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Army Reactor Program Regulatory Bases

Supporting Army Regulation 50–7

April 2025

Bruce K. McDowell
James E. Cabe
Peter P. Lowry
Jonathan B. Napier
Chad L. Painter
Kevin C. Gorecke
Charles A. Gunzel III
Nathan D. Clark
Virgil O. Peoples
Steven J. Maheras
Tiexeina Narine
Kenneth M. Thomas
Frank A. Putzu

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Summary

This report describes the regulatory bases for the 2025 revision of Army Regulation (AR) 50–7 - *Nuclear and Chemical Weapons and Materiel: Army Reactor Program* and the new associated Department of the Army pamphlet (DA PAM) *Army Reactor Program Procedures*.

Consistent with the Atomic Energy Act of 1954, as amended, the Army Reactor Office (ARO) provides regulatory oversight of Army nuclear reactors, including test reactors, stationary nuclear power plants, and mobile nuclear power plants. AR 50–7 establishes Department of the Army (DA) policies and assigns responsibilities for the use of Army reactors as part of the Army Reactor Program (ARP).

The Army is considering expanding the use of nuclear power plants for installation energy at Army bases and expeditionary energy for deployed mission areas. Since AR 50–7 (2016) was written primarily for oversight of the Fast Burst Reactor and decommissioning activities, the Army is currently updating AR 50–7 to provide an expanded regulatory framework that includes oversight of installation and expeditionary advanced power reactors. The revised draft of AR 50–7 will be accompanied by a DA PAM to provide additional guidance on implementing the requirements outlined in the updated version.

The 2025 draft revision of AR 50–7 and the new accompanying draft DA PAM update the Army's regulatory structure for managing the ARP. This structure is based on three fundamental principles: ARP objectives, Army regulatory instruments, and Army regulatory requirements that apply across all reactor life-cycle stages (Chapter 1). The fundamental objectives of the ARP are to ensure reactor safety, plant reliability, radiation safety, environmental protection, and security across all life-cycle functions. The four regulatory instruments in the draft AR 50–7 are Certification of Supporting Programs (Chapter 2), Permits and Approvals (Chapter 3), Regulatory Oversight (Chapter 4), and Required Reports (Chapter 5). In addition, this report summarizes the regulatory bases for Reactor Safety Design Criteria (Chapter 6), Standard Operating Requirements (Chapter 7), Decommissioning (Chapter 8), Transportation (Chapter 9), and Deployment/Redeployment (Chapter 10). For reader convenience, the chapter organization in this report follows the chapter organization of the draft AR 50–7 and its associated DA PAM.

The Army's fundamental approach for regulating nuclear facilities is based on its historical and ongoing reactor program. The updated regulatory approach in the 2025 draft of AR 50–7 is informed by and leverages best practices in nuclear facility regulation by the Nuclear Regulatory Commission, the Department of Energy, U.S. Naval Reactors, other national programs (e.g., Canada), the International Atomic Energy Agency, and other regulatory bodies such as the Department of Transportation. This report summarizes these regulatory bases as they were used to develop the 2025 draft of AR 50–7 and its associated DA PAM.

Acronyms and Abbreviations

ADP	Army Doctrine Publication
AEA	Atomic Energy Act of 1946, as amended
AEC	Atomic Energy Commission
ALARA	as low as reasonably achievable
ANPP	Army Nuclear Power Program
AOO	anticipated operational occurrence
AR	Army Regulation
ARC	Army Reactor Committee
ARDC	Advanced Reactor Design Criteria
ARO	Army Reactor Office
AROG	Army Reactor Office Guide
ARP	Army Reactor Program
C4I	Command, Control, Communications, Computers and Intelligence
CBRN	chemical, biological, radiological, and nuclear
CBRN-S	Chemical, Biological, Radiological, and Nuclear Survivability
CBRNE	Chemical, Biological, Radiological, Nuclear, and High-Yield Explosive
CFR	*Code of Federal Regulations*
CIO	Chief Information Officer
CISA	Cybersecurity and Infrastructure Security Agency
CJCSI	Chairman of the Joint Chiefs of Staff Instruction
CM	configuration management
CNSC	Canadian Nuclear Safety Commission
CoC	certificate of compliance
COCO	contractor owned, contractor operated
COE	Army Chief of Engineers
CONUS	continental United States
CORE	Command Operational Readiness Evaluation
D3	defense-in-depth and diversity
DA	Department of the Army
DA PAM	Department of the Army pamphlet
DASAF	Director of Army Safety
DCS	Deputy Chief of Staff
DFARS	Defense Federal Acquisition Regulation Supplement
DFTS	Defense Freight Transportation Services
DHS	Department of Homeland Security
DNFPP	Deactivated Nuclear Facility Possession Permit

DoD	Department of Defense
DoDI	DoD Instruction
DOE	Department of Energy
DORE	Deployed Operational Readiness Examination
DOT	U.S. Department of Transportation
DSCA	Defense Support of Civil Authorities
DTR	Defense Transportation Regulation
EM	emergency management
EMP	electromagnetic pulse
EOP	emergency operating procedure
ERDA	Energy Research and Development Administration
ESCSWG	Energy Sector Control Systems Working Group
FEMA	Federal Emergency Management Agency
FIPS	Federal Information Processing Standards
FORMDEPS	FORSCOM Mobilization and Deployment Planning System
FORSCOM	U.S. Army Forces Command
FSAR	Final Safety Analysis Report
GDC	General Design Criteria
HAZMAT	hazardous material
HEMP	High Altitude Electromagnetic Pulse
HIPAA	Health Insurance Portability and Accountability Act
HQDA	Headquarters, Department of the Army
HRC	Human Resources Command
IAEA	International Atomic Energy Agency
INL	Idaho National Laboratory
INPO	Institute of Nuclear Power Operations
ISFSI	interim spent fuel storage installation
JP	Joint Publication
LCO	limiting condition for operation
LLRW	low-level radioactive waste
LMP	Licensing Modernization Project
LWA	Limited Work Authorization
LWR	light-water reactor
MC&A	Material Control and Accountability
MHTGR	modular high-temperature gas-cooled reactor
MHTGR-DC	modular high-temperature gas-cooled reactor design criteria
MNPP	mobile nuclear power plant
MOU	memorandum of understanding

