQA-1-2009a (hereafter referred to as *NQA-1*), *Quality Assurance Requirements for Nuclear Facility Applications,* Part I and applicable sections of Part II; and the guidance provided in Part IV, Subpart 4.2, "Guidance on Graded Application of Quality Assurance for Nuclear Related Research and Development" [6]

The requirements stated in this plan are implemented by line and program management through a combination of AMMT, ORNL NR&D, and ORNL Standards Based Management System (SBMS) procedures and documentation. SBMS is ORNL's online system used to translate external and internal requirements into laboratory-wide policies and procedures. The requirements are conveyed to line management and staff members to help them achieve ORNL's mission in a safe and compliant manner while meeting sponsor expectations and needs. Detailed technical NR&D project- or program-specific requirements are addressed by a range of work-controlling methods, including using laboratory notebooks and generating alternate paper and electronic records and—where deemed necessary—work-controlling documents, such as test and experimental plans, technical procedures, operating guidelines, drawings, sketches, or other internally generated documents used to control the quality of work. Work can also be conducted using national or international standards or work methods and manufacturer's equipment manuals and related documentation. Decisions concerning the level of documentation needed to adequately control work are under the purview of each principal investigator/work breakdown structure (WBS) lead (see Section 3.1.1 for the description of the WBS lead role), with guidance provided by the quality representative/manager (QR).

2.1 GRADING OF REQUIREMENTS BASED ON AMMT WORK SCOPE

AMMT's mission is to rapidly demonstrate the application of advanced manufacturing processes for building and deploying a nuclear energy system to advance the vision of reliable and available, low-cost, clean energy using modern technology. Proof-of-principle activities that are implemented based on a strong, nuclear standards–based quality program will enable the US nuclear industry to adopt these technologies with the assurance that the quality requirements mandated through the NRC have been addressed during each AMMT work phase.

ORNL will apply quality requirements on a phased schedule based on the technology life cycle approach described in NQA-1 Part IV, Subpart 4.2 [6]. Within Subpart 4.2, Section 300 provides the following pertinent guidance:

> Graded approach is the application process for administrative controls. It is a process by which the level of analysis, extent of documentation, and degree of rigor of process control are applied commensurate with their significance, importance to safety, life cycle state of a facility or work, or programmatic mission.

This guidance will serve as the foundational approach for applying the necessary quality requirements based on each AMMT project phase and for the nature of the associated milestone deliverables resulting from the technical activities conducted in support of each WBS area. Figure 1 illustrates this approach and how it aligns with AMMT's planned, phased progression.

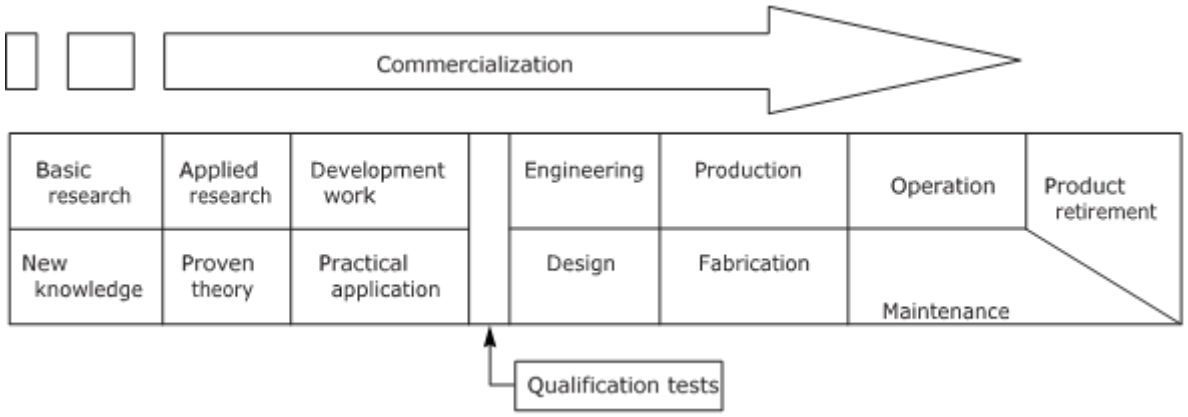


Figure 1. ASME NQA-1-2008 technology life cycle (from ASME NQA-2008 Part IV Subpart 4.2, Fig. 103) [6].

AMMT is expected to continue R&D efforts while often performing specific tasks that require higher levels of quality rigor to meet client requirements (such as in the case of producing sample nuclear parts). This innovative approach will require ORNL to provide consistent, objective evidence of a due diligence effort in the planning, conducting, and documenting of phased activities in accordance with the requirements of NQA-1 Subpart 4.2 [6]. For these activities, design control will be applied as described in Section 3.3 of this plan, "Design Control," and if applicable, software development to support the digital platform will be applied as described in Section 3.19, "Safety Software."

The AMMT QA program is designed to be equally versatile, agile, and iterative. As the list of annual milestone deliverables is formulated, each WBS area will be reviewed against the needs of the current technology phase and the planned use of the deliverables to determine (1) which NQA-1 requirements apply, (2) what documentation must be developed, and (3) what records must result from the technical activities that contribute to each milestone. This QA program plan (QAP) will be reviewed annually to determine if changes are warranted based on the progress from development to engineering and final design, as well as to production and operation and ultimately to retirement, as illustrated in Figure 1.

3. QUALITY ASSURANCE CRITERIA DESCRIPTION

The following sections contain the specific QA criteria described in NQA-1[6] and 10 CFR Part 50, Appendix B, "QA Program Requirements" [7]. These criteria also address the quality requirements associated with DOE Order 414.1D, *Quality Assurance* [2], and 10 CFR Part 830, Subpart A, "Quality Assurance" [3], as shown in Appendix A of this document.

3.1 ORGANIZATION

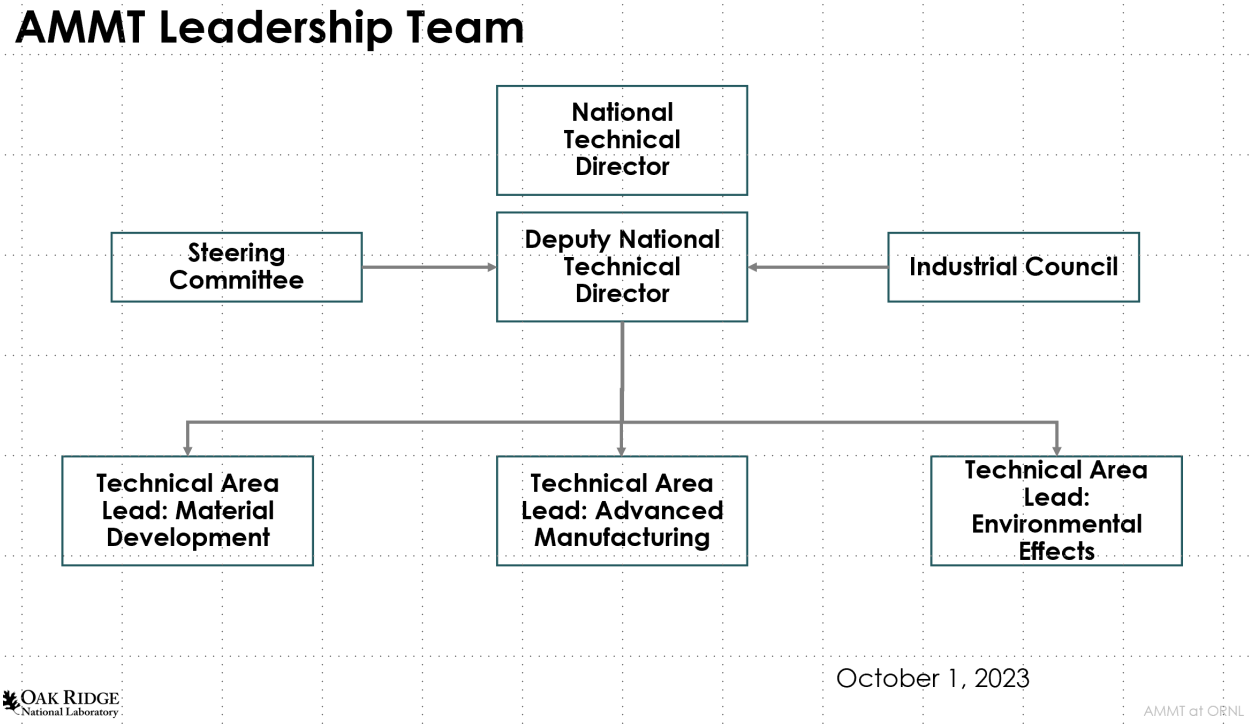
This section defines the processes and actions for meeting the requirements of NQA-1 [6] Requirement 1, "Organization," and 10 CFR Part 50, Appendix B [7], Section I, "Organization." This section defines the organizational structure, functional responsibilities, levels of authority, and lines of communication for activities affecting quality.

AMMT program management appropriately balances QA considerations with the cost and schedule in operations and related activities. In ORNL's structure, the AMMT technical manager and project manager interface with ORNL senior management and AMMT program sponsors. WBS leads work for line-based division directors on a matrixed basis. ORNL program and project managers typically delegate responsibilities for executing program-associated tasks that are performed or subcontracted by ORNL to

WBS leads or principal investigators (PIs), who are assigned to oversee technical activities conducted by AMMT staff. AMMT WBS leads and staff members, with input from program and project managers, are responsible for implementing this plan.

The AMMT technical manager and QR shall approve this QAP and obtain concurrence from a management representative of the ORNL Performance Analysis and Quality organization (PAQ). A QR reports administratively within the PAQ and is assigned as an independent resource to programs and projects. The QR interfaces with the ORNL program or project managers on QA issues. The quality program's group leader coordinates the resources necessary to support the effective implementation and oversight of the QA program.

Figure 2 and this section provide information concerning expected quality responsibilities, internal and external interfaces, and the authorities of each organization involved in AMMT efforts directly funded by DOE. For items not specifically described in this document, Appendix A defines each quality criterion, specifies its implementing documentation, and designates its responsible organization and owner. Links in Appendix A are provided for ease of reference, but are not required to be active links for the references to apply. Figure 2 provides an example of AMMT's organization and reporting structures. The approved organization chart is available on the ORNLAMMT SharePoint site for participant reference.



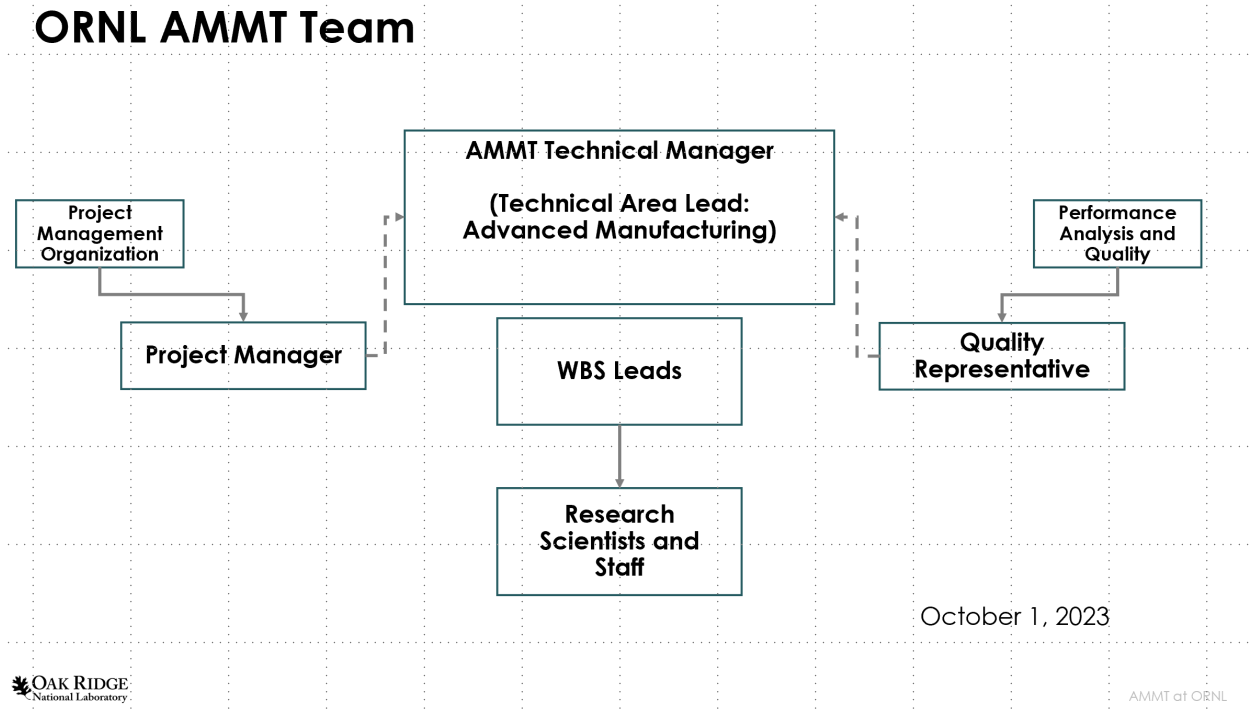


Figure 2. General AMMT organizational structure example.

3.1.1 Positions of Direct Responsibility and Authority for AMMT Program and Project Activities at ORNL

3.1.1.1 Technical Manager

The ORNL AMMT technical manager also serves as AMMT's technical area lead for and is responsible for the overall implementation of quality within AMMT's technical work scope. The technical manager also serves as the primary interface with AMMT and ORNL management and DOE. This implementation involves internal groups, divisions, and directorates, as well as external interfaces, including DOE national laboratories and other entities. This position provides the high-level strategic vision and approach for all technical activities, including those under the purview of the WBS leads. The technical manager determines the priorities within and among each WBS area and is responsible for the progress made toward completing the activities that lead to the completion of AMMT milestone deliverables. The technical manager, in conjunction with the QR, is also responsible for ensuring that AMMT personnel understand, are trained to, and adhere to the quality requirements incumbent upon AMMT activities. The technical manager can delegate the performance of specific functions of this role but will still maintain overall responsibility for the program's performance and quality.

3.1.1.2 Project Manager

The ORNL AMMT project manager develops and manages the program's scope, schedule, and budget, including the implementation of project controls, risk management, and reporting. They manage the programmatic activities associated with the defined scope of work and maintain the quality program developed to meet sponsor needs. The project manager, in conjunction with the technical manager, also serves as a programmatic interface with AMMT and ORNL management and DOE. They interact with other division directors and WBS leads or PIs to ensure that the assigned activities are successfully performed and that the quality program is consistently implemented. When necessary, the project

manager is responsible for informing AMMT and ORNL top management of quality performance issues and any associated needs for improvement. As designated by the AMMT technical manager, they are also the point of contact for ensuring that all program participants are consistently made aware of the sponsor requirements incumbent upon the work scope. The project manager develops, approves, and maintains AMMT program documentation, including controlled documents and AMMT records.

3.1.1.3 WBS Leads/Principal Investigators

ORNL WBS leads and PIs are the focal points for quality within each WBS area and serve as the task contact for the technical manager, project manager, and the QR. In response to AMMT sponsor expectations and requirements, each WBS lead/PI (hereafter referred to as the *WBS lead*) develops the overall structure for the task or segment of work under their purview through planning documents such as proposals, program plans, experimental or test plans, procedures, and any other work-controlling documentation considered necessary for satisfactorily meeting the applicable work scope specifications, processing plans, training, or test requirements, as well as related quality requirements defined or referenced in this plan. The WBS lead is also responsible for obtaining desired program or project results.

3.1.1.4 Work Area Group Leaders/Supervisors

ORNL group leaders and supervisors are the ORNL line managers responsible for the areas in the various divisions in which AMMT Program work is performed. They ensure that staff members are trained to technical and quality programs, the work and necessary documentation to support the work are defined, work activities are evaluated for safety and hazard mitigation needs, appropriate health and safety equipment is available, and the infrastructure needed to support successful completion of the planned work is in place.

3.1.1.5 Technical Staff Members

Technical staff members are responsible for achieving quality, taking required training, and for continuous improvement at the working level. Quality is achieved and maintained by those who are qualified, have been trained, and assigned responsibility for performing work. The staff members performing activities to support the technical tasks are scientists and engineers with technical support provided by technicians, hot cell operators, and other personnel with the recognized expertise needed to successfully complete AMMT activities under each task. All ORNL staff members are authorized to

- prevent the occurrence of any potential nonconforming conditions,
- identify opportunities for actions and continuous improvement initiatives,
- verify the effectiveness of preventive or corrective actions and initiatives, and
- stop work if continuing would jeopardize the safety or quality of a task.

Related to these management expectations, staff members shall ensure that the appropriate management personnel and the QR are notified so that appropriate actions can be taken and the associated documentation can be generated and maintained in support of these actions and initiatives.

Staff members also have the responsibility and authority to stop work that is considered to be a serious threat to their safety or health or the health and safety of other personnel, the public, or the environment. Staff members are also authorized to stop work if they identify a potential effect on the quality of the work, the goals of the sponsor, or the reputation of ORNL. Management expectations and the processes associated with stop-work actions are defined in the SBMS program description, “Worker Safety and Health Program.” Before starting work, each staff member is responsible for ensuring that equipment

under their purview operates correctly, that it is calibrated to the accuracy needed to support the planned work, and that work-controlling documents are the latest revision.

3.1.1.6 Quality Representative

The QR reports to the ORNL PAQ organization and is matrixed to the division director responsible for sponsor deliverables. The QR ensures that an appropriate QA plan is established and verifies that activities affecting quality are correctly performed. The QR has sufficient authority, access to work areas, direct access to management, independence from cost and schedule considerations that could adversely affect safety or quality, and organizational freedom to do the following:

- Assist the line organization in planning, developing, and implementing quality program(s)
- Interpret QA program requirements
- Assess the implementation of quality program(s)
- Identify quality-related problems and their effects
- Initiate, recommend, or provide solutions to quality-related problems through designated channels
- Verify the implementation of solutions
- Initiate stop-work orders in consultation with the affected line organization management when a condition adverse to quality cannot be satisfactorily resolved
- Ensure that further deliverable-related activities—such as processing, delivery, installation, or use—are controlled until any related nonconformances, deficiencies, or unsatisfactory conditions are properly dispositioned
- Provide input to pre-procurement planning as the quality-significant reviewer (QSR) for quality significant requisitions
- Serve as point of contact for SQA and interpret program requirements in the SBMS subject area, “Software Quality Assurance”
- Support the coordination of internal and external assessments and responses to assessments
- Assist the organization in ensuring that program work is properly documented and reviewed

As a component of the quality role in work assessment activities, the QR reviews work-controlling documents and conducts or helps conduct surveillances and audits of tasks and processes on a select basis.

3.1.2 Responsibilities for Quality

Project managers, group and WBS leads, and technical staff members associated with AMMT activities are responsible for achieving quality and for continuous improvement. Quality is achieved and maintained by those who have been assigned responsibility for performing work. Although not directly responsible for performing program work, the QR coordinates activities to ensure that program quality commitments are achieved. The WBS lead is the focal point for quality within a task and is the QR’s task contact.

In response to sponsor expectations, each WBS lead develops the overall task structure through proposals, program plans, experimental or test plans, procedures, and any other documentation considered necessary to define task workflow and completion. The WBS lead also implements any necessary improvements concerning the task structure based on feedback from participants and is responsible for obtaining desired program results.

3.2 QUALITY ASSURANCE PROGRAM

This section defines the processes and actions necessary for meeting the requirements of NQA-1 [6] Requirement 2, "Quality Assurance Program," and 10 CFR Part 50, Appendix B [7], Section II, "Quality Assurance Program." This section defines the AMMT QA program to ensure that:

- activities affecting quality are identified and controlled to an extent consistent with their importance
- personnel performing or managing activities affecting quality are indoctrinated, trained, and qualified, as necessary
- management regularly assesses the adequacy and effective implementation of the QA program.

This plan provides for the planning and accomplishment of activities affecting quality under suitably controlled conditions by judiciously applying the requirements of NQA-1 [6] based on NQA-1 Part IV, Subpart 4.2 and as described in Section 2.1 of this plan. The application of requirements is based on the technical activities in each WBS area and the nature of the deliverables associated with each task. Decisions concerning the applicability of the requirements in NQA-1 and 10 CFR Part 50, Appendix B [7], for AMMT's current work scopes are documented in this plan; in the QA-implementing procedures, which are in the applicable documents listed in Appendix A; and in any additional documentation/records deemed necessary as the project progresses. This plan was designed to ensure that appropriate planning is established and implemented commensurate with ORNL's responsibilities for the

- health and safety of workers and the public,
- protection of the environment,
- reliability and continuity of operations,
- successful accomplishment of the program's mission and objectives, and
- generation of valid results and completion of program deliverables.

This plan was prepared and shall be reviewed, approved, issued, implemented, and maintained for ORNL organizations and staff who perform quality-related activities governed by the requirements imposed by AMMT sponsors. Before the AMMT Program or project activities are closed out, open or incomplete quality-related action items shall be resolved, records shall be completed and transmitted and/or disposed of as required, and leftover or archival test materials shall be shipped or disposed of in accordance with applicable regulations and agreements between ORNL and DOE or any entities designated by DOE.

The ORNL QA program is implemented by line and program management. This QAP identifies the applicable requirements referenced in Section 2.0 that shall be implemented by AMMT management and staff. The controls required by this QAP are administrated using a graded approach, with the importance of activities, the consequence of failure, and the nature of the final deliverables used as the grading criteria. The purpose of this approach is to control the work activities as necessary to ensure that applicable requirements are met regarding the items and activities that affect each work scope and its success.

This QAP is used in conjunction with QAP-ORNL-NR&D-01, *Quality Assurance Plan for Nuclear Research and Development Activities conducted at the Oak Ridge National Laboratory* [9], which is used to implement the materials and fuel development and testing programs. QAP-ORNL-NR&D-01 implements the NR&D development and testing programs through the use of ORNL procedure NR&D-QA-08, *Materials, Test Article, and Irradiation Nuclear Core and Test Reactor Identification and Control, Processing, Handling, and Status Requirements* [10]. This procedure can be used as a standalone process control document or in conjunction with other ORNL and AMMT procedures, as referenced in this document.

3.2.1 Work Planning, Control, and Documentation Considerations

The management controls described in this plan and in the associated implementing documents provide systems and processes that enable AMMT participants to deliver products that meet or exceed the expectations of program sponsors. Quality controls shall be applied to the degree commensurate with the

- planned and possible future function or end use of the deliverable,
- consequence of failure (i.e., risk) associated with the deliverable,
- importance of the data or information being collected or analyzed,
- complexity of the equipment or software required to achieve the sponsor goals,
- uniqueness of the deliverable or degree of standardization, and
- degree to which functional compliance can be demonstrated through inspection or testing.

Activities that could affect the quality of the deliverables for which ORNL is responsible are defined as *quality-related activities*. The AMMT QA program shall control quality-related activities to an extent consistent with their importance to the results associated with the project deliverables. For planned future activities, the cognizant project manager and WBS lead, with guidance from the QR, shall determine the level of formality needed in the work-controlling documents before beginning the associated activity.

Implementing documents applicable to the program scope of work shall translate the QAP requirements into work processes in which the QAP does not do so directly. The AMMT technical manager and project manager direct the activities and resources required to develop and implement this QAP and ensure that WBS leads, and staff members consider the following elements during work planning activities:

- Definition of the work scope and objectives, as well as a list of the primary tasks involved
- Appropriate application of the QA requirements
- Definition of the necessary activities and how they will be accomplished
- Identification or development of the appropriate implementing documents
- Identification of laboratory testing equipment, software, or other equipment
- Identification of prerequisites, special controls, environmental conditions, processes, or skills
- Identification of applicable technical and management controls, required records, and verification activities
- Assignment of responsibilities
- Training and qualification
- Program closeout activities.

The technical activities undertaken to produce program deliverables are identified by the technical manager, project manager, WBS leads, and staff members and are documented in various information formats, including proposals, technical program plans, white papers, WBSs, milestone listings, memorandum purchase orders, statements of work, responses to requests for proposals/tenders, and others. These documents are expected to be revised to reflect changes in priorities and the course of work activities, and they will be updated by revising the original documents or by other means, depending on the sponsor organization’s requirements.

Because different tasks within WBS areas could have varying effects on the overall program quality, the rigor of the application of the quality requirements may commensurately vary depending on the needs and effects of a particular task.

Laboratory notebooks or electronic records shall be used as the baseline method for controlling technical activities. In every case, records shall be captured and maintained to (1) fully support the conduct of work and the conclusions or deliverables resulting from each activity and (2) facilitate the replication of the activity, if needed. Although laboratory notebooks are the baseline option for recording R&D results, alternate paper and electronic records are an acceptable alternative for developing test methods, recording testing results, and compiling the records that provide objective evidence of the work performed. This method is allowed as a convenience to the WBS leads and staff members because requiring all records be stored in laboratory notebooks is often difficult to implement and adds no value to the quality of the body of data or information generated.

In addition to using laboratory notebooks or alternate paper or electronic records, procedures, guidelines, drawings, or sketches may also be used to control the conduct of work. Other work-controlling methods include job-specific training, the qualification for a specific task by demonstrating competence, and the supervision of staff by project-level personnel. The conduct of testing activities may also be supplemented using recognized, proven methods that are described in national consensus standards and work methods and in the operating instructions contained in manufacturer's equipment manuals. In all cases, work control mechanisms shall include a clear description of the controlled conditions needed to conduct each activity, including the use of appropriate equipment and standards; maintenance of the environmental conditions suitable for accomplishing the activity, if any are required; and the processes and methods for ensuring the prerequisites for the activity are satisfied.

Because the AMMT Project is expected to include a wide range of goals for data and information—especially during the R&D activities—the documentation verifying goal accomplishment may be produced after the fact in research records using an iterative process as a result of initial test development activities. The resulting records may be used to develop a consistent approach for conducting future testing activities.

If necessary, work-controlling documents are modified during program activities and are updated using processes to ensure change control, as described or referenced in Sections 3.5 and 3.6 of this plan. Work control, for the purposes of identifying and mitigating any associated hazards, is implemented using ORNL research safety summaries provided for in SBMS subject area, "Work Control."

Program participants ensure that they are using the latest versions of documents. Documents that could affect the quality of AMMT activities shall be controlled in accordance with Section 3.6 and shall be prepared, reviewed, and approved in accordance with the requirements described in Section 3.5. Additionally, program/project managers are responsible for verifying that they are using the latest versions of nonprogram documents from external sources, such as the sponsor, and that these documents are appropriate for use.

This plan and the associated QA-implementing procedures shall be issued through ORNL's web-based Enterprise Document and Records Management (EDRM) system and made available to all program participants through online access.

3.2.2 Peer/Technical Review of Research and Development Results

NR&D conducted at or for ORNL is primarily documented through laboratory reports published by ORNL or by the sponsor for cases in which ORNL technical staff members contribute to a collaborative report generated by another entity. Additionally, the research is frequently documented in open literature reports such as scientific journals, technical publications, and conference proceedings. In all cases, all

publications and the associated research results for which ORNL is responsible are subject to peer review in accordance with SBMS subject area, "Publications and Other Scientific Communications."

ORNL AMMT reports receive a peer review through the ORNL's publications application, RESolution. All reports are internally reviewed according to the publication and clearance process for ORNL, including reviewing, commenting, and modifications, when necessary, from two or more ORNL staff members who are not involved in the work but who are qualified to review the documents for scientific merit.

All external publications receive the same type of ORNL internal peer review as that described previously, as well as the reviews required by the publishing organization, which vary in level of detail but typically include a peer review by one or more reviewers, comments, and author resolution. This process is a key quality-assuring function that ensures work is performed using controlled processes that lead to a defendable, repeatable body of data/information and deliverables that meet each sponsor's expectations and requirements.

3.2.3 Quality Problem Detection and Prevention

The AMMT Program is subject to the quality improvement initiatives required by ORNL's QA program. Participants in the program prepare and report data through line organization mechanisms as required by plans, procedures, and ORNL requirements that are used for input to management decisions affecting the success of the program.

Processes that monitor performance, identify weaknesses and deficiencies, share lessons learned, and establish and implement corrective actions are part of the quality improvement process. These processes are implemented in select targeted surveillances, audits, or other types of assessments that are scheduled, planned, performed, and documented to ensure that program quality requirements are effectively implemented in accordance with SBMS subject area, "Audits and Assessments." The identification of weaknesses and deficiencies that result from assessments, surveillances, or audits shall include a determination of whether any issue could affect the quality of the associated technical activity.

Quality improvements in day-to-day program operations are identified and implemented, as needed. Process changes are controlled and documented through the document revision process. Problems that transcend a particular program task shall be communicated to all program participants and potentially affected ORNL staff members. These programs shall be captured in the ORNL corrective action program (Section 3.16). The requirements contained in SBMS subject area, "Issues Management and Analysis," include stipulations for corrective actions (Section 3.16) that result from process and item inspections (Section 3.10), and SBMS subject area, "Audits and Assessments," addresses the corrective actions that result from the assessments. Assessments, including surveillances and audits, are used as sources of information concerning scientific, business, and operational performance by managers, staff members, and clients. These assessments provide mechanisms for continuous improvement.

3.2.4 Resolution of Quality Disputes

The problems noted at the task level are identified to the WBS lead. The WBS lead and QR define the problem and its cause, and then they recommend resolution to prevent its reoccurrence. Then, the problem is documented, and its resolution is implemented. Any differences of opinion or continuing concerns resulting from the identified problem and involving QAP requirements are brought to the attention of the cognizant ORNL project manager. The project manager and the QR work with the appropriate representative of the affected organization to satisfactorily resolve any quality problems. If this approach

does not end in a resolution, then the problem will be elevated to incrementally higher levels of management until it is resolved or until DOE or Strategic Partnership Project sponsor managers are involved and resolve the dispute.

3.2.5 Stop-Work Authority

Any ORNL staff member shall stop work if any of the following conditions exist.

- An obvious and serious condition, hazard, or near-miss is personally observed.
- The situation is viewed as one of imminent danger.
- No other immediately known options exist to correct the situation and allow the activity to continue safely.
- The situation could seriously affect the quality of the test articles or the associated collected data, especially if the test articles undergo destructive testing.

A stop-work action under these conditions is conducted in accordance with SBMS subject area, "Stop Work."

Any health, safety, environmental, or quality issue that precipitated the stop work condition must be addressed, and approval must be obtained from the relevant ORNL authorities before resuming operations. For any suspension of operations, the actions required to resume work will be identified and verified as complete before resuming in accordance with SBMS subject area, "Stop Work."

3.2.6 Training and Qualification

Each organization that participates in AMMT activities is responsible for planning, coordinating, and conducting the necessary indoctrination, performance-based training, and retraining to ensure that suitable proficiency is achieved, maintained, and documented for program tasks that could affect the quality of the work. The programmatic goal is to ensure that personnel performing or managing quality-related activities achieve and maintain a satisfactory and suitably proficient level of indoctrination, training, and qualification. Training activities shall be planned, accomplished, and documented in accordance with SBMS subject area, "Training of Staff," and its subordinate procedures. The systems and processes described in SBMS subject area, "Training of Staff," are intended to ensure that personnel are satisfactorily qualified and that only the personnel who meet the explicit indoctrination and training requirements are permitted to perform each activity.

Each organization has the flexibility to train personnel on a case-by-case basis for the particular technical task to be performed. Each organization designates the activities that require personnel qualification and establish the minimum requirements for each person. The considerations associated with indoctrination, training, and qualification include the education, training, experience, and proficiency of each individual and the scope, complexity, and importance of each technical or managerial activity. Decisions concerning the level of formality of the indoctrination and training for personnel performing or managing activities that could affect the quality of AMMT deliverables shall be the responsibility of the cognizant project manager and WBS lead. Technical and managerial staff shall be provided with indoctrination information concerning their job responsibilities and authority that includes general criteria, technical objectives, requirements of applicable codes and standards, regulatory commitments, company procedures, and QA program requirements as needed for each assignment. The baseline for this information is the roles, responsibilities, accountabilities, and authorities for project managers, PIs, and technical staff members as conveyed through SBMS subject area, "Roles, Responsibilities, Accountabilities, and Authorities." Subject matter expertise that ensures SBMS subject area, "Training of Staff," is properly implemented is

available from each line organization's training officer. Additional AMMT-specific requirements are included in AMMT-PM-PROC-002, *AMMT Organization* [11].

The indoctrination and training of personnel to support AMMT task activities are the responsibility of the WBS lead. Explicit training requirements for each activity are identified in the work-controlling documents associated with each activity as needed. Any required training records shall be identified in each work control document and maintained to document the technical training. These records may be stored in dedicated training files or in alternate files associated with the technical documents to which the training applies. In all cases, training files must be maintained so that they are protected from damage and are retrievable.

The training or qualification necessary for ensuring the quality of AMMT results shall be documented where required and shall include a specific review of the reading requirements, specific hands-on training requirements, and the specific requirements needed to achieve, demonstrate, and maintain satisfactory proficiency.

WBS leads shall ensure that the training and indoctrination planned for each activity establishes the initial necessary proficiency, maintains the proficiency on a timely basis, and promotes the skills and knowledge to adapt to changes in technology, methods, or job responsibilities associated with each activity.

WBS leads can train select staff on the general conduct of the work or on only narrow segments of the task at their discretion. Direct supervision for infrequently conducted tasks may be used when extensive training is not practical. On-the-job training shall be used if direct hands-on applications or experience are needed to achieve and maintain proficiency.

The program participant's line manager shall review the qualification and training needs of personnel outside of those who are needed explicitly for AMMT activities. Program personnel may be qualified by examining their credentials and/or observing their work performance.

Records that are maintained by nuclear program management and associated line organizations of the implementation for indoctrination and training may include attendance sheets, training logs, or personnel training records. The records of indoctrination, training, and qualification—including requalification for auditors, lead auditors, and inspection and test personnel—shall be established and maintained by each program, associated line management, or the ORNL Training organization.

AMMT personnel are indoctrinated in the program QA requirements contained in this plan and in the applicable SBMS requirements. This indoctrination shall be planned and documented, and it shall include either attendance at a AMMT training session or completion of the required reading of this plan's requirements.

Some AMMT tasks may use the services of personnel assigned to perform nondestructive examination (NDE) program responsibilities at ORNL. These personnel shall be qualified in accordance with the ORNL Fabrication Division's work control document, FHRD-ADM-ACP-11, *Qualification/Certification Requirements for NDE Examiners* [12], including *Levels 1 and 2 Certification*. These documents implement the NQA-1 [6]–referenced NDE standard, SNT-TC-1A [13], and its supplements for instances involving NDE considerations, applicable codes and standards, or relevant design criteria that control NDE personnel qualification that shall be used to establish the applicable American Society for Nondestructive Testing qualification requirement and edition or to specify an equivalent alternative requirement.

When applicable, the WBS lead ensures that any special physical characteristics that personnel need to perform an activity are identified, including initial and subsequent physical and vision examinations.

3.2.7 Independent Audits

AMMT program management and the QR are responsible for ensuring that the QA audits performed at the request of the program or a sponsor are conducted by auditing personnel with the competencies required in NQA-1 Section 3.18 [6]. These competencies and the other NQA-1 stipulations associated with the QA auditors and the auditing process, as described in paragraphs 303.1–303.6 of the standard, are addressed by implementing PAQ-AP-005, *Qualifying Auditors and Certifying Lead Auditors* [14], and SBMS subject area, "Audits and Assessment."

ORNL has established and maintains records for indoctrination and training, auditor and lead auditor qualification and requalification, and inspection and test personnel qualification and requalification by implementing SBMS subject area, "Audits and Assessments."

In addition to QA personnel, ORNL may use technical specialists to address non-QA-related topics and subject areas during audits. ORNL has established the qualifications and requirements for using technical specialists to audit the QA programs before the audit begins.

3.3 DESIGN CONTROL

It is not expected that AMMT will independently design nuclear items. If required, the requirements of NQA-1 Requirement 3, "Design Control" [6], and 10 CFR Part 50, Appendix B, Section III, "Design Control" [7], are implemented and applied in accordance with this section. The requirements in this section ensure the following:

- The design shall be defined, controlled, and verified.
- Inputs shall be specified on a timely basis and translated into design documents.
- Interfaces shall be identified and controlled.
- Adequacy shall be verified by individuals other than those who designed the item or computer program.
- Changes shall be governed by control measures commensurate with those applied to the original design.

Design control for AMMT work performed at ORNL is implemented in accordance with SBMS subject area, "Design," and AMMT-QA-PROC-001, *AMMT Technical Procedure* [15]. Configuration management at ORNL is implemented in accordance with SBMS subject area, "Configuration Management." Design activities shall include the identification, documentation, and review and approval of the applicable appropriate quality standards to be applied to the design. The baseline design requirements are developed in accordance with the NQA-1 standard [6]. The design review shall include verifying *critical characteristics*, which are characteristics that provide reasonable assurance that the item or equipment performs its intended function. ORNL design authority is applied through the Engineering Management Division. AMMT design authority shall be designated and approved by the primary ORNL design authority.

The primary design documents for AMMT activities include the following:

- Test plans or product specifications, which are often jointly developed between the sponsor and ORNL based on any sponsor-mandated test requirements (i.e., the owning ORNL organization, or the WBS lead's technical division)
- Software control plans and other documentation related to software design and development (see Section 3.19)
- Design drawings and sketches for components associated with the demonstration reactor structures, systems, or components
- AMMT-associated safety basis design documents

The complete set of requirements mandated by the sponsor and addressed by ORNL to implement the necessary material and irradiation test requirements for irradiated test capsules are contained in QA-implementing procedure NR&D-QA-08, *Materials, Test Article, and Irradiation Nuclear Core and Test Reactor Identification and Control, Processing, Handling, and Status Requirements* [10], and AMMT-DA-PROC-001, *AMMT Design Control and Configuration Management*, for reactor systems design. In some cases, ORNL procedures developed under NQA-1-2000 [8] QA requirements (or other versions) can be used by AMMT (examples include NNFD and HFIR), but where applicable, the differences between NQA-1-2000 and those requirements outlined in NQA-1-2008/9a [6] will be specifically addressed in AMMT implementing procedures. AMMT-QA-PROC-001, *AMMT Technical Procedure* [15], uses *NNFD Design Control*, *NNFD Process and Configuration Management*, and related procedures and forms. Gaps from NQA-1-2008/9a to NQA-1-2000 have been specifically identified and addressed in AMMT-QA-PROC-001. Configuration drawings or sketches produced by ORNL shall be controlled documents, shall have a unique drawing number and revision number assigned to them, and shall be issued before performing the work for which the drawing or sketch is produced. Each drawing or sketch shall be developed and signed by an individual with the appropriate background for developing the candidate drawing or sketch. The QR shall also review and sign, indicating approval, to ensure that the drawing or sketch reflects the original design and contains the QA requirements needed to ensure that design documents, calculations, and test articles are produced and controlled in compliance with program requirements. Any additional external review requirements imposed by the sponsor shall be identified and implemented.

The R&D equipment used for these activities shall be satisfactorily controlled through the test control and preoperational qualification requirements described in this plan. The control of associated calibration activities shall be established and maintained in accordance with SBMS subject area, "Calibration." In-house, one-of-a-kind equipment shall be documented in drawings or sketches at the level of detail necessary for addressing any future needs for research repeatability.

All software—including software-based models that are developed in-house or acquired—shall be evaluated against the applicable requirements in SBMS subject area, "Software Quality Assurance;" the implementation shall address applicable NQA-1 software design and development requirements per Part II, Subpart 2.7 [6] (see Section 3.19). In-house developed software inputs and outputs shall be verified and validated using alternate calculation methods, testing with materials providing a known and verified result, or through peer review. In-house developed software shall also be configuration controlled.

Based on the previously described activities associated with design and development, ORNL applies the associated quality requirements using a graded approach as described in ORNL's QAPD [4] in the section entitled "Graded Approach."

Based on the previous information, the most stringent rigor in applying quality requirements associated with AMMT shall primarily apply to the test reactor nuclear core and demonstration reactor safety system design, as well as development activities. The design and development stages for the nuclear core and test

reactor are well-defined in applicable ORNL and AMMT procedures. Nuclear core and reactor design review, verification, and validation requirements—including the formulation of appropriate calculations for each development stage and the applicable responsibilities and authorities—are governed by these procedures and the requirements of AMMT-QA-PROC-001, *AMMT Technical Procedure* [15]. The interfaces among AMMT and supporting directorates are clearly defined in AMMT and directorate procedures to facilitate effective communication and the clear assignment of responsibilities.