NFPA	National Fire Protection Association
NFV	Nuclear Facility Verification
NIMS	National Incident Management System
NIST	National Institute of Standards and Technology
NNSA	National Nuclear Security Administration
NPRP	Nuclear Personnel Reliability Program
NPT	Nuclear Non-Proliferation Treaty
NR	Naval Reactors
NRC	Nuclear Regulatory Commission
NRRO	Naval Reactors Representative Office
OCE	Office of the Chief of Engineers
OCONUS	outside the continental United States
OIF	Operation Iraqi Freedom
ONR	Office for Nuclear Regulation
OPM	Office of Personnel Management
ORA	Operational Readiness Assessment
OSA	Operational Support Area
PHI	protected health information
PHMSA	Pipeline and Hazardous Materials Safety Administration
PI	performance indicator
PII	personally identifiable information
PM	program manager
PNNL	Pacific Northwest National Laboratory
PPE	personal protective equipment
PRA	probabilistic risk assessment
PSAR	Preliminary Safety Analysis Report
QA	quality assurance
R&D	research and development
RL	reactor leader
RO	reactor operator
RSDC	Reactor Safety Design Criteria
SAR	Safety Analysis Report
SMR	small modular reactor
SNM	special nuclear material
SOP	standard operating procedure
SP	Special Publication
SRL	Senior Reactor Leader
SRP	Standard Review Plan

SSA	Strategic Support Area
SSCs	systems, structures, and components
TDR	Transportation Discrepancy Report
TMI	Three Mile Island
TPS	Transportation Protective Service
TRADOC	U.S. Army Training and Doctrine Command
TTP	tactic, technique, and procedure
UCNI	unclassified controlled nuclear information
USACE	U.S. Army Corps of Engineers
VOLT	Validated Online Lifecycle Threat
WMD	weapons of mass destruction

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1.0 Introduction

This report describes the regulatory bases for the 2025 draft revision of Army Regulation (AR) 50–7 *Nuclear and Chemical Weapons and Materiel: Army Reactor Program*[1] and the new associated Department of the Army pamphlet (DA PAM) *Army Reactor Program Procedures*.[2]

Consistent with the Atomic Energy Act of 1954, as amended (AEA 1954), the Army Reactor Office (ARO) provides regulatory oversight of Army nuclear reactors, including test reactors, stationary nuclear power plants, and mobile nuclear power plants. AR 50–7 (2016) establishes Department of the Army (DA) policies and assigns responsibilities for the use of Army reactors in the Army Reactor Program (ARP). The Army currently operates the Fast Burst Reactor at the White Sands Missile Range in New Mexico (Army 2025c) and previously operated the MH-1A STURGIS Barge, the SM-1 Deactivated Nuclear Power Plant at Fort Belvoir, Virginia, and the SM-1A Deactivated Nuclear Power Plant at Fort Greely, Alaska (USACE n.d.-d)

The Army is considering expanding the use of nuclear power plants for installation energy at Army bases and for expeditionary energy in deployed mission areas. In addition, the Army may require new or expanded test and research reactor capabilities. Since AR 50–7 (2016) was written primarily for oversight of the Fast Burst Reactor and decommissioning activities, the Army has a revised draft AR 50–7 to provide an expanded regulatory framework that includes oversight of installation and expeditionary advanced power reactors in addition to oversight of test and research reactors. The revised draft of AR 50–7 is accompanied by a new draft DA PAM to provide guidance on the implementation of the requirements in the regulation. In addition, the ARP will develop supporting programs and lower-tiered guidance documents, templates, and procedures for efficient and comprehensive regulatory oversight of the expanded program.

This report describes the background, regulations, references, and other documents that form the technical bases of the draft AR 50–7 and its DA PAM. The order of the chapters in this report generally follows the chapter organization of the draft AR 50–7 and associated DA PAM.

1.1 Army Reactor Program Background and Regulatory History

The development of the draft updates to AR 50–7 and its new DA-PAM included a review and consideration of relevant domestic and international regulatory schemes to understand and incorporate the frameworks and underlying concepts where appropriate. The Army distilled relevant provisions and best practices of these agencies, including consultations, and tailored them to its mission and requirements. The draft AR 50–7 and draft DA PAM have been harmonized with these regulatory frameworks and evaluated to assure consistency.

1.1.1 Army Reactor Program Background

The Army Nuclear Power Program (ANPP) was responsible for developing, operating, and managing nuclear power from the early days of the nuclear enterprise through the 1970s (USACE n.d.-c). The U.S. Army Corps of Engineers and the Atomic Energy Commission (AEC) worked together within the ANPP to develop nuclear power plants for military use. In 1957, the ANPP developed its first prototype nuclear reactor at Ft. Belvoir, Virginia, and it designed, built, and operated seven additional reactors in the United States and abroad :

- **Initiation:** In the 1950s, the U.S. Army initiated its own nuclear power program, separate from the Navy's successful development of nuclear-powered vessels. The Army's program aimed to

[1] Unless otherwise specified, all callouts to the AR 50–7 herein refer to the 2025 draft.
[2] Callouts to the DA PAM (unnumbered at time of publication) refer to the newly developed draft document associated with the draft AR 50–7 (2025).

develop small, transportable nuclear reactors that could provide power to remote bases and forward areas.

- **Portable Reactors:** The Army developed several small nuclear reactors, such as the SM-1, which was the first reactor to go critical in the ANPP and was installed at Fort Belvoir, Virginia (USACE n.d.-b). Other notable reactors included the ML-1, an experimental truck-mounted nuclear reactor, the MH-1A STURGIS Barge which operated at the Panama Canal, the PM-2A, which was used in Greenland, and the PM-3A, which powered the McMurdo Station in Antarctica (USACE n.d.-a).
- **Training and Operations:** The Army trained specialists and operated these reactors in various locations, including remote and challenging environments, to test the feasibility of nuclear power in support of military operations.

Currently, the Army operates the Fast Burst Reactor at the White Sands Missile Range in New Mexico to test electronic devices in a fast neutron environment. The Army also provides support for the Department of Defense (DoD) Project Pele initiative, aimed at developing and demonstrating a prototype mobile nuclear microreactor at the Idaho National Laboratory (OUSD R&E 2025). Previously operated power reactors had either been decommissioned or are undergoing decommissioning.

1.1.2 Regulatory History

The legal roots of authority and responsibility for the DoD and Military Departments to license and regulate nuclear power are in the Atomic Energy Act of 1946, as amended (AEA)—specifically, Section 91b (AEA 1946). The AEA established the AEC, a predecessor agency of the Department of Energy (DOE), and within the AEC, established the Division of Military Applications. While military applications were clear, the Army's regulatory goals could be achieved only through its AEC civilian governance because the Atomic Energy Act granted regulatory authority to the AEC.

On 11 October 1974, the AEC was abolished under the Energy Reorganization Act, assigning to the Energy Research and Development Administration (ERDA) the responsibility for the development and production of nuclear weapons, promotion of nuclear power, and other energy-related work, and assigning to the Nuclear Regulatory Commission (NRC) the regulatory work (NRC 2025b). ERDA was abolished in 1977 in the Department of Energy Organization Act, which established the DOE in the Executive Branch as the successor to ERDA (DOE 2025a).

Notwithstanding the Energy Reorganization and DOE Organization Acts, the Army retains regulatory authorities deriving from the AEA. Section 161(b) of the AEA placed regulatory authority upon the AEC to regulate defense nuclear activities (AEA 1954). With regard to DoD, Section 91b of the AEA states that:

> The President from time to time may direct the Commission (1) to deliver such quantities of special nuclear material or atomic weapons to the Department of Defense for such use as he deems necessary in the interest of national defense, or (2) to authorize the Department of Defense to manufacture, produce or acquire any atomic weapon or utilization facility for military purposes…(AEA 1954).

While the language of Section 161(b) granted the AEC very broad authority, Section 91b clarified that DoD did have a role, as defined by the President. As nuclear power grew in the DoD enterprise, President Kennedy issued a Presidential Directive on September 23, 1961 that put regulatory responsibilities upon DoD for military reactors, reflecting long-standing practices of the AEC and the military:

> Responsibility will rest with the Department of Defense for identifying and resolving health and safety problems relating to the operation of utilization facilities, or to special nuclear material for use therein, which are held by the DoD pursuant to directives of the President under Section 91b of the Atomic Energy Act. In view of the Atomic Energy Act of 1954, the AEC will participate in the identification and resolution of these problems as a matter of responsibility. In this connection, the Department of Defense or the appropriate military Department will prepare, issue and enforce

> safety standards, procedures or instruction applicable to the location and operation of utilization facilities and to special nuclear material for use therein. Advice and assistance will be obtained from the AEC on the safety aspects of the design of utilization facilities and in the preparation or amendment of safety standards, procedures or instruction relating to the location and operation of utilization facilities and to special nuclear material for use therein, and comment or concurrence shall be obtained from the AEC as to their adequacy. Any disagreement as to safety aspects, arising as a result of comment by the AEC, which cannot be directly resolved by the two agencies will be referred to the President for decision (Kennedy 1961).

As well, section 110(b) of the AEA establishes that DoD reactors are not required to undergo the NRC licensing process, provided there is a Presidential Directive pursuant to Section 91b. This exemption is restated in 10 CFR Part 50.11 (a) and 10 CFR Part 70.13 . In instances where DoD or NRC could license and regulate, NRC and DoD have negotiated which agency will license and regulate depending on the specific facts.

While the parties honored the 1961 Presidential Directive, it left ambiguities in lines of responsibilities. To address those ambiguities, DoD and AEC entered a Memorandum of Understanding (MOU) in 1967 to implement the 1961 Presidential Directive (AEC and DoD 1967). Under the MOU, DoD was required to provide to the AEC:

- Safety analysis for new and modified reactors
- Criteria and procedures to be used for qualification of reactor operators
- Proposed directives or regulations establishing nuclear safety policies, standards, and principles
- Reports of significant events, conditions or operational problems, and copies of operating reports, inspection reports and safety study reports or safety evaluation reports. Any potential health or safety problem noted by the AEC will be reported promptly by the AEC to DoD (AEC and DoD 1967).

As well, the MOU provided that AEC may conduct periodic site visits and inspections “under mutually acceptable arrangements.” The MOU applies to the DoD nuclear enterprise except for naval nuclear propulsion (AEC and DoD 1967).

In 1967, the Army Reactors Group prepared a report explaining the organization structure and lines of responsibility. The Office of the Chief of Engineers (OCE) established the Army Reactors Group as the basic Army organizational framework for nuclear reactors oversight, headed by the Director of the ANPP, U.S. Army Corps of Engineers (USACE), who also functioned as Special Assistant for Nuclear Power to OCE and as Assistant Director (Army Reactors), Division of Reactor Development and Technology, AEC. The Army Reactors Group continued to have dual responsibility in the Army and AEC, enabling it to exercise AEA authorities normally reserved to AEC.

In 2011, the Army Health Physics Office submitted a letter to the NRC requesting that NRC defer regulatory oversight of decommissioned Army reactors, citing the 1961 Presidential Directive and 1967 MOU as applicable authorities. In addition, NRC and Army executed an MOU in 2022 agreeing, in part, that the 1967 MOU continues to apply (Army and NRC 2022):

> This MOU is intended by the parties to operate in furtherance of, and consistent with, the Memorandum of Understanding (MOU) between DoD and the Atomic Energy Commission, signed on February 14/16, 1967, as applicable, given that the U.S. Department of Energy inherited the AEC’s legal authorities for reactors under AEA § 91b.

1.2 Army Reactor Program Framework

The Army Reactor Office provides the Army’s regulatory oversight of Army nuclear power plants, including test reactors, stationary power reactors, and mobile nuclear power plants. AR 50–7 (2016, 2025) establishes the Department of the Army policies and assigns responsibilities for Army nuclear reactors as part of the ARP. The purpose of the ARP is to ensure that Army nuclear reactor operations are safe, secure, environmentally compliant, and reliable from design through decommissioning. AR 50–7 (2016, 2025) designates the Deputy Chief of Staff for Operations, Plans and Training (DCS G–3/5/7), as the proponent for the ARP, and the U.S. Army Nuclear and Countering Weapons of Mass Destruction Agency as the focal point for managing the ARP and ARO.

The ARP regulatory framework in the updated AR 50–7 and other Army regulations is founded on three principles that minimize risk and uphold the highest standards for safety: Regulatory Instruments, Requirements Across Life-Cycle Functions, and Army reactor program objectives. These principles apply across every phase of the nuclear facility life cycle. Figure 1-1 provides an illustration of how the principles build a resilient and flexible framework.

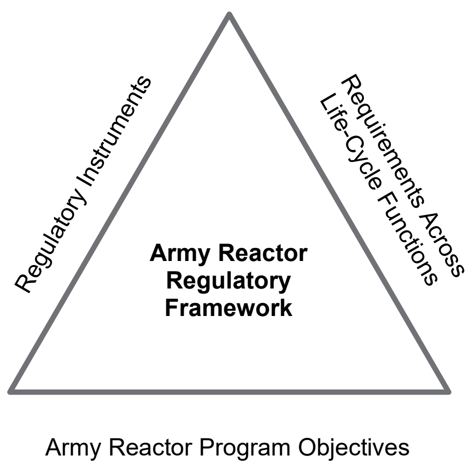

Figure 1-1. Army Reactor Regulatory Framework.