The inputs applicable to nuclear core and test reactor design are defined in AMMT procedures. These inputs include the following:

- Functional requirements, performance requirements, and associated performance calculations
- Applicable statutory and regulatory requirements governed through AMMT as the reactor owner/operator organization
- Previous and often similar nuclear core and test reactor designs; most nuclear core and test reactor reactors that are currently planned or under irradiation have been verified for their adequacy over years of experience and through numerous cycles in the reactor
- Any other unique technical requirements that could be essential for effective design and development

AMMT procedures provide for the review for adequacy and the verification that requirements incumbent upon each nuclear core and test design are complete, unambiguous, and nonconflicting.

The outputs associated with designing and developing nuclear cores and test reactors are approved before release, after they are verified against the design inputs. These outputs are explicitly verified to

- meet the input requirements as defined by AMMT and verified by AMMT for designing and developing nuclear cores and test reactors,
- provide appropriate information for the purchase of materials, subassembly production, nuclear core and test reactor, nuclear core and test reactor assembly and loading, and any associated preirradiation inspections mandated by the design documents,
- define or reference nuclear core and test reactor inspection points and acceptance criteria; and
- specify the characteristics of each nuclear core and test reactor design that are essential for its safe and compliant use in conformance with technical specifications and reactor operating requirements.

Any substantive design changes shall be approved by the same affected groups or organizations that reviewed and approved the original design documents. Any organizational change that results in a change in design ownership shall include the designation of the new responsible organization.

The stages for systematically reviewing nuclear core and demonstration reactor designs are defined in AMMT governing procedures. These procedures explicitly require the design and development results to be evaluated by AMMT design, nuclear safety, and operations staff to ensure that the applicable technical and quality requirements are met before being accepted for subsequent operation. This evaluation also ensures that any associated problems are clearly identified and documented through the ORNL nonconformance control process (see Section 3.15). This process requires applicable corrective or preventive actions to be defined and addressed (see Section 3.16). The governing procedures clearly define the technical, management, and quality reviews required for this process, and each review is documented, including any resulting actions. All final nuclear core and test reactor data packages require two documented QA reviews before they are released for installation and operation.

3.4 PROCUREMENT DOCUMENT CONTROL

The requirements of NQA-1 Requirement 4, "Procurement Document Control" [6], and 10 CFR Part 50, Appendix B, Section IV, "Procurement Document Control" [7], are implemented and applied in accordance with SBMS subject area, "Purchasing Goods and Services". In conjunction with ORNL subject matter experts (SMEs), AMMT personnel ensure that:

- the applicable design bases and other requirements needed to ensure adequate quality shall be included or referenced in the procurement of items and services and
- procurement documents require suppliers to have a QA program consistent with the applicable QA requirements, to the extent necessary.

AMMT-QA-PROC-001, *AMMT Technical Procedure* [15], implements the AMMT controls for overall document management. AMMT personnel work in conjunction with the ORNL Contracts Division to ensure that design basis documents and requirements are referenced in procurement documents with applicable QA standards.

3.5 INSTRUCTIONS, PROCEDURES, AND DRAWINGS

The requirements of NQA-1 Requirement 5, "Instructions, Procedures, and Drawings" [6], and 10 CFR Part 50, Appendix B, Section V, "Instructions, Drawings, and Procedures" [7], are implemented and applied in accordance with the ORNL associated instructions, procedures, drawings, and other related documents that could affect the quality of AMMT nuclear activities and are addressed in accordance with SBMS procedure, "Develop, Revise, and Control Other Controlled Documents." In conjunction with ORNL SMEs, AMMT personnel ensure the following:

- Quality-related activities and services are described by and performed in accordance with documented instructions, procedures, or drawings that include or reference appropriate quantitative or qualitative acceptance criteria for determining that prescribed activities have been satisfactorily accomplished
- The activity is described to a level of detail commensurate with the complexity of the activity and the need to ensure consistent and acceptable results
- The need for and level of detail in written procedures or instructions are determined based on the
  - complexity of the task
  - significance of the item or activity
  - work environment
  - worker proficiency and capability (education, training, experience)

AMMT-QA-PROC-001, *AMMT Technical Procedure* [15], implements the AMMT-specific controls for these requirements.

Each WBS lead has the authority and responsibility to make decisions concerning when and for which activities procedures, guidelines, or other work-controlling documents shall be used. Due to the nature of the scope of work for nuclear research, testing, and related activities, laboratory notebooks, other paper records, and alternate electronic records may be used to control work activities. National consensus standards/methods and manufacturer's operating manuals may also be used in the place of work-controlling documents. Measures are taken to ensure that processes are defined and repeatable for consistent NR&D results. The need for and level of detail in written procedures or instructions shall be determined based on the complexity of the task, significance of the item or activity, work environment, and worker proficiency and capability (e.g., education, training, experience).

Established documents that could affect the quality of an activity—such as procedures, guidelines, drawings, sketches, and procurement specifications—are controlled to ensure that the proper version of the document is supplied to the personnel performing task activities. Except in the cases of the use of manufacturer's equipment manuals and the subject areas and procedures conveyed through SBMS, each document used in direct performance of the work shall be identified using a unique document control number. As applicable, the document shall contain the appropriate quantitative or qualitative acceptance criteria to ensure each activity is satisfactorily accomplished. Work-controlling documents applicable to any activity shall be described at a level of detail commensurate with the complexity of the activity and the need to ensure consistent, acceptable results.

The WBS lead or line manager or a designee shall approve these documents and any subsequent changes that become necessary as activities progress. These documents shall be reviewed by relevant program, line, and support staff for accuracy; environmental, safety, and health effects; and usefulness. With input from the QR, the WBS lead or line management shall determine which documents require control. AMMT-QA-PROC-001, *AMMT Technical Procedure* [15], addresses how AMMT design drawings are specifically controlled in conjunction with AMMT document control.

3.6 DOCUMENT CONTROL

The control of instructions, procedures, and drawings for the AMMT Project shall be accomplished in accordance with AMMT-QA-PROC-001, *AMMT Technical Procedure* [15]. SBMS procedure, "Develop, Revise, and Control Other Controlled Documents," shall also be used to provide guidance in meeting ORNL-mandated baseline document control requirements for work-controlling documents used to conduct NR&D activities in other participating divisions. AMMT-QA-PROC-001 implements the controls for these requirements. In conjunction with ORNL SMEs, AMMT personnel ensure the following:

- The preparation, issue, and change of documents that specify quality requirements or prescribe quality-related activities—such as instructions, procedures, and drawings—are controlled to ensure that the correct documents are being used
- Controlled documents are reviewed for adequacy and approved for release by authorized personnel.

3.6.1 AMMT Document Control Summary

Documents shall be identified and controlled based on the requirements referenced previously. Controlled AMMT documents shall be distributed by implementing the requirements in AMMT-QA-PROC-001, *AMMT Technical Procedure* [15], and other processes mandated in other ORNL divisions, as applicable. EDRM may be used to facilitate the review of controlled documents. Each staff member determines the applicable work-controlling documents for each technical activity and verifies that they are the latest version before starting work. ORNL requirements mandate that controlled documents be reviewed for adequacy, completeness, and approval before distribution. QA-specific documents shall be distributed through EDRM. The referenced documents shall also identify the job roles for personnel responsible preparing, reviewing, approving, and distributing controlled documents.

Substantive or major changes to documents are changes that could affect the quality of the defined activity or the deliverable. When possible, major changes shall be reviewed and approved by the same organizations and SMEs who performed the original review and approval unless other organizations or people are specifically identified.

All other document changes are considered minor and are primarily editorial, such as organization name changes or position titles. Non-intent (minor) changes (e.g., typos, title change) may be implemented between revisions using the change notice function in EDRM. The non-intent change(s) must be documented in the "reason for revision" field in EDRM or in the comments field describing what has changed in the controlled document. Minor changes do not have to be incorporated into a document until a major or substantive document revision is required. These decisions are made at the discretion of the WBS lead or project manager, with subject matter expertise provided by the QR.

3.6.2 Use of Laboratory Notebooks

Laboratory notebooks may be used to record original research activities and resulting data prior to the development of technical procedures and other work-controlling documents per NQA-1 Subpart 4.2, "Guidance on Graded Application of Quality Assurance for Nuclear Related Research and Development" [6]. When used for this purpose, laboratory notebooks contain:

- the original descriptions of ideas, concepts, data, calculations, notes, and sketches pertinent to the research;
- an identification of the individuals who are performing the research and making the entry;
- an identification of the samples or test articles;
- any unusual measuring and test equipment (M&TE) calibration requirements;
- a description of the planned work, methods used to perform the work, any changes to the described methods, and obtained results; and
- any references to pertinent research data not located in the notebook.

The SBMS procedure, "Maintain Research Records," provides guidelines for using and preparing hard copy and electronic notebooks. The following practices shall be followed when using and preparing scientific notebooks.

- Entries shall be independently reviewed on a quarterly basis, and the review shall be documented by a signature and date.
- A statement of purpose shall be included in the front of each laboratory notebook or alternate test record notebook.
- The individuals authorized to make entries in the notebook shall be identified in the front of the notebook.
- The unused space on each page of the notebook shall be lined out to prevent its use.
- A table of contents shall be included in the completed notebook.
- The notebook shall be maintained under configuration control and registered per the SBMS requirements noted previously.

In-process and completed project laboratory notebooks shall be protected to prevent unauthorized entries, damage, loss, and deterioration. When appropriate, the critical data and process descriptions in the notebooks shall be collected and documented in topical reports. Laboratory notebooks are returned to the ORNL Records Management Operations group before the assigned employee retires or departs.

Technical notebooks shall be maintained as backup data to technical reports or data packages. Large amounts of data may also be stored in an electronic form. Electronic data shall be periodically backed up to prevent loss.

The controls for scientific and technical information are also described in SBMS subject area, "Publications and Other Scientific Communications."

3.7 CONTROL OF PURCHASED ITEMS AND SERVICES

The requirements of NQA-1 Requirement 7, "Control of Purchased Items and Services" [6], and 10 CFR Part 50, Appendix B, Section VII, "Control of Purchased Material, Equipment, and Services" [7], are implemented and applied in accordance with SBMS subject area, "Purchasing Goods and Services," and AMMT-QA-PROC-001, *AMMT Technical Procedure* [15]. This procedure uses NNFD procurement and item control procedures and forms. Gaps from NQA-1-2008/9a [6] to NQA-1-2000 [8] have been specifically identified and addressed in AMMT-DA-PROC-001 [16].

In conjunction with ORNL SMEs, AMMT personnel ensure that

- the procurement of items and services is controlled to ensure conformance with the specified requirements and
- the control provides for the following, as appropriate:
  - source evaluation and selection,
  - evaluation of objective evidence of quality furnished by the supplier,
  - source inspection,
  - audit, and
  - examination of items or services upon delivery or completion.

AMMT and/or its suppliers may use commercial-grade items or services in support of AMMT activities. When required, this process will be implemented according to SBMS procedure, "Obtain and Dedicate Commercial Grade Items for Nuclear Safety Applications," in conjunction with AMMT-QA-PROC-001, *AMMT Technical Procedure* [15]. In conjunction with ORNL SMEs, AMMT personnel ensure the following:

- The use of commercial-grade items or services must be preceded by the following actions:
  - Technical evaluation to determine that the item or service performs a safety function
  - Confirmation that the item or service meets the commercial-grade definition criteria
  - Identification of the critical characteristics, including acceptance criteria

- If any critical characteristics for acceptance cannot be verified by these dedication methods, then another method of qualification is used.

3.8 IDENTIFICATION AND CONTROL OF ITEMS

The requirements of NQA-1 Requirement 8, "Identification and Control of Items" [6], and 10 CFR Part 50, Appendix B, Section VIII, "Identification and Control of Materials, Parts, and Components" [7], are implemented and applied in accordance with AMMT-QA-PROC-001, *AMMT Technical Procedure* [15]. This procedure uses NNFD procurement and item control procedures and forms. Gaps from NQA-1-2008/9a [6] to NQA-1-2000 [8] have been specifically identified and addressed in AMMT-QA-PROC-001. In conjunction with ORNL SMEs, AMMT personnel ensure that

- controls are established to ensure that only correct and accepted items are used or installed and
- documentation of item identification is maintained on the items or in documents traceable to the items, or in a way that ensures that identification is established and maintained.

AMMT personnel identify, maintain, and control items of production (e.g., batch, lot, component, part) from the initial receipt and fabrication of items up to and including installation and use. This identification relates an item to an applicable design or other pertinent specifying document. Physical identification is used, if possible; if this method is impractical or insufficient, then physical separation, procedural control, or other appropriate means are used.

The identification and control of nuclear materials is applied in accordance with SBMS subject area, "Nuclear Materials Control and Accountability." AMMT-specific procedures will be developed to address the special identification and control requirements for items, as required.

3.9 CONTROL OF SPECIAL PROCESSES

The requirements of NQA-1 Requirement 9, "Control of Special Processes" [6], and 10 CFR Part 50, Appendix B, Section IX, "Control of Special Processes" [7], are implemented and applied in accordance with applicable AMMT QA-implementing procedures and SBMS subject areas. AMMT personnel ensure that the special processes that control or verify quality—such as those used in additive manufacturing, welding, heat treating, and NDE—shall be performed by qualified personnel using qualified procedures in accordance with specified requirements.

Special, unique processes will be used during AMMT task activities. If the specific task or requirement is not covered by previously identified SMBS subject areas and/or other requirements referenced in this document, then specific procedures or controls will be developed to implement those activities safely and with requisite quality.

Examples of special or unique processes might include:

- additive/advanced manufacturing techniques, systems, and/or machines
- nuclear irradiation experiments
- materials testing and characterization
- welding
- heat treatment
- NDE
- component or system assembly/disassembly
- special optics, cameras, and sensors.

3.10 INSPECTIONS

The requirements of NQA-1 Requirement 10, "Inspections" [6], and 10 CFR Part 50, Appendix B, Section X, "Inspections" [7], are implemented and applied in accordance with SBMS subject area, "Inspection and Acceptance Testing." In conjunction with ORNL SMEs, AMMT personnel ensure that

- inspections that are required to verify the conformance of an item or activity to specified requirements or the continued acceptability of items in service are planned and executed,
- the characteristics subject to inspection and inspection methods are specified,
- inspection results are documented, and
- inspections for acceptance are performed by qualified persons other than those who performed or directly supervised the work being inspected.

The AMMT WBS leads and associated principal investigators ensure that the inspection requirements and acceptance criteria include specified requirements in the applicable design documents or other pertinent

approved technical documents. Mandatory inspection hold points and in-process inspection steps are indicated in appropriate documents and performed by qualified individuals. Inspection and acceptance testing include monitoring for suspect/counterfeit items (S/CIs) in accordance with SBMS procedure, "Identify, Handle, Report, and Verify Suspect/Counterfeit Items and Defective Items" (see Section 3.21).

3.11 TEST CONTROL

The requirements of NQA-1 Requirement 11, "Test Control" [6], and 10 CFR Part 50, Appendix B, Section XI, "Test Control" [7], are implemented and applied in accordance with SBMS subject area, "Inspection and Acceptance Testing." In conjunction with ORNL SMEs, AMMT personnel ensure that the:

- tests required to collect data, such as for design input, to verify the conformance of an item or computer program to specific requirements or to demonstrate satisfactory performance for service are planned and executed
- characteristics to be tested and test methods to be employed are specified
- test results are documented, and their conformance with test requirements and acceptance criteria are evaluated.

For nuclear materials, fuels, and irradiation testing, NR&D-QA-08, *Materials, Test Article, and Irradiation Nuclear Core and Test Reactor Identification and Control, Processing, Handling, and Status Requirements* [10], implements the required controls.

If special AMMT testing activities are required and are not already covered by SBMS and/or this document, then a specific test procedure and/or test plan will be developed to document the required controls. For research activities, test control and planning can be integrated into specific test plans or in scientific notebooks.

3.12 CONTROL OF MEASURING AND TEST EQUIPMENT

The requirements of NQA-1 Requirement 12, "Control of Measuring and Test Equipment" [6], and 10 CFR Part 50, Appendix B, Section XII, "Control of Measuring and Test Equipment" [7], are implemented in accordance with this section and SBMS subject area, "Calibration." In conjunction with ORNL SMEs, AMMT personnel ensure the following:

- The tools, gages, instruments, and other M&TE used for quality-related activities are:
  - controlled
  - calibrated at specific periods
  - adjusted as necessary
  - maintained to required accuracy limits.
- If any of these are found out of tolerance, then it:
  - is tagged and/or segregated
  - is removed from service
  - is not used until recalibrated
  - has its previous application evaluated for effects.

In addition to these requirements, the ORNL Metrology organization provides support to AMMT as a registered supplier of calibration services that are compliant with the ISO/IEC 17025 standard, *General Requirements for the Competence of Testing and Calibration Laboratories* [19]. To verify these services, audits are conducted annually at a minimum by assessors from the US National Institute of Standards and

Technology's National Voluntary Laboratory Accreditation Program. Laboratories certified under ISO/IEC 17025 or similar national standards can perform nuclear quality material testing and calibration services without the need for a supplier audit. Additional review might be required to add testing laboratories to the ORNL evaluated suppliers list.

Calibration service providers are required to document the traceability of calibration standards to nationally recognized standards. Calibration procedures shall identify or reference the required accuracy for each instrument. The methods for and frequency of checking the accuracy of calibrated M&TE shall follow established ORNL calibration procedures or the associated manufacturers' requirements and recommendations provided with the equipment.

As specified, tests shall be conducted to determine if the equipment performs as specified before it is put into service. M&TE shall be properly handled and stored to maintain accuracy, and instrumentation that is consistently found to be out of calibration shall be repaired or replaced. M&TE shall be stored, used, and calibrated in accordance with the manufacturers' recommendations as described in operating and maintenance documentation, such as equipment manuals. Each equipment user is responsible for to determining the calibration status of the equipment and ensuring it is appropriately calibrated for its intended use before using the equipment.

In situations involving M&TE found to be out of calibration, an evaluation regarding the validity of the data previously taken with the M&TE item is conducted and documented.

3.13 HANDLING, STORAGE, AND SHIPPING

The requirements of NQA-1 Requirement 13, "Handling, Storage, and Shipping" [6], and 10 CFR Part 50, Appendix B, Section XIII, "Handling, Storage, and Shipping" [7], are implemented and applied in accordance with SBMS subject area, "Property Management," and AMMT-QA-PROC-001, *AMMT Technical Procedure* [15]. This procedure uses NNFD procurement and item control procedures and forms. Gaps from NQA-1-2008/9a [6] to NQA-1-2000 [8] have been specifically identified and addressed in AMMT-QA-PROC-001. In conjunction with ORNL SMEs, AMMT personnel ensure the following:

- The handling, storage, cleaning, packaging, shipping, and preservation of items are controlled to prevent damage or loss and to minimize deterioration.
- These activities are conducted in accordance with:
  - established work and inspection instructions
  - drawings
  - specifications
  - shipment instructions
  - other pertinent documents or procedures specified for use in conducting the activity.

Nonhazardous, hazardous, and radioactive materials and spent nuclear fuel shall be handled, stored, and shipped off-site in accordance with SBMS subject area, "Off-Site Transportation." Additional handling, storing, and shipping requirements may be documented depending on the type of materials being procured or maintained and the related standards, codes, and/or permit requirements.

3.14 INSPECTION, TEST, AND OPERATING STATUS

The requirements of NQA-1 Requirement 14, "Inspection, Test, and Operating Status" [6], and 10 CFR Part 50, Appendix B, Section XIV, "Inspection, Test, and Operating Status" [7], are implemented and applied in accordance with Sections 3.10 and 3.11. Additional inspection, test, and/or operating status

procedures or documentation that are required for AMMT-specific activities will be developed, as required. Inspection, test, and operating status for the nuclear materials testing program is applied per NR&D-QA-08, *Materials, Test Article, and Irradiation Nuclear Core and Test Reactor Identification and Control, Processing, Handling, and Status Requirements* [10]. In conjunction with ORNL SMEs, AMMT personnel ensure the following:

- The status of the inspection and test activities is identified either on the items or in documents traceable to the items for which it is necessary to ensure that required inspections and tests are performed.
- Items that have not passed the required inspections and tests are not inadvertently installed, used, or operated.
- The status is maintained through indicators such as
  - physical location,
  - tags,
  - markings,
  - shop travelers,
  - stamps,
  - inspection records, or
  - other suitable means.
- The authority for applying and removing tags, markings, labels, and stamps is specified.
- The status indicators are also provided to indicate the operating status of systems and components of the nuclear facility—such as by tagging valves and switches—to prevent inadvertent operation.

3.15 CONTROL OF NONCONFORMING ITEMS

The requirements of NQA-1 Requirement 15, "Control of Nonconforming Items" [6], and 10 CFR Part 50, Appendix B, Section XV, "Nonconforming Materials, Parts, or Components" [7], are implemented through SBMS subject area, "Nonconformance Control." In conjunction with ORNL SMEs, AMMT personnel ensure that the

- items that do not conform to the specified requirements are controlled to prevent inadvertent installation or use and
- controls provide for the
  - identification
  - documentation
  - evaluation
  - segregation, when practical
  - disposition of nonconforming items
  - notification to affected organizations.

In addition to the SBMS requirements, the following additional requirements apply to the control of nonconforming items associated with nuclear AMMT items:

- AMMT WBS lead, in conjunction with the QR and client engineering point of contact, is responsible for and serves as the authority for controlling the further testing, delivery, installation, or use of nonconforming items in conjunction with design, nuclear safety, and operation approvals.
- Each WBS lead is designated to perform evaluations to determine a disposition for a nonconforming condition associated with materials testing or test article fabrication activities and shall demonstrate competence in the specific area being evaluated, shall have an understanding of the applicable requirements, and shall have access to pertinent background information. Demonstrated competence

is based on education and experience, and it is verified by the QR as a part of the nonconformance control process.

- The nonconformances associated with applicable design requirements that are dispositioned as *use-as-is* or *repair* shall be subject to design control measures commensurate with those applied to the original design. Required as-built drawings, test article fabrication documentation, and other associated records shall reflect the use-as-is or repair condition(s) of the associated test article(s). Reworked or repaired test articles shall be reexamined in accordance with applicable procedures and with the original acceptance criteria unless the disposition has established alternate acceptance criteria.

3.16 CORRECTIVE ACTION

The requirements of NQA-1 Requirement 16, "Corrective Action" [6], and 10 CFR Part 50, Appendix B, Section XVI, "Corrective Action" [7], are implemented in SBMS subject area, "Issues Management and Analysis." In conjunction with ORNL SMEs, AMMT personnel ensure that

- the conditions adverse to quality are identified promptly and corrected as soon as practicable
- in the case of a significant condition adverse to quality, the cause of the condition is determined, and corrective action is taken to preclude recurrence
- the identification, cause, and corrective action for significant conditions adverse to quality are documented and reported to appropriate levels of management
- the completion of corrective actions is verified.

3.17 QUALITY ASSURANCE RECORDS

The requirements of NQA-1 Requirement 17, "Quality Assurance Records" [6], and 10 CFR Part 50, Appendix B, Section XVII, "Quality Assurance Records" [7], are implemented in AMMT-QA-PROC-001, *AMMT Technical Procedure* [15], and SBMS subject area, "Records Management." In conjunction with ORNL SMEs, AMMT personnel ensure that:

- the control of QA records is established consistently with the schedule for accomplishing work activities and
- QA records furnish documentary evidence that items or activities meet specified quality requirements.

AMMT personnel shall capture and maintain QA records that furnish the documentary evidence that items or activities meet specified quality requirements in laboratory notebooks, alternate records notebooks, or electronic formats that allow for efficient retrieval. WBS leads are responsible for ensuring that records are

- identified
- generated to provide objective evidence of the work performed
- authenticated through a periodic review by someone other than the person responsible for generation
- maintained in a way that ensures their retrieval
- specified as to final disposition
- maintained to support the replication of the original work, if necessary.

3.17.1 QA Records Requirements and Responsibilities

Each WBS lead ensures that QA records are identified and maintained in a legible form, are traceable to associated items and activities, and accurately reflect the work accomplished or information required for each item or activity. A list of candidate QA records is provided in AMMT-QA-PROC-001, *AMMT Technical Procedure* [15].

Based on the NQA-1 definitions for permanent and nonpermanent QA records [6], all ORNL records generated for AMMT nuclear parts are classified as *Level 1, permanent*, per the National Archives and Record Administration (NARA). This corresponds to the NQA-1 definition of *lifetime records*, which are records that meet one or more of the following criteria:

- Those that would be of significant value in demonstrating capability for safe operation
- Those that would be of significant value in maintaining, reworking, repairing, replacing, or modifying an item
- Those that would be of significant value in determining the cause of an accident or malfunction of an item
- Those that provide required baseline data for in-service inspections.

Per NQA-1 [6], lifetime records are required to be maintained by or for the owner for the life of the particular item while it is installed in the plant or stored for future use.

If classified as *permanent*, per the NARA requirements, then AMMT records shall be maintained at ORNL for up to 25 years after the completion of the program. Thereafter, the records will be transferred to NARA for final disposition. During the conduct of program activities at ORNL, no records shall be disposed of or destroyed until or unless the DOE sponsor is consulted and written permission for planned final disposal is obtained.

Records pertaining to the materials and associated items received from other organizations shall be maintained by the WBS lead as a subset of the task QA records set and stored in the applicable laboratory notebook, alternate paper format, or electronic records format. Examples include procurement records for calibrated equipment and materials certifications for test materials provided by external program participants.

AMMT records shall be stored in electronic systems/servers, facilities, containers, or a combination thereof that are constructed and maintained in a manner that minimizes the risk of damage or destruction from natural disasters, such as winds, floods, or fires; environmental conditions, such as high and low temperatures and humidity; and infestation of insects, mold, or rodents. Methods to be used include:

- storing records in electronic servers/databases with access control and backups
- storing records in metal file cabinets in offices that are locked during off-hours
- keeping in-process records, such as laboratory notebooks, in laboratories under access control requirements during working hours
- ensuring that there are no electromagnetic fields to damage electronic records media in areas where AMMT records are stored
- storing records in areas where room temperature is maintained by standard thermostat controls; and
- storing records in designated nonsmoking areas and/or areas protected by sprinkler systems.

No situations associated with ORNL AMMT activities have been identified that would require dual storage facilities or containers.

Each WBS lead ensures that records under their purview are maintained and that no actions are taken thereafter to dispose of records unless authorized through the appropriate project manager. The WBS lead shall also ensure that records are protected from damage or loss and maintained in a retrievable form.

Corrections to hard copy QA records shall include the dated initials or signature of the person authorized to make the change. Persons authorized to correct QA records include the originator of the record, the WBS lead, and the project manager. The only approved method for correcting a hardcopy QA record is to draw a single line through the information to be replaced and handwrite the new information into the record. The new entry shall be initialed and dated by the authorized person. Using correction fluid (e.g., White Out) or any other correction method is not permitted.

Revisions or corrections to electronic records shall include logs or electronic approvals of the person authorized to make the change.

Any records that are not paper forms shall be reviewed for any special storage needs. Examples include considerations associated with radiographs, photographs, negatives, microfilm, and magnetic and optical media to prevent damage from excessive light, stacking, electromagnetic fields, temperature, and humidity.

3.18 AUDITS

The requirements of NQA-1 Requirement 18, “Audits” [6], and 10 CFR Part 50, Appendix B, Section XVIII, “Audits” [7], are implemented in accordance with SBMS subject area, “Audits and Assessments.” In conjunction with ORNL SMEs, AMMT personnel ensure that:

- audits are performed to:
  - verify compliance to QA program requirements,
  - verify that performance criteria are met
  - determine the effectiveness of the program
- the audits are performed in accordance with written procedures or checklists by personnel who do not have direct responsibility for performing the activities being audited
- audit results are documented, reported to, and reviewed by responsible management; and
- follow-up actions are taken, as indicated.

3.19 SAFETY SOFTWARE

AMMT is not expected to produce nuclear safety software, but if necessary, requirements of NQA-1 Requirement 3, “Design Control” [6]; 10 CFR Part 50, Appendix B, Section III, “Design Control” [7]; NQA-1 Part II, Subpart 2.7, “Quality Assurance Requirements for Computer Software for Nuclear Facility Applications” [6]; and/or other safety software requirements are implemented in accordance with this section. This section also applies the requirements specified in DOE Order 414.1D, *Quality Assurance*, Attachment 4, “Safety Software Quality Assurance Requirements for Nuclear Facilities” [2]. SBMS subject area, “Software,” lists specific controls for these requirements. Additional ORNL procedures might be required to fully implement the requirements associated with software quality assurance according to NQA-1. In conjunction with ORNL SMEs, AMMT personnel ensure that

- adequate controls are in place for software acquisition, development, maintenance, and retirement and
- requirements are applied, including requirements for the following software engineering activities:
  - software acquisition method(s) for controlling the acquisition process for software and software services

- software engineering method(s) for managing the software life cycle activities
- application of standards, conventions, and other work practices that support the software life cycle
- controls for support software used to develop, operate, and maintain computer programs.

3.20 RESEARCH AND DEVELOPMENT

This program applies a graded approach to QA-related basic R&D efforts within AMMT, as described in Section 2.1 and as implemented in accordance with SBMS procedure, "Maintain Research Records," and SBMS subject area, "Publications and Other Scientific Communications." The ORNL graded approach and management of risk is further described in the ORNL QAPD section entitled "Graded Approach." In conjunction with ORNL SMEs, AMMT personnel use this guidance to ensure the following:

- Extension of the scope for NQA-1 [6] from nuclear design, production, construction, and operational activities to
  - basic research
  - applied research
  - development work
- Application of a graded approach and risk mitigation based on importance and significance of activities.
- Good practices to ensure quality of research include:
  - peer review
  - publication of results in refereed journals
  - maintenance of records to describe R&D events and ensure their reproducibility, including:
    - laboratory notebooks
    - electronic media
    - databases
    - alternate means of recording and storage.

3.21 SUSPECT/COUNTERFEIT ITEMS

The requirements of DOE Order 414.1D, Attachment 3, "Suspect/Counterfeit Items Prevention" [2], are implemented in accordance with SBMS subject area, "Suspect/Counterfeit Items and Defective Items." The program's WBS leads, in conjunction with the QR and ORNL's S/CI coordinator, are responsible for ensuring that purchased items and services (including software) meet the specified requirements to prevent the entry of S/CIs into the AMMT development activities. In conjunction with ORNL SMEs, AMMT personnel use this guidance to

- ensure that items and services meet specified requirements
- prevent the entry of S/CIs into the DOE supply chain
- ensure the detection, control reporting, and disposition of S/CIs.

4. RECORDS

This document does not generate records. AMMT-QA-PROC-001, *AMMT Technical Procedure* [15], provides detailed records management requirements.

5. REFERENCES

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[4] ORNL. QA Program Description. Oak Ridge: Oak Ridge National Laboratory.

[5] ANSI. 2015. Quality Management Systems—Requirements. ANSI/ISO/ASQ(E) Q9001:2015.

[6] ASME. 2008. *Quality Assurance Requirements for Nuclear Facility Applications*. NQA-1-2008/9a standard, including the NQA-1a-2009 Addendum.

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[17] ORNL NNFD. *NNFD Design Control*. Oak Ridge: Oak Ridge National Laboratory.

[18] ORNL NNFD. *NNFD Process and Configuration Management*. Oak Ridge: Oak Ridge National Laboratory.

[19] International Organization for Standardization. 2005. *General Requirements for the Competence of Testing and Calibration Laboratories.* ISO/IEC 17025.

APPENDIX A. IMPLEMENTING DOCUMENT MATRIX

Note: Links in Appendix A are provided for ease of reference but are not required to be active links for the references to apply.

ASME NQA-1-2008/9a criterion [6]	DOE Order 414.1D [2]	ORNL implementing documents	Responsible manager
1. Organization	1. Management/Program	AMMT-QA-PLAN-001, *Quality Assurance Plan for Advanced Materials and Manufacturing Technology Activities Conducted at the Oak Ridge National Laboratory*, Section 3.1, "Organization" AMMT-QA-PROC-001, *AMMT Technical Procedure* Roles, Responsibilities, Accountabilities, and Authorities	Project manager
2. QA Program Training and Qualification	3. Management/Quality Improvement 9. Assessment/ Management Assessment 10. Independent Assessment 2. Management/Training and Qualification	AMMT-QA-PLAN-001, *Quality Assurance Plan for Advanced Materials and Manufacturing Technology Activities Conducted at the Oak Ridge National Laboratory*, Section 3.2, "Quality Assurance Program" ORNL Quality Assurance Plan Description Audits and Assessments Training of Staff	Quality representative/ manager (QR) Project manager
3. Design Control	6. Design	AMMT-QA-PLAN-001, *Quality Assurance Plan for Advanced Materials and Manufacturing Technology Activities Conducted at the Oak Ridge National Laboratory*, Section 3.3, "Design Control" AMMT-QA-PROC-001, *AMMT Technical Procedure* NR&D-QA-08, *Materials, Test Article, and Irradiation Nuclear core and test reactor Identification and Control, Processing, Handling, and Status Requirements* Design	Design manager (AMMT design authority) Fuels WBS lead

ASME NQA-1-2008/9a criterion [6]	DOE Order 414.1D [2]	ORNL implementing documents	Responsible manager
4. Procurement Document Control	7. Procurement	AMMT-QA-PLAN-001, *Quality Assurance Plan for Advanced Materials and Manufacturing Technology Activities Conducted at the Oak Ridge National Laboratory*, Section 3.4, "Procurement Document Control" AMMT-QA-PROC-001, *AMMT Technical Procedure* Purchasing Goods and Services	ORNL Procurement director Project manager ORNL Contracts Division manager
5. Instruction, Procedures, and Drawings	4. Documents and Records 5. Work Processes	AMMT-QA-PLAN-001, *Quality Assurance Plan for Advanced Materials and Manufacturing Technology Activities Conducted at the Oak Ridge National Laboratory*, Section 3.5, "Instructions, Procedure, and Drawings" AMMT-QA-PROC-001, *AMMT Technical Procedure* Develop, Revise, and Control Other Controlled Documents	Project manager Design authority Project manager
6. Document Control	4. Documents and Records	AMMT-QA-PLAN-001, *Quality Assurance Plan for Advanced Materials and Manufacturing Technology Activities Conducted at the Oak Ridge National Laboratory*, Section 3.6, "Document Control" AMMT-QA-PROC-001, *AMMT Technical Procedure* Develop, Revise, and Control Other Controlled Documents Maintain Research Records	Project manager
7. Control of Purchased Items and Services	7. Procurement	AMMT-QA-PLAN-001, *Quality Assurance Plan for Advanced Materials and Manufacturing Technology Activities Conducted at the Oak Ridge National Laboratory*, Section 3.7, "Control of Purchased Items and Services" AMMT-QA-PROC-001, *AMMT Technical Procedure* Purchasing Goods and Services	Project manager AMMT design authority ORNL Contracts Division director

ASME NQA-1-2008/9a criterion [6]	DOE Order 414.1D [2]	ORNL implementing documents	Responsible manager
8. Identification and Control of Items	5. Work Processes	AMMT-QA-PLAN-001, *Quality Assurance Plan for Advanced Materials and Manufacturing Technology Activities Conducted at the Oak Ridge National Laboratory*, Section 3.8, "Identification and Control of Items" AMMT-QA-PROC-001, *AMMT Technical Procedure* R&D-QA-08, *Materials, Test Articles, and Irradiation Nuclear core and test reactor Identification and Control, Processing, Testing, Handling and Status Requirements,* Section 1.0, "Identification and Control of Materials and Test Articles"	Design authority Reactor operations manager
9. Control of Special Processes	5. Work Processes	AMMT-QA-PLAN-001, *Quality Assurance Plan for Advanced Materials and Manufacturing Technology Activities Conducted at the Oak Ridge National Laboratory*, Section 3.9, "Control of Special Processes" NR&D-QA-08, *Materials, Test Articles, and Irradiation Nuclear core and test reactor Identification and Control, Processing, Testing, Handling and Status Requirements*, Section 2.0, "Control of Special Processes"	WBS lead
10. Inspection	8. Inspection and Acceptance Testing	AMMT-QA-PLAN-001, *Quality Assurance Plan for Advanced Materials and Manufacturing Technology Activities Conducted at the Oak Ridge National Laboratory*, Section 3.10, "Inspections" NR&D-QA-08, *Materials, Test Articles, and Irradiation Nuclear core and test reactor Identification and Control, Processing, Testing, Handling and Status Requirements*, Section 3.0, "Inspection" Inspection and Acceptance Testing	QR

ASME NQA-1-2008/9a criterion [6]	DOE Order 414.1D [2]	ORNL implementing documents	Responsible manager
11.Test Control	8. Inspection and Acceptance Testing	AMMT-QA-PLAN-001, *Quality Assurance Plan for Advanced Materials and Manufacturing Technology Activities Conducted at the Oak Ridge National Laboratory*, Section 3.11, "Test Control" NR&D-QA-08, *Materials, Test Articles, and Irradiation Nuclear core and test reactor Identification and Control, Processing, Testing, Handling and Status Requirements*, Section 4.0, "Test Control" NR&D-QA-08, *Materials, Test Article, and Irradiation Nuclear core and test reactor Identification and Control, Processing, Handling, and Status Requirements* Inspection and Acceptance Testing	WBS lead QR
12. Control of Measuring and Test Equipment	5. Work Processes 8. Inspection and Acceptance Testing	AMMT-QA-PLAN-001, *Quality Assurance Plan for Advanced Materials and Manufacturing Technology Activities Conducted at the Oak Ridge National Laboratory*, Section 3.12, "Control of Measuring and Test Equipment," and Section 3.10, "Inspections" Calibrations	QR
13. Handling Storage and Shipping	5. Work Processes	AMMT-QA-PLAN-001, *Quality Assurance Plan for Advanced Materials and Manufacturing Technology Activities Conducted at the Oak Ridge National Laboratory*, Section 3.13, "Handling, Storage, and Shipping" AMMT-QA-PROC-001, *AMMT Technical Procedure* NR&D-QA-08, *Materials, Test Articles, and Irradiation Nuclear core and test reactor Identification and Control, Processing, Testing, Handling and Status Requirements*, Section 5.0, "Test Material and Article Handling, Storage, and Shipping"	ORNL Procurement manager AMMT WBS lead QR

ASME NQA-1-2008/9a criterion [6]	DOE Order 414.1D [2]	ORNL implementing documents	Responsible manager
14. Inspection, Test and Operating Status	8. Inspection and Acceptance Testing	AMMT-QA-PLAN-001, *Quality Assurance Plan for Advanced Materials and Manufacturing Technology Activities Conducted at the Oak Ridge National Laboratory*, Section 3.14, "Inspection, Test, and Operating Status" AMMT-QA-PROC-001, *AMMT Technical Procedure* NR&D-QA-08, *Materials, Test Articles, and Irradiation Nuclear core and test reactor Identification and Control, Processing, Testing, Handling and Status Requirements*, Section 6.0, "Inspection, Test, and Operating Status"	QR Reactor operations manager Design authority QR
15. Control of Nonconforming Items	3. Quality Improvement	AMMT-QA-PLAN-001, *Quality Assurance Plan for Advanced Materials and Manufacturing Technology Activities Conducted at the Oak Ridge National Laboratory*, Section 3.15, "Control of Nonconforming Items" Nonconformance Control	QR
16. Corrective Action	3. Quality Improvement	AMMT-QA-PLAN-001, *Quality Assurance Plan for Advanced Materials and Manufacturing Technology Activities Conducted at the Oak Ridge National Laboratory*, Section 3.16, "Corrective Action" Issues Management and Analysis Stop Work	QR
17. Quality Assurance Records	4. Documents and Records	AMMT-QA-PLAN-001, *AMMT Quality Assurance Program Plan*, Section 3.17, "Quality Assurance Records" AMMT-QA-PROC-001, *AMMT Technical Procedure* Records Management	Project manager
18. Audits	10. Independent Assessment	AMMT-QA-PLAN-001, *AMMT Quality Assurance Program Plan*, Section 3.18, "Audits" Audits and Assessments QAP-AP-005, *Qualifying Auditors and Certifying Lead Auditors*	QR

ASME NQA-1-2008/9a criterion [6]	DOE Order 414.1D [2]	ORNL implementing documents	Responsible manager
2.7, Software (also referenced in sections 3 & 7)	Attachment 4, "Safety Software Quality Assurance Requirements for Nuclear Facilities"	Program Plan, Section 3.19, "Safety Software" AMMT-QA-PROC-001, *AMMT Technical Procedure* Software Quality Assurance	QR QR
4.2, Research and Development	All	AMMT-QA-PLAN-001, *Quality Assurance Plan for Advanced Materials and Manufacturing Technology Activities Conducted at the Oak Ridge National Laboratory*, Section 3.20, "Research and Development" NR&D-QA-08, *Materials, Test Article, and Irradiation Nuclear core and test reactor Identification and Control, Processing, Handling, and Status Requirements* Maintain Research Records	AMMT technical manager
N/A	Attachment 3, "Suspect/Counterfeit Items Prevention"	Suspect/Counterfeit Items and Defective Items AMMT-QA-PLAN-001, *Quality Assurance Plan for Advanced Materials and Manufacturing Technology Activities Conducted at the Oak Ridge National Laboratory*, Section 3.21, "Suspect/Counterfeit Items"	ORNL Procurement manager QR

APPENDIX C. AMMT-QA-PROC-001, *AMMT Technical Procedure*

Advanced Materials and Manufacturing Technology Program Technical Procedure

Michael Russell

October 2023

OAK RIDGE National Laboratory

ORNL IS MANAGED BY UT-BATTELLE LLC FOR THE US DEPARTMENT OF ENERGY

Advanced Materials and Manufacturing Technology Program

TECHNICAL PROCEDURE

Michael Russell

October 2023

Prepared by
OAK RIDGE NATIONAL LABORATORY
Oak Ridge, TN 37831
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This document has been electronically approved. Electronic signature(s) of approver(s) are listed in the EDRM View/Print page associated with the EDRM Record # above.	
The only OFFICIAL COPY of this document is the online electric version in EDRM. Use of printed copies should be limited. Before using a printed copy or any other electronic copy, verify that it is the most current version by checking EDRM.	