The Army's regulatory framework of objectives, regulatory instruments, and requirements across life-cycle functions is consistent with nuclear regulatory structures in the U.S. and as implemented by other nuclear nation states (see Section 1.3). The Army evaluated other regulatory structures in place in the U.S. for oversight of nuclear reactors by federal agencies in the development of the current revision to the Army's regulatory approach. These other regulatory structures are focused on specific regulatory practices that do not necessarily conform to the regulatory approach necessary for the Army to regulate its installation power reactors, research and test reactors, or mobile nuclear power plants. However, best practices of these programs were evaluated and, in some cases, incorporated directly or with modification into the updated draft AR 50–7 and the associated DA PAM.

1.2.1 Army Reactor Objectives

The ARP objectives as defined in the updated AR 50–7 and further discussed in the draft DA PAM are the core of the ARP regulatory framework. These objectives are reactor safety, plant reliability, radiation safety, environmental protection, and security (NRC 2011a).

Reactor safety focuses on minimizing the probability of reactor incidents and mitigating their consequences should they occur. The ARP established reactor safety through:

- **Safety Culture** – Fostering a culture of safety through self-assessments and independent oversight across the reactor or facility life cycle.
- **Safe Design** – Ensuring the reactor design incorporates safety features capable of withstanding all expected operational and accidental conditions.

- **Operational Guidelines** – Developing and enforcing robust protocols for construction, operation, maintenance, emergency response, and transportation.
- **Training and Qualification** – Implementing a comprehensive training and qualification program to ensure personnel competency.

Plant reliability is defined as the probability of the reactor or facility performing its intended function under stated conditions for a specified time. The ARP enhances plant reliability through:

- **Redundancy and Design Resilience**: Ensuring reactor and facility systems include redundant, independent, and diverse safety mechanisms to maintain operational capability.
- **Quality Assurance** – Verifying system performance through rigorous procurement, acceptance testing, and quality control processes.
- **Operational Discipline** – Requiring strict adherence to approved operational and maintenance procedures.
- **Condition Monitoring** – Implementing continuous monitoring systems to detect and correct equipment issues before they compromise or challenge mission capability.

Radiation safety aims to minimize personnel and public exposure to ionizing radiation, keeping exposures within regulatory limits and as low as reasonably achievable (ALARA) principles. The ARP ensures radiation safety through:

- **Radiological Design Criteria** – Designing reactors and facilities to limit radiation exposure during normal and abnormal operations.
- **ALARA Compliance** – Implementing engineering and administrative controls to maintain exposures ALARA, including during accident conditions.
- **Regulatory Compliance** – Ensuring adherence to radiological transportation and handling requirements.
- **Radiation Monitoring** – Conducting continuous radiation monitoring using properly calibrated equipment.

Environmental protection aims to prevent, minimize, and mitigate adverse impacts on human health and natural ecosystems. Environmental protection is achieved through:

- **Regulatory Compliance** – Adhering to environmental protection laws and standards.
- **Impact Mitigation** – Assessing and mitigating the environmental impact of reactor facilities, including radiological and nonradiological effects.
- **Sustainable Design Practices** – Engineering reactor systems to minimize emissions, effluents, and waste generation.
- **Environmental Surveys** – Conducting periodic environmental assessments to ensure compliance.
- **Decommissioning Standards** – Ensuring facilities undergoing decommissioning meet unrestricted release conditions.

Security measures protect Army reactors from unauthorized access, sabotage, material diversion, and hostile actions. The ARP enforces security through:

- **Physical and Cybersecurity** – Implementing strict access controls, surveillance, and cybersecurity protocols.
- **Security Planning** – Developing and enforcing security plans tailored to the nuclear facility.
- **Threat Assessments and Countermeasures** – Conducting vulnerability assessments, risk evaluations, and implementing proportionate protective measures.

1.2.2 ARP Foundation and Pillars of Execution

Achieving the ARP objectives requires foundation of a strong safety culture and operational discipline. The ARP framework emphasizes core values—Leadership, Integrity, Accountability, and Personal Courage—that are rooted in the nuclear safety culture (see for example NRC (2011b)) and traditional Army values like Duty, Loyalty, and Honor. Figure 1-2 of the draft DA PAM (repeated here) depicts how the foundation and pillars achieve the objectives of the ARP.

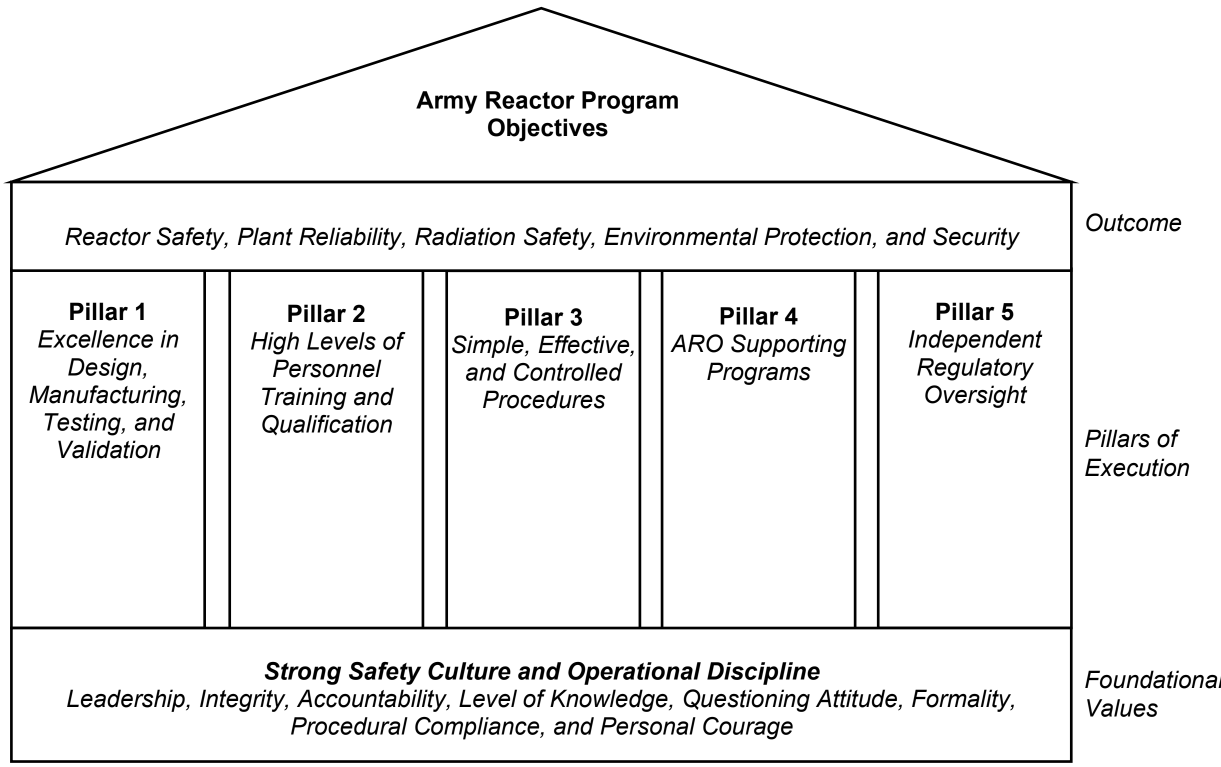

Figure 1-2. Achieving the ARP Objectives

The foundational values of the Army Reactor Program are:

- **Leadership**
  - Leadership sets the tone for safety by prioritizing reactor and nuclear safety above all other mission objectives.
  - Strong leadership fosters a culture where safety concerns are heard, addressed, and acted upon.
  - Leaders model safety behaviors and enforce standards consistently across all ranks.
  - Commanders and supervisors ensure that personnel have the training and resources necessary to uphold safety requirements.
  - Leadership accountability reinforces the expectation that all personnel contribute to a robust safety culture.
- **Integrity**
  - Honest and ethical behavior are critical when reporting safety concerns, near misses, or violations.
  - Personnel must follow technical and ethical standards even under operational pressure.

- Safety-related decisions should always be based on facts, risk assessments, and regulatory compliance.
- Integrity ensures a transparent safety culture where individuals do not fear reprisal for identifying risks.
- A culture of trust enables open communication between all levels of command.

- **Accountability**
  - Every individual, from junior to senior leaders, is responsible for upholding reactor safety.
  - Clear expectations and consequences for noncompliance reinforce commitment to safety.
  - Personnel must take ownership of their actions and decisions that impact reactor operations.
  - Accountability mechanisms such as performance evaluations and safety reviews ensure adherence to safety protocols.
  - A strong accountability system fosters reliability, discipline, and operational excellence.
- **Level of Knowledge**
  - Reactor operators and support personnel must have deep technical expertise in nuclear safety principles.
  - Continuous training and education ensure personnel maintain proficiency in reactor operations and emergency response.
  - Understanding lessons learned from past incidents enhances safety awareness.
  - Leaders must be well-versed in regulatory requirements, operational limits and engineering fundamentals.
  - Knowledge-sharing across units and organizations strengthens the overall safety culture.
- **Questioning Attitude**
  - Personnel must be encouraged to challenge assumptions and verify information to prevent complacency.
  - A mindset of “trust but verify” ensures operational and maintenance tasks are performed correctly.
  - Individuals should feel empowered to raise concerns, even if it challenges higher authority.
  - A questioning attitude prevents normalization of deviation and reinforces procedural compliance.
  - Regular safety drills and self-assessments encourage critical thinking and readiness.
- **Formality**
  - A structured and disciplined approach to operations prevents errors and reinforces safety.
  - Military hierarchy and clear command structures ensure accountability in decision-making.
  - Standardized procedures, checklists, and documentation ensure consistency in reactor operations.
  - Clear, precise communication (both written and verbal) reduces the likelihood of misunderstandings.
  - Formality ensures that safety is not left to individual interpretation but is systematically enforced.
- **Procedural Compliance**
  - Strict adherence to established procedures prevents human error and operational drift.
  - Reactor safety depends on following technical specifications, maintenance schedules, and emergency protocols.
  - Deviation from procedures must only occur under authorized conditions with proper documentation and oversight.

  - Compliance audits and inspections ensure that safety procedures are consistently followed.
  - Reinforcement through training and leadership expectations embed procedural discipline into daily operations.
- **Personal Courage**
  - Individuals must have the moral and physical courage to stop unsafe operations, regardless of rank or mission pressures.
  - Reporting hazards, violations, or near misses demonstrates commitment to reactor safety.
  - Speaking up against shortcuts, complacency, or rule-breaking safeguards both personnel and mission success.
  - Personal courage fosters a culture where safety concerns are taken seriously and addressed promptly.
  - Decision-making under uncertain conditions requires balancing operational demands with risk mitigation, prioritizing safety above expedience.

Each of these attributes contributes to a strong safety culture, ensuring that the five pillars and the Army reactor program objectives are met. The realization of ARP objectives is supported by five "pillars" of execution. They are:

- **Pillar 1 – Excellence in Design, Manufacturing, Testing, and Validation.** This pillar underlines the importance of a sound reactor design, established through rigorous technical processes managed by competent experts.
- **Pillar 2 – High Levels of Personnel Training and Qualification.** Well-trained personnel are critical, ensuring that every operator and support staff can independently assess and respond to operational challenges.
- **Pillar 3 – Simple, Effective, and Controlled Procedures.** This includes robust protocols for operations, maintenance, transport, and emergency response—ensuring that procedures evolve with design changes and lessons learned.
- **Pillar 4 – ARP Supporting Programs.** Comprehensive supporting programs provide systematic methodologies, processes, and roles to ensure safety across all reactor functions.
- **Pillar 5 – Independent Regulatory Oversight.** This pillar guarantees unbiased assessments of reactor design, manufacture, construction, and operations to verify that ARP objectives are consistently met.

1.2.3 Regulatory Instruments

To meet ARP objectives, thereby ensuring the safe operation of Army nuclear facilities the ARP employs four instruments within the Army's regulatory framework: Supporting Programs, Permits and Approvals, Regulatory Oversight, and Required Reports.

Supporting Programs describe systematic methodologies, processes, procedures, and roles and responsibilities associated with key reactor safety-impacting activities (e.g., radiological health, criticality safety, physical security). The Supporting Programs are detailed in Chapter 2 of the revised draft AR 50–7 and in Chapter 2 and Appendix B of the draft DA PAM. They generally align with similar functions required by the NRC, DOE, International Atomic Energy Agency (IAEA), and the UK, which established expectations for safe, controlled operation of nuclear facilities through defined procedures, personnel training, and organizational responsibilities. The ARO's regulatory instrument is the certification of Supporting Programs that meet the purpose defined in the updated draft AR 50–7 and the attributes listed in the draft DA PAM.