REVISION LOG

Rev.	Date	Affected Pages	Revision Description
0	10/01/2023	All	Initial release

Table of Contents

1. PURPOSE, SCOPE, AND APPLICABILITY

1.1 Purpose and Scope

This procedure establishes the processes and responsibilities for performing work under Oak Ridge National Laboratory's (ORNL's) AMMT-QA-PLAN-001, *AMMT Quality Assurance Program Plan*. The ORNL Advanced Materials and Manufacturing Technologies (AMMT) Program follows existing ORNL procedures whenever possible. The controls in this document were established for areas that require supplemental procedures or deviations from ORNL requirements to ensure that controlled documents and records are developed and maintained to meet requirements, standardized in format, reviewed for adequacy, approved for release, and available for use. The ORNL AMMT program is a continuation of the ORNL Transformational Challenge Reactor (TCR) program and can be used to perform AMMT or TCR related work activities.

1.2 Applicability

This procedure applies to all ORNL AMMT or TCR work on parts or data destined for use in a nuclear application. Other organizations can use this procedure with the approval of the AMMT Technical Manager.

2. GENERAL INFORMATION

2.1 Document Control and Records Management

This procedure was developed using the document management requirements described in the following documents:

- ORNL Standards-Based Management System (SBMS) procedure, "Develop, Revise, and Control Other Controlled Documents"
- American Society of Mechanical Engineers (ASME) NQA-1-2008, *Quality Assurance Requirements for Nuclear Facility Applications*, and NQA-1a-2009, *Addenda* (hereafter referred to as *NQA-1*):
  - Requirement 5, "Instructions, Procedures, and Drawings"
  - Requirement 6, "Document Control"

Controlled documents are managed within two document management applications: the Electronic Document and Records Management (EDRM) system and Microsoft (MS) SharePoint. The native files for documents that do not require information protection are stored in EDRM. The native files for export-controlled documents are stored in a protected MS SharePoint library, and a note is entered into EDRM stating the location of the file.

AMMT procurement documents (e.g., purchase requisitions, purchase orders, drawings, contracts, specifications, or instructions used to define purchase requirements) are developed and controlled SBMS subject area, "Purchasing Goods and Services," and NQA-1, Requirement 4, "Procurement Document Control." Records generated from AMMT procurement activities are required to be maintained as part of the approved AMMT records schedule in accordance with this procedure.

AMMT records are managed in accordance with SBMS subject area, "Records Management," and NQA-1, Requirement 17, "Quality Assurance Records," in conjunction with ORNL's Records Management Application (RMA). The AMMT Program was designated as a US Department of Energy (DOE) Research and Development (R&D) Project Case File Level 1, which requires permanent retention of program records. Requirements and guidance for storing AMMT records, including preservation and safekeeping, are specified in SBMS subject area,

"Records Management."

The Publications module of RESolution is ORNL's platform for reviewing and approving scientific communications (including, but not limited to, ORNL technical reports, journal articles, conference proceedings, and presentations). Except for internal documents (e.g., procedures, charters, and some plans), all documents created to satisfy a DOE Office of Nuclear Energy (NE) milestone deliverable are managed through RESolution. For a full list of documents expected to be entered into RESolution, refer to SBMS exhibit, "Scientific and Technical Communication Types." Documents issued in RESolution that are considered controlled documents or program records will be electronically linked or manually entered into EDRM and/or RMA, as appropriate.

Documents and records that require information protection (e.g., Export Control, Privacy Act Information, Safeguards and Security, Supplier Proprietary Information) are managed in accordance with SBMS subject area, "Information Protection." Internal Export Control reviewers guide AMMT staff and participants through the initial screening process and determine the level of protection required for a controlled document or record to be developed. Documents and records subject to information protection requirements are appropriately marked and managed per SBMS procedure, "Classify and Control Sensitive Information."

Project Information Collection System: NE (PICS:NE) is a US Government information system used to collect program information for DOE NE. AMMT generates documents and information (in the Publications module of RESolution described in Section 2.1.6) and submits them into the PICS:NE system to demonstrate completion of deliverables or milestones. These documents are considered AMMT program records and must be managed in accordance with this procedure. Any document submitted into PICS:NE must also be entered into EDRM and/or RMA, as appropriate.

The AMMT program manager is responsible for the implementation of the document control and records management process in conjunction with the AMMT work breakdown structure (WBS) leads.

2.2 Training and Qualification Process

This plan applies the requirements outlined in NQA-1**,** Requirement 2, "Quality Assurance Program," in section 200, "Indoctrination and Training," and section 300, "Qualification Requirements." This plan also applies the requirements outlined DOE Order 414.1D, *Quality Assurance*, "Management/Personnel Training and Qualification," and the SBMS Training and Qualification Management System (TQMS).

The AMMT Program comprises multiple participating ORNL organizations and capabilities, including the additive manufacturing capabilities developed at the Energy Science and Technology Directorate at the Manufacturing Demonstration Facility; the artificial intelligence and large data management capabilities of the Computing and Computational Sciences Directorate; the materials characterization and testing in the Physical Sciences Directorate; the nuclear fuels and reactor design in the Fusion and Fission Energy and Science Directorate; and the nuclear facility management, engineering, and modification activities of the Nonreactor Nuclear Facilities Division (NNFD). For the purposes of this procedure, ORNL and external organizations participating in the AMMT Program are herein identified as *participating organizations*. Individuals within those organizations are identified as *AMMT participants*. This procedure does not encompass training and qualification (T&Q) requirements of the participants primary organization. Rather, this procedure identifies AMMT-specific T&Q requirements, which are often developed in cooperation with participating organization line management,

subject matter experts (SMEs), and training staff.

The AMMT Program comprises three overlapping phases: design, assembly, and operation. T&Q requirements will be analyzed during each of the three phases and throughout the life cycle of the AMMT Program. As appointed by the associate laboratory director of the Fusion and Fission Energy and Science Directorate, the AMMT director has ultimate responsibility for the T&Q of participants assigned to the AMMT Program. The administration of this responsibility is primarily delegated to AMMT WBS leads, who are supported by the AMMT division training officer (DTO) and, as appropriate, the participating organization DTOs and division training managers (DTMs). AMMT thrustWBS coordinate AMMT T&Q activities with the AMMT director, the DTOs and DTMs of the participating organization, and other SMEs, as necessary, to identify T&Q requirements for specific functions and job positions associated with the AMMT Program.

WBS leads approve each job position function and designate individual AMMT participants to perform those functions. The *AMMT Integrated Training Matrix and Roster* (ITM&R) identifies T&Q requirements for specific functions and activities for each AMMT WBS Additionally, rosters of AMMT participants are maintained for each thrust area WBS the ITM&R. AMMT participants are approved and qualified to perform work for AMMT via AMMT-TQ-FORM-001, *AMMT Personal Qualification and Training Requirements Form*. The form documents initial qualification requirements and AMMT-specific T&Q requirements for individual AMMT participants. An example of this form is provided in Appendix C, “Example AMMT Personnel Qualification and Training Requirements Form.”

The AMMT director shall ensure that AMMT participants are qualified through appropriate training as required in SBMS subject area, “Training of Staff,” and this procedure. The indoctrination and training of personnel to support AMMT activities are the responsibility of the WBS lead or delegate. The type of training and method of delivery (i.e., classroom, web-based, on-the-job training [OJT] for localized AMMT-specific training) is discussed in Section 2.2.

The AMMT DTO assists WBS leads and AMMT staff with the administration of this procedure and maintains the AMMT ITM&R. Additionally, the AMMT DTO maintains all temporary records generated from the implementation of this procedure in accordance with AMMT-PM-PROC-001, *AMMT Document Control and Records Management*, until the records are submitted to the ORNL records system. The AMMT DTO is not responsible for assigning institutional training requirements (ITRs) or division-specific T&Q for individual participants; this is the responsibility of the manager and DTO of the participant’s primary organization. The AMMT DTO coordinates AMMT-specific T&Q requirements with the participant’s primary organization DTOs and DTMs.

2.3 AMMT Special Processes

Special processes within AMMT take the form of advanced manufacturing, heat treatment, machining, powder control, test planning, operating manuals, and other standard operating procedures or plans specific to the detailed work activities. As such, specific technical procedures have been developed and will continue to be developed to support these activities. A current list of subject procedures/plans is described in Appendix H, “AMMT Technical Procedures and Plans List.”

3. PROCEDURE

3.1 Document Control and Records Management

NOTE 1: SBMS exhibit, "ORNL Publications and Style Guide," is used for all document development.

NOTE 2: The preparation, issue, and change of AMMT documents that specify quality requirements or prescribe activities affecting quality such as instructions, procedures, and drawings are controlled to ensure that the correct documents are being used. These documents are reviewed for adequacy and approved for release by authorized personnel.

3.1.1 New Internal Controlled Document Development

WBS Lead

3.1.1.1 **DETERMINE** when and what type of document needs to be prepared.

Document Management Coordinator (DMC)

3.1.1.2 **IF** the type of document has been determined (e.g., report, plan, procedure, letter), **THEN ASSIGN** a document control number (DCN) as described in Appendix B.

3.1.1.3 **IF** the document is an AMMT procedure, plan, charter, or internal report, **THEN PROVIDE** an AMMT electronic template.

WBS Lead

3.1.1.4 **APPOINT** an author and/or point of contact (POC) to prepare the controlled document.

Author/POC

3.1.1.5 **PREPARE** the controlled document as described in the next steps for internal documents (e.g., procedures, plans, forms) using the appropriate template provided by the DMC.

3.1.1.6 **IF** applicable, **THEN PREPARE** the controlled documents using the instructions found in Appendix C.

3.1.1.7 **IF** developing a plan or report that is mandated by a requirement, commitment, or deliverable **AND** it contains the minimum information outlined in SBMS procedure, "Develop, Revise, and Control Other Controlled Documents," **THEN USE** an alternate format.

NOTE 1: Forms must be associated with an AMMT procedure as either an exhibit or appendix and must include instructions on proper completion, review, and approval/authentication.

NOTE 2: Completed forms become official records and are managed as such. Instructions on how forms are held and transferred to RMA are included in the instructions or procedure.

NOTE 3: At a minimum, the DCN and effective date should be entered in the created document.

3.1.1.8 **IF** developing a form, **THEN PERFORM** the following:

- **CREATE** the document in Microsoft (MS) Word or Excel.
- **ENTER** the DCN and effective date to ensure proper version control.

3.1.1.9 **DETERMINE** initially the level of protection required per SBMS subject area, "Information Protection."

NOTE 1: Documents under development must be handled at the highest potential sensitivity level until reviewed by an export controller (EC) and/or derivative classifier (DC).

NOTE 2: These steps must be performed before initiating the review and approval process.

3.1.1.10 **SEND** a draft of the controlled document to the EC for review.

3.1.1.11 **IF** applicable, **THEN SEND** a draft of the controlled document to the DC to verify the level of protection required.

NOTE: Verification and validation (V&V) documentation, if separate from the controlled document, is maintained as a AMMT program record.

3.1.1.12 **IF** documentation exists that is separate from the controlled document, **THEN INCORPORATE** V&V into the document development process.

3.1.1.13 **PROVIDE** the following to the DMC:

- MS Word/Excel file or electronic storage location
- Desired approval and issue date
- Date the document is required to be effective (if different from the approval/issue date)
- Level of information protection required
- Required review cycle (maximum of 5 years)
- List of reviewers and approvers per Appendix D
- Distribution list

DMC

3.1.1.14 **IF** changes were made to the document, **THEN UPDATE** the revision log to note the changes made.

3.1.1.15 **IDENTIFY** the native draft in either EDRM or a protected SharePoint library.

3.1.1.16 **MAINTAIN** the native draft in either EDRM or a protected SharePoint library.

3.1.2 Internal Controlled Document Review, Approval, and Management

DMC

3.1.2.1 **CREATE** a new document in EDRM

3.1.2.2 **INITIATE** review of new document in EDRM.

Reviewers/Approvers

3.1.2.3 **REVIEW** the document to determine if it is adequate, including, but not limited to, the following requirements in Steps 2.2.2.4–2.2.2.8.

3.1.2.4 **ENSURE** the document includes all the required information per applicable standards and requirements and in accordance with AMMT-QA-PLAN-001, *AMMT Quality Assurance Plan*.

3.1.2.5 **ENSURE** the review is conducted in accordance with SBMS procedure, "Develop, Revise, and Control Other Controlled Documents."

3.1.2.6 **ENSURE** the document is clear, concise, and states requirements for proper completion.

3.1.2.7 **IF** V&V process is included, **THEN EVALUATE** the effectiveness of the V&V process.

3.1.2.8 **ENTER** comments in EDRM on or before the assigned review date.

3.1.2.9 **IF** no comments are noted during the review, **THEN SELECT** the "No Comments" button in EDRM to document the review.

POC

NOTE: EDRM automatically generates an email message notifying all individuals that the comment period has ended and provides a link to the comment/resolution report.

3.1.2.10 **RESOLVE** comments in EDRM.

3.1.2.11 **WHEN** reviewers and approvers concur with comment resolution, **THEN NOTIFY** the DMC that the review is complete.

DMC

3.1.2.12 **PREPARE** the document for electronic approval in EDRM.

NOTE 1: Notices of the newly approved controlled documents are automatically sent to the distribution list.

NOTE 2: An MS Word file of the approved revised document is designated and maintained as the native document and stored in either EDRM or in a protected SharePoint library.

3.1.2.13 **WHEN** approved, **THEN** perform the following:

- **FINALIZE** the document (i.e., enter the approved, issue, and effective dates and the EDRM record number in the document and update the revision log).
- **SAVE** a PDF of the document in EDRM or in the appropriate protected SharePoint library.
- **ACTIVATE** the document in EDRM.

3.1.3 Internal Document Change Notices and Revisions

NOTE 1: Changes and revisions to controlled documents are performed in accordance with SBMS procedure, "Develop, Revise, and Control Other Controlled Documents," and NQA-1, Requirement 6, "Document Control." Controlled documents are reviewed in accordance with

required review intervals no later than once every 5 years.

NOTE 2: EDRM provides automatic notices of upcoming review dates to the DMC, POC, and reviewers/approvers at 90 days, 30 days, and 1 week. Overdue notices are sent weekly after a missed review date.

NOTE 3: Changes to a document are considered *minor*, *major*, or *critical*.

Minor changes do not alter the outcome of the steps or processes outlined in the document. They do not change the intent or outcome of the step, process, or document. Examples include correcting grammar or spelling without changing meaning; updating organizational titles; and clarifying to provide explanation without affecting the purpose of the document. Minor changes to a document are reviewed, approved, and issued as a change notice in accordance with Step 3.1.3

Major changes do not alter the outcome of steps or processes described in the document. Examples include resequencing sections; resequencing, adding, or deleting steps; making changes to steps that affect the outcome of the step or process; changing processes or requirements; and changing responsibilities. Major changes to a document are reviewed, approved, and issued using the same process that is used for the original document in accordance with Step 3.1.3

Critical revisions to controlled documents prompted by a quality-affecting event (e.g., audit, occurrence, malfunction, safety issue) are reviewed, approved, and issued using the same process that was used for the original document. A critical revision is noted in the revision log. A critical revision is not altered unless the significance of the effect is evaluated against the issue that prompted the revision.

DMC

3.1.3.1 **LOCATE** the native document.

3.1.3.2 **SELECT** "Revision" in EDRM.

3.1.3.3 **IF** the document has major changes, **THEN ENSURE** the document is reviewed, approved, and issued using the same process that was used for the original document in accordance with Section 3.1.3.

3.1.3.4 **IF** the document has minor changes, **THEN PERFORM** the following:

- **USE** the change notice function in EDRM to implement changes between revisions.
- **DOCUMENT** the minor changes in the "Reason for Revision" field in EDRM or in the "Comments" field.
- **DESCRIBE** the change in the document.

NOTE 1: EDRM sends automatic notices of minor changes to the original reviewers and approvers.

NOTE 2: EDRM automatically updates and creates document history file(s).

3.1.3.5 **FINALIZE** the document.

3.1.3.6 **ADD** the change number.

3.1.3.7 **UPDATE** the revision log.

3.1.4 Archiving Obsolete Internal Controlled Documents

WBS Lead, Author/POC, Reviewers, Approvers, and DMC

3.1.4.1 **CONCUR** with the decision to archive a controlled document.

DMC

3.1.4.2 **WHEN** concurrence is received, **THEN DOCUMENT** the reason for concurrence in the EDRM "Comments" field.

NOTE: EDRM maintains the history of the archived document.

3.1.4.3 **UPDATE** the storage location of the archived document in EDRM.

3.1.4.4 **ENTER** the archived controlled documents into EDRM.

3.1.4.5 **IF** stored in RMA, **THEN ENTER** the archived controlled documents into RMA.

3.1.5 External Document Development, Review, and Approval

NOTE 1: Other than internal plans, reports, and procedures, the AMMT Program creates several other documents that must be managed as controlled documents and/or records. Some examples include technical reports, scientific papers, journal articles, presentations, regulatory submittals, safety basis documents, drawings, laboratory notebooks, operator aids, Laboratory Directed Research and Development reports, and organization charts. All documents created to satisfy a DOE NE milestone deliverable are managed through RESolution. Different formats may be used to meet requirements, but all documents are managed as controlled documents and/or AMMT project records as defined in this procedure.

NOTE 2: The following AMMT-specific steps are followed when developing documents for release through the Publications module of RESolution to ensure documents are properly identified, approved, and controlled as AMMT program documents/records and to ensure adherence to the requirements and guidelines in SBMS subject area, "Publications and Other Scientific Communications."

Author/POC

NOTE: Perform the following step before entering document information into the system.

3.1.5.1 **DETERMINE** the level of information protection required for a document per SBMS subject area, "Information Protection."

3.1.5.2 **IF** the document is a technical report, **THEN PREPARE** the document using the ORNL Report Template.

3.1.5.3 **FOLLOW** the workflow requirement in the Publications application of RESolution.

3.1.5.4 **IF** the document has an AMMT DCN, **THEN ADD** the AMMT DCN as a secondary document number in RESolution.

3.1.5.5 **SELECT** "Transformational Challenge Reactor" from the drop-down menu under "Research Centers and Institutes" to ensure that the AMMT-specific workflows are implemented.

3.1.5.6 **SELECT** the "Reviewers" tab.

3.1.5.7 **ENTER** the required reviewers per Appendix D.

3.1.5.8 **SEND** for review, approval, and release in accordance with workflow requirements.

NOTE 1: An ORNL DCN is assigned in RESolution.

NOTE 2: The following steps are for other controlled documents.

Author/POC

3.1.5.9 **IF** the document is an organization chart, **THEN ENTER** the DCN, issue date, and approver into the lower left-hand corner of the organization chart.

NOTE: Laboratory notebooks are registered as required by SBMS and are controlled documents and official AMMT records.

3.1.5.10 **MANAGE** laboratory notebooks and associated data (hard copy and/or electronic) in accordance with SBMS procedure, "Maintain Research Records."

3.1.5.11 **IF** the document is any other controlled documents such as drawings and operator aids, **THEN SEE** the DMC or quality assurance (QA) manager for appropriate formatting, controls, and DCN assignment.

3.1.6 Records Management

NOTE: The control of AMMT QA records, hereafter referred to as *records*, is established to facilitate the schedule for accomplishing AMMT work activities as shown in Appendix E. AMMT records provide documentary evidence that items or activities meet specified quality requirements and are identified, generated, authenticated, maintained, and dispositioned as specified in SBMS subject area, "Records Management;" NQA-1, Requirement 17, "Quality Assurance Records;" and this procedure. Several systems are used to electronically control documents and records, including EDRM, the AMMT SharePoint site, the Directors Information System (DIS), and other AMMT-specific systems such as parts tracking systems. RMA is used to identify the storage location of electronic records and other records within the approved record series 1706. Requirements and guidance for storing AMMT records, including preservation and safekeeping, are specified in SBMS subject area, "Records Management."

Records Management Officer (RMO)

3.1.6.1 **ASSIST** AMMT staff in identifying documents that must be maintained as records.

AMMT Staff/Participants

3.1.6.2 **ENSURE** records are legible, accurate, and completed appropriate to the work accomplished so that they can be read, understood, and traced to the associated items or activities.

3.1.6.3 **PROVIDE** the following information to the RMO:

- Record copy and storage location (PDF file or hard copy location)
- Record category and type (per Appendix E)
- Name of the WBS lead responsible for record authentication

RMO

3.1.6.4 **EMAIL** the ORNL records analyst with a request to enter a record in RMA.

ORNL Records Analyst

3.1.6.5 **FULFILL** the request.

3.1.6.6 **AUTHENTICATE** the record by adding initials and date in the RMA "Comments" field.

RMO

3.1.6.7 **REGISTER** AMMT-specific data and recordkeeping systems in the ORNL Software Registration System or as otherwise specified in SBMS subject area, "Software Quality Assurance."

3.1.6.8 **ENTER** the electronic recordkeeping location of the AMMT-specific data and the recordkeeping system in RMA.

3.1.6.9 **IF** the document is correspondence, commitments, noncommitments, or work authorizations to DOE, state, and regulatory agencies on behalf of UT-Battelle LLC, **THEN PERFORM** the following:

- **USE** the DIS.
- **ENTER** the electronic recordkeeping location of the record in RMA.

Author of Document Submitted into PICS:NE

NOTE: Documents and information submitted into the PICS:NE system to demonstrate completion of a deliverable or milestone are considered AMMT program records and are managed according to this procedure.

3.1.6.10 **CONTACT** the RMO.

RMO

3.1.6.11 **IF** using RMA, **THEN ENTER** the record in RMA.

3.1.6.12 **COMPLETE** a records inventory in RMA every 2 years, as required.

3.1.6.13 **VERIFY** that the associated schedule information and the actual records (PDF files, contact information, electronic storage location, and boxes/hard copies) are current per SBMS subject area, "Records Management."

3.1.6.14 **MAINTAIN** records generated from AMMT procurement activities (e.g., indexed, stored) in the AMMT record series in accordance with this procedure and SBMS subject area, "Records Management."

3.1.6.15 **WHEN** the biennial records inventory occurs, **THEN WORK** with the procurement organization and procurement documentation generators to ensure that appropriate procurement records are transferred to the AMMT records schedule.

WBS Lead

3.1.6.16 **ENSURE** that records of terminating employees and nonemployees (e.g., subcontractors, partners) are retrieved prior to departure.

3.2 Design Control, Configuration Management, Inspection, and Testing

NOTE: The ORNL AMMT program is not expected to perform the design of nuclear items, but the program will more likely working with items provided by external organizations. If aspects of design control, configuration management, inspection, and/or testing are required, the following procedure steps will be implemented.

3.2.1 Configuration Management and Change Control

AMMT Lead Engineer/Engineer

3.2.1.1 Implement configuration management requirements in accordance with SBMS subject area, "Configuration Management," and NNFD-002, *NNFD Change Control of Modifications*, in addition to the following requirements:

3.2.1.2 **IF** using Nonreactor Nuclear Facilities Division (NNFD) documents as templates, **THEN REPLACE** NNFD-specific responsibilities, including the design authority, with AMMT personnel and organizational responsibilities.

AMMT Design Authority

3.2.1.3 **DEVELOP** an AMMT-specific listing of configuration items and designations to which configuration management will be applied.

3.2.1.4 **DOCUMENT** in EDRM the AMMT-specific listing of configuration items and designations.

Applicable Group/Organization

NOTE: The same affected groups or organizations that reviewed and approved the original design documents approve changes to AMMT configured items and/or related documents.

3.2.1.5 **APPROVE** the changes to design inputs, final designs, field changes, and temporary and permanent modifications to operating facilities.

AMMT Design Authority

NOTE: The following step is an update per NQA-1-2008/9a, Section 3, 600(a).

3.2.1.6 **IF** the same group or organization is not available, **THEN DESIGNATE** a new responsible organization for the review.

3.2.1.7 **APPROVE** all changes to AMMT-configured items and/or related documents.

3.2.2 Design Process and Control

AMMT Lead Engineer/Engineer

3.2.2.1 **IMPLEMENT** design process and control requirements in accordance with NNFD-ENG-955, *NNFD Design Process*, and the related forms, in addition to the following requirements:

3.2.2.2 **IF** using NNFD documents as templates, **THEN REPLACE** NNFD-specific responsibilities, including the design authority, with AMMT personnel and organizational responsibilities.

AMMT Design Authority

3.2.2.3 **APPROVE** all items documented under the AMMT design control process.

3.2.2.4 **ENSURE** the design process identifies and documents appropriate quality standards.

NOTE: The following step is an update per NQA-1-2008/9a, Section 300(a).

3.2.2.5 **ENSURE** the selection is reviewed and approved.

NOTE: The following step is an update per NQA-1-2008/9a, Section 3, 700.

3.2.2.6 **ENSURE** the interface control assigns responsibility and establishes procedures among participating design organizations for review, approval, release, distribution, and revision of documents involving design interfaces.

3.2.3 Engineering Calculations

AMMT Lead Engineer/Engineer

3.2.3.1 **IMPLEMENT** engineering calculations requirements in accordance with NNFD-ENG-950, *NNFD Engineering Calculations*, and the related forms, in addition to the following requirements:

3.2.3.2 **IF** using NNFD documents as templates, **THEN REPLACE** NNFD-specific responsibilities, including the design authority, with AMMT personnel and organizational responsibilities.

3.2.3.3 **IF** no software items can be found already created, **THEN DEVELOP** software items for performing AMMT safety calculations in accordance with this section and in conjunction with AMMT-SQ-PROC-001, *AMMT Software Quality Assurance*.

3.2.3.4 **USE** software items used to perform AMMT safety calculations in accordance with this section and in conjunction with AMMT-SQ-PROC-001, "AMMT Software Quality Assurance."

AMMT Design Authority

3.2.3.5 **APPROVE** all AMMT engineering calculations.

3.2.4 Engineering Drawing Management

AMMT Lead Engineer/Engineer

3.2.4.1 **IMPLEMENT** engineering drawing management requirements in accordance with NNFD-ENG-953, *NNFD Drawing Management*, and the related forms, in addition to the following requirements:

3.2.4.2 **IF** using NNFD documents as templates, **THEN REPLACE** NNFD-specific responsibilities, including the design authority, with AMMT personnel and organizational responsibilities.

AMMT Design Authority

3.2.4.3 **APPROVE** all initial and changes to AMMT drawings.

3.2.5 Engineering Specifications

AMMT Lead Engineer/Engineer

3.2.5.1 **IMPLEMENT** engineering specification requirements in accordance with NNFD-ENG-954, *NNFD Engineering Specifications*, and the related forms, in addition to the following requirements:

3.2.5.2 **IF** using NNFD documents as templates, **THEN REPLACE** NNFD-specific responsibilities, including the design authority, with AMMT personnel and organizational responsibilities.

AMMT Design Authority

3.2.5.3 **APPROVE** all AMMT engineering specifications.

3.2.6 Design Reviews

AMMT Lead Engineer/Engineer

NOTE: Formal design reviews are performed on internal design inputs and external subcontractor design deliverables as part of the procurement acceptance process.

3.2.6.1 **IMPLEMENT** design review requirements in accordance with NNFD-ENG-952, *NNFD Design Reviews*, and the related forms, in addition to the following requirements:

3.2.6.2 **IF** using NNFD documents as templates, **THEN REPLACE** NNFD-specific responsibilities, including the design authority, with AMMT personnel and organizational responsibilities.

3.2.6.3 **IF** reviewing an engineering design analysis or calculation, **THEN ENSURE** conversions are provided between United States Customary System (USCS) and International System of Units (SI) units for all major inputs, outputs, and conclusions.

3.2.6.4 **VERIFY** all unit conversions as part of the review process.

AMMT Design Authority

3.2.6.5 **FACILITATE** all AMMT design reviews.

3.2.6.6 **APPROVE** all AMMT design reviews.

3.2.6.7 **ENSURE** that an independent verification of the design is performed.

NOTE 1: Design verification may be performed by someone from the same organization as the originator.

NOTE 2: Design verification may be performed by the originator's supervisor, provided that (1) the supervisor did not specify a singular design approach or rule out certain design considerations and did not establish the design inputs used in the design or (2) the supervisor is the only individual in the organization competent to perform the verification (NQA-1-2008/9a, Section 3, 500(a) update).

NOTE 3: Cursory supervisory reviews do not satisfy the intent of this requirement.

NOTE 4: Design verification is performed by competent individuals, including supervisor reviews, with engineering subject- and system-specific education, background, experience, and qualifications to perform comprehensive technical reviews.

3.2.6.8 **ENSURE** AMMT design and related documentation are verified by competent individual(s) or group(s) other than the originator.

NOTE: The following step is an update per NQA-1-2008/9a, Section 300(c).

3.2.6.9 **ENSURE** the critical characteristics that need to be verified are characteristics that provide reasonable assurance that the item will perform its intended safety function.

3.2.6.10 **ENSURE** the results and methods of the independent design verification are documented, including design modifications that address verification findings.

AMMT Lead Engineer/Engineer

NOTE: Qualification tests demonstrate the adequacy of performance under conditions that simulate the most adverse design conditions, including operating modes and environmental conditions (NQA-1-2008, Section 3, 501.3 update).

3.2.6.11 **PERFORM** qualification tests in accordance with NNFD-014, *Facility Equipment Startup Testing*.

3.2.7 Systems Design Descriptions

AMMT Lead Engineer/Engineer

3.2.7.1 **IMPLEMENT** system design description requirements in accordance with NNFD-ENG-951, *NNFD Systems Design Descriptions*, and the related forms, in addition to the following requirements:

3.2.7.2 **IF** using NNFD documents as templates, **THEN REPLACE** NNFD-specific responsibilities, including the design authority, with AMMT personnel and organizational responsibilities.

AMMT Design Authority/Systems Owner

3.2.7.3 **APPROVE** all AMMT systems design descriptions.

3.2.8 Procurement and Receipt Inspection

AMMT Lead Engineer/Engineer

3.2.8.1 **IMPLEMENT** procurement and receipt inspection requirements for all nuclear safety–related (Procurement Class 1), dedicated commercial-grade (Procurement Class 2), and defense-in-depth in accordance with SBMS subject area, "Purchasing Goods and Services;" NNFD-010, *NNFD Procurement and Receipt Inspection for NNFD Supplies*; and the related forms, in addition to the following requirements:

NOTE: The following step is updated per NQA-1-2008/9a, Section 7, 400.

3.2.8.2 **IMPLEMENT** controls to ensure the submittal and evaluation of supplier-generated documents and that changes are accomplished in accordance with procurement document requirements.

NOTE: The following step is updated per NQA-1-2008/9a, Section 7, 501.

3.2.8.3 **WHILE** items or services are being accepted, **ENSURE** that the extent of the verification activities by the purchaser are a function of the relative importance,

complexity, and quantity of the item or services procured and the supplier's quality performance.

3.2.8.4 **PERFORM** the commercial-grade dedication of items in accordance with NNFD-010, *NNFD Procurement and Receipt Inspection for NNFD Supplies*, including form NNFD-FRM-035, *Commercial Grade Dedication*, in accordance with the requirements outlined in NQA-1-2009/9a, Subpart II, Section 2.14, "Quality Assurance Requirements for Commercial Grade Items and Services."

3.2.8.5 **IF** using NNFD documents as templates, **THEN REPLACE** NNFD-specific responsibilities, including the design authority, with AMMT personnel and organizational responsibilities.

3.2.8.6 **PROCURE** AMMT safety-related software.

3.2.8.7 **CONTROL** AMMT safety-related software in accordance with AMMT-SQ-PROC-001, *AMMT Software Quality Assurance*.

3.2.9 Fabrication Control

AMMT Lead Engineer/Engineer

3.2.9.1 **IMPLEMENT** fabrication control requirements in accordance with NNFD-017, *NNFD Fabrication Control*, and the related forms, in addition to the following requirements:

3.2.9.2 **IF** using NNFD documents as templates, **THEN REPLACE** NNFD-specific responsibilities, including the design authority, with AMMT personnel and organizational responsibilities.

AMMT Design Authority

3.2.9.3 **IF** fabricated, **THEN APPROVE** all AMMT-specific design packages and drawings for safety-related components.

3.2.10 Control and Storage of Components and Items

AMMT Lead Engineer/Engineer

3.2.10.1 **IMPLEMENT** control and storage requirements in accordance with SBMS subject area, "Property Management;" NNFD-025, *NNFD Control and Storage of NNFD Components and Items*; and the related forms, in addition to the following requirements:

3.2.10.2 **IF** using NNFD documents as templates, **THEN REPLACE** NNFD-specific responsibilities, including the design authority, with AMMT personnel and organizational responsibilities.

AMMT Design Authority

NOTE: Perform the following step before receipt of safety-related components.

3.2.10.3 **APPROVE** all AMMT-specific control and storage plans for safety-related components.

3.2.11 Commercial-Grade Items and Services

AMMT Lead Engineer/Engineer

3.2.11.1 **IMPLEMENT** requirements for commercial grade items and services in accordance with SBMS subject area, "Commercial Grade Dedication;" and NNFD-010, *NNFD Procurement and Receipt Inspection for NNFD Supplies*, including form NNFD-FRM-035, *Commercial Grade Dedication*, and the related forms, in addition to the following requirements:

3.2.11.2 **IF** using NNFD documents as templates, **THEN REPLACE** NNFD-specific responsibilities, including the design authority, with AMMT personnel and organizational responsibilities.

3.2.11.3 **PERFORM** the commercial-grade dedication of items in accordance with NNFD-010, *NNFD Procurement and Receipt Inspection for NNFD Supplies*, including form NNFD-FRM-035, *Commercial Grade Dedication*, in accordance with the requirements outlined in NQA-1-2009/9a, Subpart II, Section 2.14, "Quality Assurance Requirements for Commercial Grade items and Services."

AMMT Design Authority

NOTE: Perform the following step before receipt of safety-related components.

3.2.11.4 **APPROVE** all AMMT-specific commercial grade plans for safety-related components.

3.2.12 Training

Responsible Personnel

3.2.12.1 **TRAIN** to the referenced AMMT and NNFD procedures and forms as designated within the procedure and/or as assigned per NNFD training requirements.

AMMT Training Coordinator

3.2.12.2 **APPLY** AMMT training assignments in conjunction with the NNFD training coordinator.

3.2.12.3 **IF** updates to the NNFD training requirements are communicated, **THEN ASSIGN** them to the applicable AMMT personnel.

3.2.13 Design Control between ORNL and External Engineering Subcontractors

Technical Project Officer (TPO)

NOTE 1: For nondocument design data (e.g., 3D models), a data storage system more suitable to the data type and size may be used in place of an MS SharePoint site, provided this system retains version history and meets applicable cybersecurity requirements. **NOTE 2:** This section can also apply to other external design/engineering entities (e.g., other DOE national laboratories, universities).

3.2.13.1 **ESTABLISH** a SharePoint site through ORNL processes that is approved to handle data of moderate sensitivity (e.g., export-controlled information) and that is accessible by both ORNL and external subcontractor personnel.

AMMT Design Authority

3.2.13.2 **ENSURE** that up-to-date versions of fundamental design documents (e.g., piping and instrumentation diagrams and specifications) are maintained under configuration control on the SharePoint site and

3.2.13.3 **ENSURE** that up-to-date versions of fundamental design documents are accessible to both ORNL and external subcontractor personnel.

AMMT Design Authority/TPO

3.2.13.4 **ENSURE** that the following instructions are provided to engineering subcontractors through the appropriate procurement mechanism:

3.2.13.5 **ENSURE** that all ORNL-provided data used for design purposes are received through the SharePoint site.

3.2.13.6 **IF** data are received from ORNL through other means (e.g., email or verbal communication), **THEN FORWARD** the information to the ORNL TPO for uploading to the MS SharePoint site.

NOTE: The version number of a document on the SharePoint site is available by right-clicking the document and selecting "Version History."

3.2.13.7 **IF** using ORNL-provided data in a report, calculation, or other design deliverable AND the the input document does not have formal revision control through an approved ORNL process (e.g., EDRM), **THEN REFERENCE** the SharePoint version or date of the input document used.

NOTE: A task list or similar document may be used to document the resolution of minor issues and requests for information.

3.2.13.8 **IF** responding to questions from ORNL personnel AND documenting on SharePoint is practical, **THEN ENSURE** the answers are documented on the SharePoint site.

3.2.13.9 **PROVIDE** all design deliverables to ORNL through the SharePoint site.

3.2.13.10 **PROVIDE** design and engineering documents in units of measurement consistent with Section 3.2.14.

AMMT Personnel

NOTE: Minor issues and requests for information may be resolved by email or verbally, but these items should be documented on SharePoint through a task list or similar method.

3.2.13.11 **IF** external contractors are involved, **THEN PROVIDE** data to external subcontractors through the SharePoint site.

3.2.13.12 **IF** using data provided by an external subcontractor AND the input document does not have formal revision control through an approved ORNL process, **THEN REFERENCE** the SharePoint version or date of the input document used.

3.2.13.13 **HELP** the AMMT design authority maintain up-to-date versions of fundamental design documents on the externally facing SharePoint site.

NOTE: This section applies only to document development for the AMMT demonstration reactor design. It does not apply to other documents, including those for additive manufacturing, safety basis, and public or scientific communication.

3.2.14 Units of Measurement

Engineer/AMMT Personnel

NOTE: If a vendor supplies a product as SI units only or if the fabricator has expressed a preference for SI units, then fabrication drawings and documents may be produced in SI.

3.2.14.1 **USE** USCS units with no other units provided for all fabrication drawings, construction drawings, and documents intended to be used in the field for fabrication and construction.

Engineer

NOTE 1: Electrical quantities (e.g., ohm, volt, ampere, electrical watt) are taken to be both USCS and SI, and no conversion is required for these quantities.

NOTE 2: For the purposes of radiological dose and related quantities, the USCS system is taken to include the traditional centimeter-gram-second units for those quantities (e.g., rad and rem), whereas the SI is taken to include the corresponding meter-kilogram-second units (e.g., grey and sievert).

3.2.14.2 **IF** engineering calculations, analyses, reports, and so on are intended for design purposes, **THEN PERFORM** engineering calculations, analyses, reports, and so in either USCS or SI units.

3.2.14.3 **IF** the document is intended for design use, **THEN PROVIDE** conversions to the system not used (i.e., USCS or SI) for all major inputs, outputs, and conclusions of the document.