Permits and Approvals are specific regulatory actions that indicate ARO's approval of a specific activity. Permitting and Approvals are detailed in Chapter 3 of the updated draft AR 50–7 and the draft DA PAM. They generally align with similar functions conducted by the NRC, DOE, and the UK's Office for Nuclear

Regulation (ONR). The permits and approvals regulatory instrument aligns with the IAEA requirements for its Member States for the regulation of nuclear facilities and materials.

Regulatory Oversight over all phases and elements of Army Reactor Program permitted activities, plans, and programs ensures Army reactor objectives are being satisfied across all life-cycle functions. Regulatory Oversight is detailed in Chapter 4 of the updated draft AR 50–7 and in the draft DA PAM. Regulatory Oversight by the ARO allows for the independent assessment of safety effectiveness, inspections, and reviews at each life-cycle stage. Further, it ensures ongoing compliance with ARP objectives and identifies and addresses emerging safety concerns. It also aligns with similar functions conducted by the NRC, DOE, the UK's ONR, and IAEA's assessment processes.

Required Reports facilitate early identification and awareness of safety problems or problems that other nuclear power plant units or facilities might experience. Required Reports are detailed in Chapter 5 of the updated draft AR 50–7 and the draft DA PAM. The information being reported allows the regulator to assess and evaluate trends, develop fleet-wide corrective actions, focus limited resources, and plan regulatory oversight activities. Required Reports also support the development and tracking of corrective actions and causal analyses that address significant conditions adverse to quality.

1.2.4 Requirements Across All Life-Cycle Functions

The Army's Reactor Program Regulatory Framework and the development of its requirements are informed by recognized "gold standard" frameworks in nuclear regulation while being specifically tailored to support the Army's mission and operational needs for nuclear reactors and materials. The framework establishes clear, enforceable compliance standards applicable across all reactor life-cycle functions, ensuring safety, security, reliability, and environmental protection throughout design, construction, operation, refueling, storage, and decommissioning.

Additionally, requirements for cross-cutting functions—including training, maintenance, quality assurance, security, and emergency response—are implemented using a graded approach based on risk. This risk-informed methodology ensures that regulatory oversight is proportional to the potential hazards of specific activities, avoiding a one-size fits all approach. By allowing for flexible and mission-driven implementation, the Army ensures that reactor operations remain safe, reliable, efficient, and compliant while also accommodating the unique challenges of military applications.

1.3 Other Regulatory Structures Evaluated

1.3.1.1 Nuclear Regulatory Commission

The NRC is an independent agency charged with enforcing the requirements that originate from the Atomic Energy Act of 1954 for commercial and certain federal uses of radioactive materials that are not specifically excluded by the AEA (i.e., Section 91(b)). The NRC regulates active use of materials and authors the regulations found in Chapter 1 of Title 10 of the *Code of Federal Regulations* (CFR). The current U.S. reactor fleet comprises large light-water reactors (LWRs) and the regulations are written to include actions specific to their safe operation. The following CFRs are frequently referred to during reactor licensing:

- 10 CFR Part 20 *Standards for Protection Against Radiation*
- 10 CFR Part 26 *Fitness for Duty Programs*
- 10 CFR Part 30 *Rules of General Applicability to Domestic Licensing of Byproduct Material*
- 10 CFR Part 40 *Domestic Licensing of Source Material*
- 10 CFR Part 50 *Domestic Licensing of Production and Utilization Facilities*
- 10 CFR Part 51 *Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions*
- 10 CFR Part 52 *Licenses, Certifications, and Approvals for Nuclear Power Plants*

- 10 CFR Part 70 *Domestic Licensing of Special Nuclear Material*
- 10 CFR Part 71 *Packaging and Transportation of Radioactive Material*
- 10 CFR Part 72 *Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste*
- 10 CFR Part 73 *Physical Protection of Plants and Materials*
- 10 CFR Part 74 *Material Control and Accounting of Special Nuclear Material*
- 10 CFR Part 100 *Reactor Site Criteria*

Regulations in 10 CFR are intended to be applicable to multiple circumstances and can be left to interpretation. The NRC staff has identified methods that will comply with regulations. These methods are found in NRC Regulatory Guides. The guides are written such that applicants or licensees may follow the guide to meet associated regulations. These are focused on the current reactor fleet of LWRs and may not directly apply to advanced reactors. Regulatory guides are split into 10 divisions and listed below (NRC 2024d).

1. Power Reactors (NRC 2024k)
2. Research and Test Reactors (NRC 2024m)
3. Fuels and Materials Facilities (NRC 2024g)
4. Environmental and Siting (NRC 2024f)
5. Materials and Plant Protection (NRC 2024i)
6. Products (NRC 2024l)
7. Transportation (NRC 2024n)
8. Occupational Health (NRC 2024j)
9. Antitrust and Financial Review (NRC 2024e)
10. General (NRC 2024h)

Additionally, the NRC NUREG series of publications can include detailed technical descriptions or technical basis for considerations or justification of regulatory limits and processes. The NUREG series of documents can also include standard review plans, which are documents that guide the NRC staff during their reviews. The use of standard review plans promote consistency by the NRC staff during their review of different applications.

The NRC proposes to establish an optional technology-inclusive regulatory framework in 10 CFR Part 53 for use by applicants for new commercial advanced nuclear reactors (NRC 2023b). The regulatory requirements developed in this rulemaking would use methods of evaluation, including risk-informed and performance-based methods, that are flexible and practicable for application to a variety of advanced reactor technologies. The proposed rule accommodates all reactor technologies and includes a self-contained licensing framework featuring a probabilistic risk assessment (PRA)-led approach that aligns with the DOE cost-shared, industry-led Licensing Modernization Project methodology.

The NRC licenses and provides independent oversight of commercial nuclear power plants. The Army Reactor Program, on the other hand, is established to oversee government-owned and government-operated nuclear power plants and research and test reactors. The revised AR 50–7 (2025) leverages best practices and regulatory frameworks established by the NRC, for example in 10 CFR Part 50 C (Licensing of Production and Utilization Facilities) and 10 CFR Part 52 (Licenses, Certifications, and Approvals for Nuclear Power Plants); and guidance from NUREG-1537 (Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors) (NRC 1996), NUREG-0800 (Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition) (NRC 2016b), and regulatory guides, such as RG 1.206 (Applications for Nuclear Power Plants) (NRC 2018a).

1.3.1.2 U.S. Naval Nuclear Propulsion Program

The Navy's regulations for nuclear-powered vessels ensure safe, efficient, and secure operation of nuclear propulsion reactors in the demanding environments of submarines, aircraft carriers, and other vessels. These regulations cover personnel accession, training, qualification, reactor operation, safety, security, maintenance, emergency protocols, and other topics. Key applicable aspects of the Navy's regulations have been adapted to the Army's ARP for land-based microreactors, especially in areas related to safety, security, personnel, and maintenance.

The Navy's nuclear propulsion safety program involves routine radiation monitoring, safety zones around reactors, and decontamination procedures in case of a radiation leak. The Army needs similar programs to ensure safe radiation monitoring and handling, develop and maintain proper exposure limits, and build adequate containment, detection, and shielding systems.

Nuclear-powered vessels are high-priority targets for security threats and the Navy employs strict access control measures to ensure that only authorized personnel can access nuclear reactors or materials. This includes physical barriers, armed guards, and the use of security clearances for personnel. These concepts also apply to land-based microreactors including access control, physical barriers, security personnel, surveillance systems, and personnel screening.

The Navy's personnel training program for nuclear-powered vessels is rigorous and ensures that only qualified officers and enlisted service members operate and maintain nuclear reactors. This includes the *Naval Nuclear Propulsion Training Program*, which is mandatory for those who work in nuclear propulsion. The Army needs to establish a similar training program tailored to land-based microreactors that requires extensive training and certification prior to being allowed to operate or maintain nuclear reactors.

Beyond those listed, the Navy has many additional regulations including rigorous maintenance protocols, emergency response plans for nuclear propulsion plants, strict regulations for the disposal of nuclear waste, and regulations overseeing the prevention of environmental contamination. Benchmarking Navy regulations ensures ARP programs are comprehensive and managed with a similar high standard of safety, security, and environmental responsibility.

1.3.1.3 Department of Energy

The U.S. DOE was established as a result of the Energy Reorganization Act of 1974 and by the Department of Energy Organization Act in 1977. The DOE Office of Nuclear Energy's primary mission is to advance nuclear power as a resource capable of making major contributions in meeting our nation's energy supply, environmental, and energy security needs (DOE 2025b). For example, the DoD is currently developing a full-scale transportable microreactor prototype under Project Pele at DOE's Idaho National Laboratory (DOE ONE 2024). The construction and operation of this prototype microreactor will be under DOE's jurisdiction and will be overseen by DOE's Idaho National Laboratory (INL) Site Office.

To complete its mission, DOE follows similar safety requirements as those enforced by NRC. However, the regulatory structure is different. DOE implements its rules through a document hierarchy that is shown in Figure 1-3, which is taken from DOE (1994).

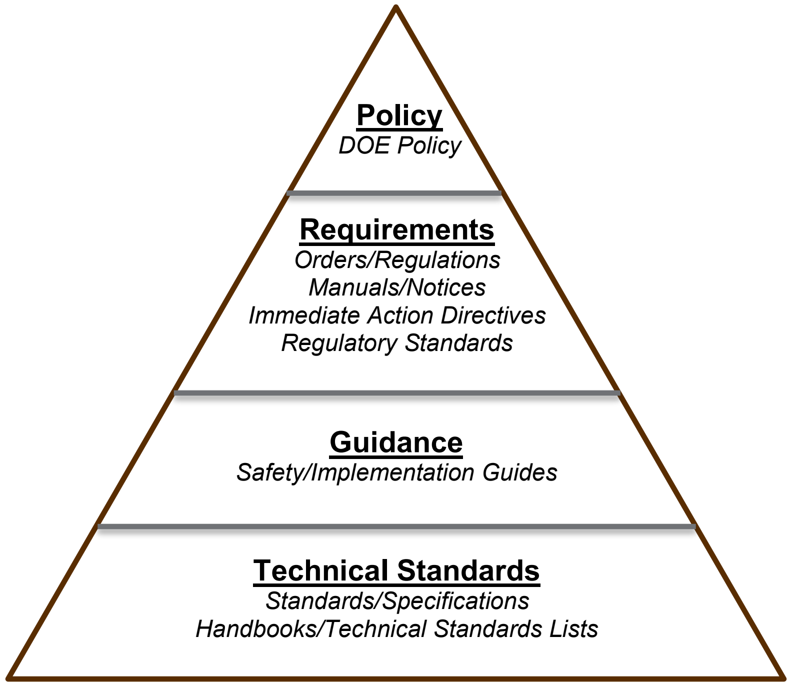

Figure 1-3. DOE regulatory document hierarchy.

DOE operations are subject to regulations outlined in various parts of Chapter 3 of Title 10 of the *Code of Federal Regulations*, including those related to nuclear activities, safety, environmental policy, and more. The Department of Energy sets nuclear safety policy using DOE Policy 420.1 (DOE 2011a), which states that

> It is the policy of the Department of Energy to design, construct, operate, and decommission its nuclear facilities in a manner that ensures adequate protection of workers, the public, and the environment.

From this policy, requirements, guidance, and technical standards have been documented to ensure compliance with this policy. The documentation is focused on nuclear facilities, which may or may not be nuclear reactors. These documents, when considered in combination with DOE's mission statement, indicate that the regulatory structure is focused on research and development use of nuclear material, not specifically power generation.

DOE plays a crucial role in nuclear matters, encompassing both nuclear energy and nuclear security, with its primary mission being to advance nuclear power as a resource and ensure the safety and security of the nation's nuclear stockpile and related activities. The DOE Office of Nuclear Energy's mission is to advance nuclear energy science and technology to meet U.S. energy, environmental, and economic needs, focusing on research, development, and demonstration activities to address technical, cost, safety, waste management, proliferation resistance, and security challenges.

DOE nuclear operations are governed, in part, by the following regulations:

- 10 CFR Part 830, *Nuclear Safety Management*
- 10 CFR Part 835, *Occupational Radiation Protection*
- 10 CFR Part 840, *Extraordinary Nuclear Occurrences*

Under the Energy Reorganization Act of 1974 (Section 201(f), 42 U.S.C § 5841), the NRC is the agency that licenses and regulates commercial power reactors (NRC 1974). Section 201(f) transferred authority to NRC for “all the licensing and related regulatory functions of the Atomic Energy Commission…” As well, Sections 101 and 102 of the Atomic Energy Act reserve to the NRC the license and regulatory authority for utilization or production facilities (42 U.S.C. §§ 2131, 2132). Section 104(c) of the Energy Reorganization Act transferred functions of the AEC to ERDA (which became DOE in 1977) which were not transferred to NRC (42 U.S.C. § 5801).