3.2.14.4 **IF** the inputs or results are shown in graphical form, **THEN PROVIDE** dual scales so that the figure can be read in either system of units.

Reviewer

3.2.14.5 **IF** reviewing an engineering design analysis or calculation, **THEN ENSURE** conversions are provided between USCS and SI units for all major inputs, outputs, and conclusions.

3.2.14.6 **VERIFY** all unit conversions as part of the review process.

3.3 Training and Qualification Process

3.3.1 Identifying and Establishing AMMT-Specific T&Q Requirements

AMMT WBS Leads

3.3.1.1 **IDENTIFY** the AMMT-specific training, including continuing training or qualifications required to perform specific functions within the AMMT Program.

WBS Leads and Appropriate Organizational Participants

NOTE 1: Existing division-level training may be available to fulfil training needs for a particular AMMT function. However, in some cases, local training requirements (LTRs)

may be required for AMMT activities. AMMT-specific LTRs shall be developed in accordance with SBMS TQMS and as identified in this procedure.

NOTE 2: Generally, AMMT T&Q requirements follow the work activities being performed. Work might be performed in various laboratories and facilities at ORNL, including the Manufacturing Demonstration Facility at the ORNL Hardin Valley campus. Training requirements can be identified in work-controlling documents, such as research safety summaries (RSSs), associated with each activity. Facility access requirements can also include required training per the organization that owns the facility and the space in which work is performed. Training requirements associated with work-controlled activities under an RSS and facility access requirements are generally determined by the participating organization's facility and/or space owner. Additional training requirements might be necessary to perform specific AMMT activities under an RSS or work location. For example, if measurement data must be captured by using specialized processes not covered under an RSS, then the WBS lead must determine the LTRs specific for that work activity.

NOTE 3: For other quality-affecting work activities—such as nondestructive examination, inspections, and audits—ORNL SBMS and AMMT-specific requirements will apply, as specified in the *AMMT Quality Assurance Plan* and this procedure.

NOTE 4: The degree of rigor associated with AMMT-specific T&Q requirements correlates with the degree of risk and/or complexity associated with a particular activity or job function. As such, some T&Q requirements could require more formality in approach, as specified in SBMS subject area, "Instructional System Design." Other T&Q requirements may be identified in a participating organization's LTRs as identified in division training plans or work-controlling documents, such as RSSs.

3.3.1.2 **ANALYZE** specific functions, operations, and activities to determine the need for qualifications, training, and continuing training necessary to maintain job proficiency.

WBS Lead

NOTE: The type of training and method of delivery (i.e., classroom, computer, OJT for localized AMMT-specific training) is typically incorporated into AMMT lesson plans, as described in Section 3.3.6.

3.3.1.3 **DEVELOP** training lesson plans to meet specific T&Q needs for the AMMT, as identified in Section 3.3.6

3.3.1.4 **IDENTIFY** required reading to meet specific T&Q needs for the AMMT, as identified in Section 3.3.5.

WBS Lead for Design and Analysis

NOTE: Other broad categories of work, such as design, are controlled under AMMT-DA-PROC-001, *AMMT Design Controls*, which integrates design activities with other ORNL organizations, specifically the NNFD.

3.3.1.5 **WORK** with NNFD line management, training organization, and SMEs (e.g., the design authority) to identify T&Q requirements for design activities.

3.3.2 Roles and Responsibilities for Implementing AMMT-Specific T&Q Requirements

NOTE: Implementing the designated training identified in this plan requires a coordinated effort between the AMMT director, WBS leads, DTOs, participating organization management, SMEs, and AMMT participants. These responsibilities compliment the staff and participant roles and responsibilities identified in AMMT-PM-PROC-002, *AMMT Organization*.

AMMT Director

NOTE: Administration of this responsibility is primarily delegated to AMMT WBS leads.

3.3.2.1 HOLD overall responsibility for the T&Q of participants assigned to the AMMT program.

3.3.2.2 **APPROVE** each job position function.

3.3.2.3 **DESIGNATE** individual AMMT participants to perform those functions.

3.3.2.4 **INITIATE** AMMT-TQ-FORM-001, *AMMT Personal Qualification and Training Requirements Form*, for each participant assigned to the AMMT program.

3.3.2.5 **APPROVE** AMMT-TQ-FORM-001, *AMMT Personal Qualification and Training Requirements Form*, for each participant assigned to the AMMT program.

3.3.2.6 **ENSURE** that AMMT participants are qualified through appropriate training as required in SBMS subject area, "Training of Staff."

3.3.2.7 **DESIGNATE** an individual as DTO for the AMMT Program to interface with the ORNL Office of Technical Training (OTT) and participating organizations' DTO and DTMs.

3.3.2.8 **IDENTIFY** specific responsibilities for the AMMT DTO within this procedure to meet AMMT Program needs.

3.3.2.9 **REVIEW** periodically the implementation of TQMS requirements—including those established for supervisors, staff, instructors, and training providers—to ensure continuing adequacy and effectiveness.

3.3.2.10 **COORDINATE** this review with the AMMT quality assurance manager or quality representative.

3.3.2.11 **APPOINT** AMMT DTO.

AMMT WBS Leads

NOTE: Some, or all, of these roles and responsibilities may be delegated, as deemed appropriate.

3.3.2.12 **COORDINATE** AMMT T&Q activities with the AMMT director and appropriate participating organizations to identify T&Q requirements for specific functions and job positions associated with the AMMT.

3.3.2.13 **WORK** with organizational management and SMEs to identify and develop training requirements and materials for AMMT activities for specific AMMT WBS areas.

3.3.2.14 **IDENTIFY** T&Q requirements by job position on the ITM&R.

3.3.2.15 **PROVIDE** requirements and assigned participants to the AMMT DTO for inclusion on the AMMT ITM&R.

3.3.2.16 **IF** T&Q requirements for an activity cannot be met by using existing ITRs or organizational LTRs, **THEN DEVELOP** training content, such as required reading and/or lesson plans, as specified in this procedure.

3.3.2.17 **ADMINISTER** T&Q requirements to specified audience.

3.3.2.18 **DOCUMENT** T&Q completion on the attendance roster or equivalent method.

3.3.2.19 **PROVIDE** records of completion to the AMMT DTO.

NOTE: Perform the following task before assigning AMMT participants to specific work activities.

3.3.2.20 **VERIFY** that training and qualification requirements are met.

AMMT Quality Assurance Manager/Quality Representative

3.3.2.21 **EVALUATE** the effectiveness of the AMMT T&Q program through surveillance and assessment activities.

3.3.2.22 **REVIEW** training materials and qualifications per AMMT-PM-PROC-001, *AMMT Document Control and Records Management*.

3.3.2.23 **APPROVE** training materials and qualifications per AMMT-PM-PROC-001, *AMMT Document Control and Records Management*.

AMMT DTO

3.3.2.24 **ASSIST** the director in the administration of T&Q requirements for the AMMT, as identified in this procedure.

3.3.2.25 **SERVE** as the AMMT DTO per SBMS TQMS and as stated in AMMT-PM-PROC-002, *AMMT Organization*.

3.3.2.26 **ASSIST** AMMT director and WBS leads in the implementation of this T&Q procedure for the AMMT Program.

3.3.2.27 **PARTICIPATE** in DTO meetings/forums.

3.3.2.28 **COORDINATE** activities with the OTT.

3.3.2.29 **MAINTAIN** the AMMT ITM&R.

3.3.2.30 **COORDINATE** T&Q activities with DTO and DTMs from participant organizations.

3.3.2.31 **MAINTAIN** T&Q records in accordance with AMMT-PM-PROC-001, *AMMT Controlled Documents and Records Management*.

DTM and DTO of Participating Organizations

3.3.2.32 **SERVE** as primary DTM/DTO for staff and AMMT participants for the assignment of laboratory-level ITRs and other requirements per SBMS subject area, “Training of Staff.”

3.3.2.33 **INTERFACE** with the AMMT DTO in assigning AMMT-specific T&Q requirements to AMMT participants.

3.3.2.34 **HELP** AMMT WBS leads analyze and identify T&Q requirements for the AMMT Program.

AMMT Staff and Participants

NOTE: Perform the following tasks before independently performing the work.

3.3.2.35 **FULFILL** training requirements for assigned work.

3.3.2.36 **VERIFY** training requirements for assigned work.

3.3.2.37 **PARTICIPATE** in the analysis of training needs and requirements for the AMMT-specific job positions.

3.3.2.38 **TAKE** ownership of their individual training requirements.

3.3.2.39 **MAINTAIN** training and qualification requirements.

3.3.2.40 **WORK** with DTO or DTM and supervisors to schedule, attend, and complete initial and continuing training requirements.

3.3.2.41 **HOLD** account for the quality and effectiveness of the training received through participant evaluation and feedback.

3.3.3 AMMT Integrated Training Matrix and Roster

NOTE 1: The AMMT ITM&R identifies T&Q requirements for specific functions and activities for each AMMT WBS area.

NOTE 2: Rosters of AMMT participants are maintained for each WBS area within the matrix. AMMT participants are approved and qualified to perform work for AMMT by using AMMT-TQ-FORM-001, *AMMT Personal Qualification and Training Requirements Form*, which is defined in Section 3.3.4.

NOTE 3: An example of a matrix is included in Appendix B, "Example AMMT Integrated Training Matrix and Roster."

AMMT DTO

3.3.3.1 **OBTAIN** input from AMMT WBS leads.

3.3.3.2 **MAINTAIN** the matrix as an MS Excel file on the AMMT SharePoint site.

3.3.4 AMMT Personal Qualification and Training Requirements

NOTE: AMMT-TQ-FORM-001, *AMMT Personal Qualification and Training Requirements Form*, is used to document initial qualification requirements, such as education, experience, and proficiencies of the participant, as well as AMMT-specific T&Q requirements assigned to the job position that the participant will hold. This also includes continuing training requirements required to maintain job proficiency. Localized training requirements from participating organizations shall be listed, as well as AMMT-specific lesson plans and required reading assignments. An example of the form is shown in Appendix C, "Example AMMT Personnel Qualification and Training Requirements Form."

AMMT Director or Delegate

3.3.4.1 **APPROVE** the form.

AMMT DTO

3.3.4.2 **MAINTAIN** the form as temporary project records until submitted to the permanent ORNL records system in accordance with AMMT-PM-PROC-001, *AMMT Document Control and Records Management*.

3.3.5 AMMT Required Reading Program and Indoctrination Meetings

NOTE: Required reading is an essential element of an effective conduct of operations program. It enhances personnel awareness of important information relevant to a participant's job assignment. Required reading can be used to indoctrinate a participant to the content of a procedure, test plan, or requirement; increase awareness of expectations or policies; and communicate information (e.g., lessons learned and program updates) across the AMMT Program.

Insert Role

NOTE: Meetings/sessions held to indoctrinate program information to AMMT participants, such as required *All-Hands* meetings, are effectively used by AMMT to convey program updates, management expectations, clarify organizational responsibilities, and more.

3.3.5.1 Maintain content of indoctrination meetings and attendance records as program records in accordance with AMMT-PM-PROC-001, *AMMT Document Control and Records Management*.

WBS Lead

NOTE 1: AMMT may use the NNFD required reading program, NNFD-TRN-909, *Nonreactor Nuclear Facilities Division Required Reading Program*, or the ORNL LRN, for its required reading program.

NOTE 2: Perform the following action before initiating a required reading assignment.

NOTE 3: Required reading assignments can be maintained by AMMT job position within the AMMT ITM&R.

3.3.5.2 **IDENTIFY** the target audience.

3.3.5.3 **PROVIDE** the following information directly to the AMMT DTO or NNFD training manager (or OTT) to initiate a required reading assignment:

- PDF of the document for which required reading is assigned
- Names and three-digit user ID of participants to be assigned required reading
- Date when assignment is to be completed

AMMT DTO

3.3.5.4 **REQUEST** reports of required reading assignments and completions with the NNFD training manager.

3.3.5.5 **IF** appropriate, **THEN UPDATE** AMMT ITM&R.

3.3.6 AMMT Lessons Plans

NOTE: The format and content of this section is modeled after NNFD procedure NNFD-TRN-

907, *Lesson Plans*. Lesson plans are detailed descriptions of a course of instruction for WBS leads to consistently use to achieve intended learning outcomes. Lesson plans can be used for a variety of objectives, such as to indoctrinate a process or facility, communicate program expectations, provide OJT, and provide equipment indoctrination. They can be used for self-study, classroom, OJT, and so on.

Insert Role

3.3.6.1 **GIVE** the lesson plan a unique AMMT DCN.

NOTE: In addition to a title page, the lesson plan can be formatted by using a PowerPoint presentation or guidance in Appendix D, "AMMT Lesson Plan Outline." The cover slide of a PowerPoint presentation should include the AMMT DCN, and the body should contain other information provided in Appendix D, "AMMT Lesson Plan Outline," as appropriate.

3.3.6.2 **DEVELOP** the lesson plan per AMMT-PM-PROC-001, *AMMT Document Control and Records Management.*

3.3.6.3 **REVIEW** the lesson plan per AMMT-PM-PROC-001, *AMMT Document Control and Records Management.*

3.3.6.4 **APPROVE** the lesson plan per AMMT-PM-PROC-001, *AMMT Document Control and Records Management*.

WBS Lead

NOTE: Lesson plans should be reviewed on a 3-year minimum basis. Lesson plans are controlled documents and shall be maintained in EDRM as part of the AMMT Program record series.

3.3.6.5 **SERVE** as the point of contact for lesson plans.

3.3.6.6 **APPROVE** lesson plans.

3.3.7 Administering AMMT T&Q Requirements

WBS Leads

NOTE: The forum (e.g., classroom, self-study, virtual/remote) in which the T&Q are to be administered will need to be considered. Electronic records of virtual/remote sessions (Teams session recording and list of participants, for example) and/or self-study programs will also need to be taken into consideration.

3.3.7.1 **DETERMINE** the need to administer T&Q requirements (initial and continuing).

3.3.7.2 **COMMUNICATE** to the AMMT DTO the AMMT-specific job position, individual participants, and T&Q requirements (e.g., lesson plan, required reading, and/or ITRs/LTRs) to be administered.

AMMT DTO

3.3.7.3 **UPDATE** the training matrix, AMMT job positions, and training assignments in the AMMT ITM&R.

3.3.7.4 **SCHEDULE** training per WBS lead instructions.

WBS Leads

3.3.7.5 **ADMINISTER** T&Q requirements.

3.3.7.6 **USE** an attendance roster (see Appendix E, "Example AMMT Attendance Roster") or equivalent for electronic sessions to document course information and participants who attended.

3.3.7.7 **FORWARD** attendance rosters and other records of completion to the AMMT DTO.

AMMT DTO

3.3.7.8 **UPDATE** the ITM&R in accordance with AMMT-PM-PROC-001, *AMMT Document Control and Records Management*.

3.3.7.9 **MAINTAIN** training records in accordance with AMMT-PM-PROC-001, *AMMT Document Control and Records Management*.

3.3.8 Evaluation

NOTE: In accordance with the TQMS and Systematic Approach to Training, the AMMT T&Q approach will be evaluated for adequacy, suitability, and effectiveness on a continuing basis. Because of the nature of this type of research project, T&Q requirements are evaluated at each phase of the project and before each activity is planned. Likewise, any change in direction will necessitate an evaluation of T&Q needs. The AMMT T&Q plan will be formally evaluated as an assessment at least every 3 years, as required by this procedure.

Insert Role

3.3.8.1 **EVALUATE** AMMT T&Q approach for adequacy, suitability, and effectiveness.

3.3.8.2 **DOCUMENT** results of the evaluation in the ITM&R or equivalent process.

4. RECORDS

This document generates records as described in the procedure sections.

5. STANDARDS AND REFERENCES

5.1 Standards

- ASME NQA-1-2008, *Quality Assurance Requirements for Nuclear Facility Applications*, and NQA-1a-2009, *Addenda*
- DOE Order 414.1D, *Quality Assurance*

5.2 References

- *AMMT Integrated Training Matrix and Roster*
- AMMT-PM-PROC-001, *AMMT Document Control and Records Management*
- AMMT-PM-PROC-002, *AMMT Organization*
- AMMT-QA-PLAN-001, *AMMT Quality Assurance Plan*
- AMMT-SQ-PROC-001, *AMMT Software Quality Assurance*
- AMMT-TQ-FORM-001, *AMMT Personal Qualification and Training Requirements Form*

- NNFD-010, *NNFD Procurement and Receipt Inspection for NNFD Supplies*
- NNFD-014, *Facility Equipment Startup Testing*
- NNFD-025, *NNFD Control and Storage of NNFD Components and Items*
- NNFD-ENG-950, *NNFD Engineering Calculations*
- NNFD-ENG-951, *NNFD Systems Design Descriptions*
- NNFD-ENG-952, *NNFD Design Reviews*
- NNFD-ENG-953, *NNFD Drawing Management*
- NNFD-ENG-954, *NNFD Engineering Specifications*
- NNFD-ENG-955, *NNFD Design Process*
- NNFD-FRM-035, Commercial Grade Dedication
- NNFD-TRN-907, *NNFD Lesson Plans*
- NNFD-TRN-909, *NNFD Required Reading Program*
- QAP-ORNL-NR&D-01, *Quality Assurance Plan for Nuclear Research and Development Activities Conducted at the Oak Ridge National Laboratory*
- SBMS exhibit, “ORNL Publications and Style Guide”
- SBMS exhibit, “Scientific and Technical Communication Types”
- SBMS procedure, “Classify and Control Sensitive Information”
- SBMS procedure, “Develop, Revise, and Control Other Controlled Documents”
- SBMS procedure, “Maintain Research Records”
- SBMS subject area, “Commercial Grade Dedication”
- SBMS subject area, “Information Protection”
- SBMS subject area, “Instructional System Design”
- SBMS subject area, “Property Management”
- SBMS subject area, “Publications and Other Scientific Communications”
- SBMS subject area, “Purchasing Goods and Services”
- SBMS subject area, “Records Management”
- SBMS subject area, Software Quality Assurance
- SBMS subject area, “Training of Staff”
- SBMS Training and Qualification Management System (TQMS)

6. APPENDICES

- Appendix A: Acronyms and Definitions
- Appendix B: Document Control Number Assignment
- Appendix C: Controlled Document Template Instructions

- Appendix D: Recommended Reviewers and Approvers
- Appendix E: Records Retention Schedule
- Appendix F: Design Control Matrix
- Appendix G: AMMT Personnel Qualification and Training Requirements
- Appendix H: AMMT Technical Procedures and Plans List

Appendix A: Abbreviations and Definitions

Abbreviations

AMMT	Advanced Materials and Manufacturing Technologies
DC	derivative classifier
DCN	document control number
DIS	Directors Information System
DMC	document management coordinator
DOE	US Department of Energy
DTM	division training manager
DTO	division training officer
EC	export controller
EDRM	Electronic Document and Records Management
ITM&R	*AMMT Integrated Training Matrix and Roster*
ITR	institutional training requirement
LTR	local training requirement
MS	Microsoft
NE	Office of Nuclear Energy
NNFD	Nonreactor Nuclear Facilities Division
OJT	on-the-job training
ORNL	Oak Ridge National Laboratory
OSTI	DOE Office of Science and Technical Information
OTT	ORNL Office of Technical Training
OUO	Official Use Only
PICS:NE	Project Information Collection System: Office of Nuclear Energy
POC	point of contact
QA	quality assurance
R&D	research and development
RMA	Records Management Application
RMO	records management officer
RSS	research safety summary
SBMS	Standards-Based Management System
SI	International System of Units
SME	subject matter expert
TPO	technical project officer

TQMS	Training and Qualification Management System
USCS	United States Customary System
V&V	verification and validation
WBS	work breakdown structure

Definitions

abstract: a brief summary of a larger work or project, which might or might not be related to a conference. Reviewed in RESolution.

approval date: the date a controlled document is approved electronically through EDRM.

charter: an internal document that identifies a team's or project's purpose; clearly defines membership and roles, responsibilities, and operating rules; and establishes protocols for both the team/project and management on communicating, reporting, and decision-making. Managed in EDRM.

conference paper: a paper to be presented at a conference and published in a proceeding or journal. Reviewed in RESolution.

controlled document: a version-controlled document under document control.

critical revision: a revision of a controlled document that addresses a nonconformance, audit finding, or other quality-affecting anomaly.

derivative classifier (DC): an individual who identifies the level of protection required for a controlled document.

Directors Information System (DIS): an ORNL intranet database application used to record, track, and process documents received and generated by the ORNL Directors Office.

document control number (DCN): a unique alphanumeric identifier assigned to AMMT controlled documents.

document control: the act of ensuring that documents are reviewed for adequacy, approved for release by authorized personnel, and distributed to and used at the location where the proscribed activity is performed.

document: any written, pictorial, or electronic information describing, defining, specifying, reporting, or certifying activities, requirements, procedures, or results.

drawing: an internal document that provides a detailed design documentation on how to fabricate, assemble, troubleshoot, repair, and operate a piece of equipment or a system. Managed in EDRM.

effective date: the date an approved and issued controlled document is effective. Effective dates may be different than the approval and issue dates. (e.g., to allow time for an implementation process).

export-controlled information: an unclassified category of DOE-produced scientific and technical information in the possession of DOE or its contractors that a private individual person could not export lawfully without a license issued under the terms of the Arms Export Control Act, the Export Administrative Act, the Atomic Energy Act, or the Nuclear Nonproliferation Act. It is generally proprietary research and from industrial development, design, production, and product use, the results of which are restricted for proprietary or national security reasons. It does not apply to basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community. Export-controlled information is designated as Official Use Only (OUO) information, Exemption 3, by definition, and all requirements apply per DOE Order 471.3, *Identifying and Protecting Official Use Only Information*.

external report: reports that are reviewed through RESolution, including letter reports (designated *LTR*), technical memos (designated *TMs*), and sponsor reports (designated *SPRs*).

internal document: a document that is assigned a AMMT DCN and written using an AMMT electronic template that follows the drafting, review, and approval process described in this document and are meant for internal use at the AMMT Program.

internal report: a document that presents the results of a review, assessment, activity, or analysis. Internal reports are assigned a AMMT DCN and written using an AMMT electronic template that follows the drafting, review, and approval process described in this document and are meant for internal use at the AMMT Program. Managed in EDRM.

issue date: the date assigned in EDRM when a document is approved and finalized. A document must be approved before it can be issued. Issuing involves obtaining approval and preparing the document for final issuing (e.g., adding final dates).

laboratory notebooks: the means for keeping a permanent record of a researcher's work in research and development, providing a basic resource that the researcher and others can refer to at a later date, and they can be used as legal evidence of date of conception (i.e., idea, invention), to support scientific integrity, and to demonstrate that project requirements are met. (Other commonly used terms may include *research and development (R&D) notebook*, *research notebook*, *scientific notebook*, or *scientific and technical notebook.*) Laboratory notebooks must be registered per SBMS requirements.

letter report (designated *LTR* in DCN): typically a very brief report (<10 pages) that might include a letter, often used as a status or interim report to a sponsor. In RESolution, select "Non-STI" unless it is intended for public release. Reviewed in RESolution.

major revision: changes that do not alter the outcome of the steps or processes outlined in the document. They do not change the intent or outcome of the step, process, or document. Examples include correcting grammar or spelling without changing meaning, updating organizational titles, and clarifying to provide explanation without affecting the purpose of the document.

minor revision: changes that do not alter the outcome of steps or processes described in the document. Examples include resequencing sections; resequencing, adding, or deleting steps; making changes to steps that affect the outcome of the step or process; changing processes or requirements; and changing responsibilities.

native document: the original MS Word file of an approved document.

native draft: the original MS Word file of the draft under formal review.

Official Use Only (OUO) information: certain unclassified information that may be exempt from public release under the Freedom of Information Act that could damage governmental, commercial, or private interests if disseminated to persons who do not need to know the information to perform their jobs or DOE-authorized activities.

plan: an internal document that describes a program of action for achieving goals and commitments. A plan identifies or maps how personnel convert requirements (e.g., regulatory, contractual) into compliant execution. A plan describes how applicable requirements or commitments are implemented. Managed in EDRM.

policy: an internal document that describes the philosophies and fundamental values of applicable departments and areas of responsibility. A policy is limited to the scope and content needed to establish AMMT's mission, vision, expectations for performance or compliance, and established standards. Policies do not contain specific required actions. Managed in EDRM.

poster: a paper poster containing research information that will be presented at a conference or other event for participants to view. Reviewed in RESolution.

presentation: slides or other presentation material. Reviewed in RESolution.

procedure: an internal document that prescribes a performed process (i.e., sequence of actions) that achieves a defined outcome. A procedure contains, at a minimum, the responsibilities and sequenced direction for personnel to perform a specific process. Managed in EDRM.

procurement document: purchase requisitions, purchase orders, drawings, contracts, specifications, or instructions used to define requirements for purchase.

publication (journal article): an article to be published in a scholarly peer-reviewed journal or trade publication. These typically have an unlimited distribution after they are published. Reviewed in RESolution.

quality assurance (QA) record: a completed document that furnishes evidence of the quality of items and/or activities affecting quality.

record copy: a record, regardless of format (e.g., electronic or hard copy), that is designated as the official ORNL copy.

record schedule: a policy that defines how long data items must be kept and provides disposal guidelines for how data items should be discarded.

record: documentation regardless of format (e.g., electronic, hard copy, email) created or received by an organization in the conduct of business that provides evidence of an activity, decision, or compliance with requirements, preserves valuable information, or is an archived version of a controlled document.

Records Management Application (RMA): the ORNL electronic records management system in which records are collected, organized, and categorized to facilitate their preservation, retrieval, use, and disposition.

records series: the basic unit for organizing and controlling files; a group of files or documents kept together (either physically or intellectually) because they

- relate to a particular subject or function,
- result from the same activity,
- document a specific type of transaction,
- take a particular physical form, or
- have some other relationship arising out of their creation, receipt, maintenance, or use.

Software Registration System: system used by software owners/developers at ORNL to register the required QA information for their software; also provides an inventory of software at ORNL and serves as a central repository for software information and documentation.

specification: an internal document that provides a detailed description of the design and/or materials used to make, procure, or use materials and equipment. Managed in EDRM.

sponsor report (designated *SPR* in DCN): a report authored in whole or in part by an ORNL researcher that will be released by the sponsor or external collaborator. Will be sent to the DOE Office of Scientific and Technical Information (OSTI) unless an OSTI distribution limitation is selected. Reviewed in RESolution.

technical memo (designated *TM* in DCN): a technical report that is authored in whole or in part by an ORNL researcher that reports scientific or technical information. Will be sent to OSTI unless an OSTI distribution limitation is selected. Reviewed in RESolution.

test plan: an internal document that describes the approach for testing a system or component. Test plans identify the items to be tested, tasks to be performed, and responsibilities for the testing activities. Managed in EDRM.

verification and validation (V&V): a process by which a procedure or software item is reviewed and tested to ensure that the flow of the procedure and all its steps meet requirements and specifications and that it fulfills its intended purpose.

Appendix B: Document Control Number Assignment

A unique document control number (DCN) is assigned to all Advanced Materials and Manufacturing Technologies (AMMT) controlled documents. The DCN consists of four segments separated by hyphens. The Electronic Document and Records Management (EDRM) is used to assign sequential numbering as controlled documents are created.

1. Organizational Designation

AMMT	Advanced Materials and Manufacturing Technologies

2. AMMT Organization Code (two characters)

AM	Additive Manufacturing	OP	Operations
DP	Digital Platform	PM	Program Management
EN	Engineering	QA	Quality Assurance
IC	Instrumentation and Control	RG	Regulatory
MT	Materials and Testing	TQ	Training and Qualification
NF	Nuclear Fuels		

3. Document Type Code (four characters)

CHTR	charter	PLAN	plan
COMS	communications	PLCY	policy
DRWG	drawing	PROC	procedure
FACT	fact sheet	RPRT	report
FLOW	flow chart	SPEC	specification
FORM	form	TEST	test plan, procedure, or report
OAID	operator aid	TRNG	training and qualification
ORGC	organization chart		

4. Document Number (three digits)

001 and sequential

Can be broken down into series by the responsible AMMT organization

Note: During the drafting process, draft versions are assigned alphanumeric identifiers, with *01* being the first draft, followed by a letter (A–Z) for edits of the first draft.

Appendix C: Controlled Document Template Instructions

Electronic Advanced Materials and Manufacturing Technologies (AMMT) controlled document templates for procedures, plans, charters, and internal reports are available from the document management coordinator. These documents are developed in Microsoft Word. Use these templates to develop documents in conjunction with this procedure.

Electronic templates contain instructions and basic guidance in bracketed, italicized text. When developing new content, add text where indicated, and remove the instructional text.

Appendix D: Recommended Reviewers and Approvers

Document Type	DOE	AMMT program manager	AMMT technical manager	QA manager	WBS lead(s)	Technical SME(s)	EC/DC review	Other (see note)
QA plan	—	A	R	A	R	R	—	A
QA procedures	—	A	R	A	R	R	—	—
Technical plans and procedures	—	A	A	A	A	R	R	—
Operational plans and procedures	—	A	R	A	A	R	—	—
Program plans and reports	—	A	R	—	R	R	R	—
Technical and scientific publications	R	A	R	—	A	R	R	—
Nuclear/facility safety documentation	A	A	R	R	R	R	R	—
Regulatory submittals	R	A	R	R	R	R	R	—
Engineering documents	—	—	A	R	R	R	R	—
Drawings and design documents	—	—	A	R	R	R	R	—
Test plans and reports	—	—	A	R	R	R	R	—
Training materials	—	—	R	R	R	R	R	—
Other as needed (see note)	—	—	—	—	—	—	—	—

A = Approve and review
R = Review
QA = quality assurance
EC = export controller
SME = subject matter expert
Note: Other reviewers, including those outside the Advanced Materials and Manufacturing Technologies (AMMT) organization, may be included, as appropriate. Other reviewers can include a derivative classifier (DC), Oak Ridge National Laboratory Management System owners, design authority, program managers, associate laboratory directors, external partners, etc.

Appendix E: Records Retention Schedule

Approved Schedule for AMMT Program Project Files

The Advanced Materials and Manufacturing Technologies (AMMT) Program (50450589) is scheduled in the Records Management Application (RMA) as a single project under R&D Level I with a permanent retention.

> Level I Definition: Projects that received national or international awards of distinction; active participation of nationally or internationally prominent investigators; research that resulted in a significant improvement in public health, safety, or other vital national interests; scientific endeavors that were the subject of widespread national or international media attention and/or extensive Congressional, DOE, or other government agency investigation; projects that show the development of new and nationally or internationally significant techniques that are critical for future scientific endeavors; or projects that significantly affected the development of national or international scientific, political, economic, or social priorities.
>
> Level I Disposition Instructions: Permanent. Cutoff after project/program completion, cancellation, or termination, or in 5-year blocks. Retire to FRC 2 years after project/program termination. Transfer to the National Archives and Records Administration 30 years after project/program termination.

AMMT Record Series: One AMMT record series is associated with the approved AMMT Program Records Retention Schedule in RMA—1706. The record series includes records categories and types as metadata for ease in organization, search, and retrieval.

Example AMMT record categories (additional categories can be added in RMA, as needed):

AM Additive Manufacturing

DP Digital Platform

EN Engineering

IC Instrumentation and Control

MT Materials and Testing

NF Nuclear Fuels

OP Operations

PM Program Management

QA Quality Assurance

RG Regulatory

AMMT record types (additional types can be added in RMA as needed):

- Completed forms
- Completed training records
- Correspondence, commitments, noncommitments, or work authorizations to US Department of Energy, state, and regulatory agencies on behalf of UT-Battelle LLC
- Data and calculations
- Design drawings and specifications
- Emails
- Engineering specifications
- Fact sheets and informational brochures
- Inspection, testing, and calibration records
- Laboratory notebooks
- Operator aids
- Other correspondence
- Presentations
- Procurement records/packages
- PM reports
- Scientific and technical publications and reports
- Test plans and reports

Appendix F: Design Control Matrix

NQA-1 (2008/9a) design requirement	Requirement title	AMMT/NNFD procedures
2008/9a, Requirement 3, Part 100	"Basic"	AMMT-QA-PROC-001, *AMMT Technical Procedure* NNFD-ENG-955, *Design Process*
2008/9a, Requirement 3, Part 200	"Design Input"	AMMT-QA-PROC-001, *AMMT Technical Procedure* NNFD-ENG-955, *Design Process*
2008/9a, Requirement 3, Part 300	"Design Process"	AMMT-QA-PROC-001, *AMMT Technical Procedure* NNFD-ENG-955, *Design Process*
2008/9a, Requirement 3, Part 400	"Design Analysis"	AMMT-QA-PROC-001, *AMMT Technical Procedure* NNFD-ENG-955, *Design Process* NNFD-ENG-950, *Engineering Calculations*
2008/9a, Requirement 3, Part 400, Part 401	"Use of Computer Codes"	AMMT-QA-PROC-001, *AMMT Technical Procedure* AMMT-SQ-PROC-001, *AMMT Software Quality Assurance* NNFD-ENG-955, *Design Process*
2008/9a, Requirement 3, Part 500	"Design Verification"	AMMT-QA-PROC-001, *AMMT Technical Procedure* NNFD-ENG-955, *Design Process* NNFD-ENG-952, *Design Reviews*
2008/9a, Requirement 3, Part 501.3	"Design Verification/ Qualification Tests"	AMMT-QA-PROC-001, *AMMT Technical Procedure* NNFD-ENG-955, *Design Process* NNFD-ENG-952, *Design Reviews* NNFD-014, *Facility Equipment Startup Testing*
2008/9a, Requirement 3, Part 600	"Change Control/ Configuration Management"	AMMT-QA-PROC-001, *AMMT Technical Procedure* NNFD-002, *Change Control of Modifications*
2008/9a, Requirement 3, Part 700	"Interface Control'	AMMT-QA-PROC-001, *AMMT Technical Procedure* NNFD-ENG-955, *Design Process*
2008/9a, Requirement 3, Part 800	"Software Design Control"	AMMT-QA-PROC-001, *AMMT Technical Procedure* NNFD-ENG-955, *Design Process*
2008/9a, Requirement 3, Part 900	"Documentation and Records"	AMMT-QA-PROC-001, *AMMT Technical Procedure* AMMT-PM-PROC-001, *AMMT Document Control and Records Management*
2008/9a, Requirements 7; 8; 13	"Control of Purchased Items and Services;" "Identification and Control of Items;" "Handling, Storage, and Shipping"	AMMT-QA-PROC-001, *AMMT Technical Procedure* NNFD-025, *NNFD Control and Storage of NNFD Components and Items* NNFD-010, *NNFD Procurement and Receipt Inspection for NNFD Supplies*
2008/9a, Requirement 10	"Inspection"	AMMT-QA-PROC-001, *AMMT Technical Procedure* NNFD-010, *NNFD Procurement and Receipt Inspection for NNFD Supplies*
2008/9a, Requirement 11; 14	"Test Control;" "Inspection, Test, and Operating Status"	AMMT-QA-PROC-001, *AMMT Technical Procedure* NNFD-014, *Facility Equipment Startup Testing*

Appendix G: AMMT Personnel Qualification and Training Requirements

AMMT Personnel Qualification and Training Requirements

Name:
Position:
A. Program-Specific Position
Responsibilities: [Text]
Describe specific work responsibilities: [Text]
Education, experience, and training requirements: • **Experience:** [Text] • **Education:** [Text] • **Required reading:** [Text] • **Training:** [Text] • **Qualifications:** [Text] • Training to the quality assurance requirements contained in AMMT-QA-PLAN-001, *AMMT Quality Assurance Plan*, and QAP-ORNL-NR&D-01, *Quality Assurance Plan for Nuclear Research and Development Activities Conducted at the Oak Ridge National Laboratory*.
B. Applicable Individual Qualifications/Training (attach resume and supporting documentation)
Education: • Specific individual education to meet requirements
Professional experience: • [#] years of experience in [XXX] • [#] years of experience in [XXX]
Training/Qualifications (in addition to any previously described): • Other generic training • General Employee

Qualified Employee Signature:

Print/Sign	Position	Date	Organization

Technical Verification Signature:

Print/Sign	Position	Date	Organization

Form Instructions:

1. Provide the name of the individual being qualified.
2. Provide the position to which the individual is being qualified.
3. Describe generic responsibilities to which the individual is being qualified.
4. Describe specific job responsibilities to which the individual is being qualified.
5. Describe the job-specific experience, education, required reading and training/qualification requirements.
6. Describe the individual's education.
7. Describe the individual's years of associated professional experience.

8. Describe the individual's training and/or qualifications.
9. Attach the individual's resume and supporting documentation.
10. Qualified Employee: Print name, position, date, and organization and sign form
11. Technical Verifier:
    a. Verify required information is documented and attached.
    b. Print name, position, date, and organization and sign form

Appendix H: AMMT Technical Procedure and Plans List

Note: This list is compiled from AMMT related technical procedures available at the time of publication and may not be inclusive of all AMMT related procedures to be developed in support of the AMMT program.

Technical Subject	Procedure/Plan ID	Title
AM Machines	AMMT-AM-PROC-200	*AMMT AM Concept Laser Cusing Setup*
	AMMT-AM-PROC-201	*AMMT AM Concept Laser Job Design and Slicing*
	AMMT-AM-PROC-400	*AMMT AM Renishaw AM250 and AM400 Setup and Build Start*
	AMMT-AM-PROC-401	*AMMT AM Renishaw AM250 and AM400 Job Design and Slicing*
Machining	AMMT-AM-PROC-004	*AMMT AM Part Separation, EDM, and Machining*
Characterization	AMMT-AM-PROC-005	*AMMT AM Part Characterization*
	AMMT-AM-PROC-006	*AMMT AM Metallography Specimen Preparation*
Powder	AMMT-AM-PROC-002	*AMMT AM Powder Sampling and Recycling*
Planning	AMMT-AM-PROC-001	*AMMT AM Job Control*
	AMMT-AM-FORM-001	*AMMT Job Traveler Form*
	AMMT-MT-TEST-001	*AMMT Uniaxial Tensile Test Plan*

APPENDIX D. ADDITIONAL PROCEDURES

Advanced Materials and Manufacturing Technologies Program
AM Job Traveler Form

Michael Russell

October 2023

OAK RIDGE National Laboratory

ORNL IS MANAGED BY UT-BATTELLE LLC FOR THE US DEPARTMENT OF ENERGY

AMMT-AM-PROC-001-R0

Advanced Materials and Manufacturing Technology Program AM Job Control

Michael Russell

October 2023

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AMMT-AM-PROC-002-R0

Advanced Materials and Manufacturing Technology Program AM Powder Sampling and Recycling

Michael Russell

October 2023

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AMMT-AM-PROC-004-R0

Advanced Materials and Manufacturing Technology Program
AM Part Separation, EDM, and Machining

Michael Russell

October 2023

OAK RIDGE National Laboratory

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AMMT-AM-PROC-005-R0

Advanced Materials and Manufacturing Technology Program AM Part Characterization

Michael Russell
Andres Marquez

October 2023

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AMMT-AM-PROC-006-R0

Advanced Materials and Manufacturing Technology Program AM Metallography Specimen Preparation

Michael Russell

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Advanced Materials and Manufacturing Technology Program AM Concept Laser M2 Cusing Setup

Michael Russell
Ryan Dehoff

October 2023

OAK RIDGE National Laboratory

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AMMT-AM-PROC-201-R0

Advanced Materials and Manufacturing Technology Program AM Powder Sampling and Recycling

Michael Russell
Ryan Dehoff

October 2023

OAK RIDGE National Laboratory

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Advanced Materials and Manufacturing Technology Program AM Renishaw AM250 and AM400 Setup and Build Start

Michael Russell
Christian Petrie

October 2023

OAK RIDGE National Laboratory

ORNL IS MANAGED BY UT-BATTELLE LLC FOR THE US DEPARTMENT OF ENERGY

AMMT-AM-PROC-401-R0

Advanced Materials and Manufacturing Technology Program AM Renishaw AM250 and AM400 Job Design and Slicing

Michael Russell
Christian Petrie

October 2023

OAK RIDGE National Laboratory

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Advanced Materials and Manufacturing Technologies Project Uniaxial Tensile Test Plan

Michael Russell
T. S. Byun

October 2023

OAK RIDGE National Laboratory

ORNL IS MANAGED BY UT-BATTELLE LLC FOR THE US DEPARTMENT OF ENERGY