Although the licensing and regulation of commercial power reactors is the responsibility of NRC, the draft AR 50–7 leverages DOE best practices in nuclear regulation, particularly in the Supporting Programs. The Conduct of Operations Program, for example, draws directly from the very succinct and applicable DOE O 422.1 for Conduct of Operations (DOE 2010a). This order mirrors exactly what is suggested and needed for the ARP, namely, high-level requirements, clear operational characteristics, and focus on discipline and rigor in performing operating actions. The Maintenance Program also uses several DOE orders to supply key maintenance requirements for nuclear facilities. Several other programs were formed with DOE as a primary basis, including the Personnel and Facility Safety Program, and the Training and Qualification of Operation and Support Personnel Program. In these and other cases, DOE provided an appropriate approach and level of detail to laying out high-level requirements compared to other references.

1.3.1.4 International Regulatory Structures

1.3.1.4.1 International Atomic Energy Agency

The IAEA is the international center for cooperation in the safe use of nuclear materials (IAEA 2025). The Agency works with its Member States and multiple partners worldwide to promote the safe, secure and peaceful use of nuclear technologies. The Army’s regulatory framework is informed by the robust, internationally recognized IAEA framework and draws extensively from IAEA safety standards, such as[1]

- Safety Standards Series - SSG-2 (Rev.1), *Deterministic Safety Analysis for Nuclear Power Plants* (IAEA 2019)
- Safety Standards Series No. SSR-2/1 (Rev. 1), *Safety of Nuclear Power Plants: Design* (IAEA 2016c)
- Safety Standards Series No. SSR-3, *Safety of Research Reactors* (IAEA 2016d)
- Safety Standards Series - SSG-61, *Format and Content of the Safety Analysis Report for Nuclear Power Plants* (IAEA 2021b)
- Safety Standards Series - GSR Part 4 (Rev. 1), *Safety Assessment for Facilities and Activities* (IAEA 2016b)
- TECDOC-1936, *Applicability of Design Safety Requirements to Small Modular Reactor Technologies Intended for Near Term Deployment* (IAEA 2020a)
- International Nuclear Safety Advisory Group Series No. 16, *Maintaining Knowledge, Training and Infrastructure for Research and Development in Nuclear Safety* (IAEA 2004b).

The IAEA frameworks mandate the development of a comprehensive safety analysis report that consolidates all technical evaluations, clearly demonstrating how design limits and safety margins are maintained in the face of operational challenges. The convergence of international best practices in the IAEA provides a strong regulatory basis for the Army’s regulatory structure and instills confidence that the Army’s design criteria and regulatory framework are rigorous and effective in safeguarding nuclear operations and activities.

[1] See the IAEA Resources page for additional publications and information: https://www.iaea.org/resources.

1.3.1.4.2 Canada

The Canadian Nuclear Safety Commission (CNSC) regulatory framework shares many of the same core principles that underpin the NRC, DOE, and Army regulatory systems, providing an international benchmark for nuclear safety and design evaluation (CNSC 2025a). This parallelism offers significant confidence that the Army's regulatory framework, as established under the updated AR 50–7 (2025), is built on a robust, risk-informed, and performance-based foundation.

> The Canadian framework, like the U.S. counterparts, employs a phased, incremental review process. Early site evaluations, detailed safety assessments, and staged licensing—comparable to the NRC's Early Site Permit, Limited Work Authorization, and Combined License processes—allow for early identification and mitigation of potential hazards. This stated approach enables continual refinement of safety measures and design criteria, ensuring that nuclear facilities are developed and operated under conditions that maintain the highest level of safety.

By incorporating these well-established principles, the Army not only benefits from decades of international nuclear safety experience, but also enhances its own ability to manage reactor safety, design integrity, and environmental protection at every stage of the nuclear facility life cycle.

1.3.1.4.3 United Kingdom

The United Kingdom's ONR provides a well-established, globally recognized regulatory framework that closely parallels the Army regulatory framework (ONR 2025). The UK nuclear regulatory framework, like those of the NRC, DOE, CNSC, and IAEA, is built upon risk-informed, performance-based principles that ensure nuclear safety as described in ONR's Safety Assessment Principles for Nuclear Facilities.

This approach places the responsibility on the operator to demonstrate that their facility meets high safety and security standards, an approach that aligns with the Army's emphasis on a strong safety culture, accountability, and operational discipline. The Army's structured permitting system aligns with the ONR's nuclear site licensing and safety review process, ensuring that reactor facilities meet stringent safety, security, and environmental requirements.

The Army's permitting process and structure, which includes design, site, construction, operational, and decommissioning permits, parallels ONR's licensing system. In the UK, nuclear sites operate under a nuclear site license, supplemented by regulatory assessments and periodic safety reviews, which is a structure that is highly comparable to the Army's life-cycle-based regulatory instruments. Further, independent regulatory oversight is a key principle in both frameworks. The ONR performs routine inspections, compliance monitoring, and safety reviews, just as the ARO independently evaluates the safety and effectiveness of permitted activities under the Army framework. This independent oversight enhances confidence in the regulatory framework by ensuring objective safety assessments at every state of a nuclear facility's life cycle.

The Army and ONR emphasize early regulatory engagement, ensuring that regulatory requirements, safety expectations, and potential risks are well understood before formal approvals are granted. The ARP regulatory engagement process provides early coordination between applicants and the Army Reactor Office to clarify expectations, define regulatory requirements, and identify potential technical challenges. The ONR follows a similar approach through its early engagement practices, particularly during the Generic Design Assessment process, where regulatory interactions with applicants help resolve technical issues before full license applications are submitted.

The strong parallels between the Army's regulatory framework and the UK's ONR regulatory model reinforce the credibility of the Army's regulatory framework and its approach to nuclear safety, design approval, and operational oversight (ONR 2025). By aligning with the established international regulatory practices, the Army ensures that its nuclear reactor program is built upon a globally recognized foundation of safety and operational excellence.

1.4 Army Document Hierarchy

The DoD issuances contain the various policies and procedures the govern and regulate activities and missions across the defense enterprise. They take the form of formal directives, instructions, publications and manuals, administrative instructions, and directive-type memoranda (DoD 2021a). Each military department publishes forms and regulations that similarly govern and regulate the activities within its respective military branch. In general, the policies and procedures for overseeing the ARP are found in the following types of Army documents subject to AR 25–30 (Army 2021a), and DA PAM 25–40 (Army 2024a):

DoD Instructions (DoDIs) are, as a subset of the DoD Issuance Program, a type of guidance document used within the U.S. Department of Defense to implement policies, plans, or actions, assigning responsibilities and delegate authority to DoD Components, and outlining specific actions for executing a directive. There are two types of DoD instructions: policy and non-policy. The DoD may publish various documents to supplement instructions, including manuals, guides, and handbooks.

Army Regulations are the official publications that sets forth missions, responsibilities, policies, procedures, and standards for the U.S. Army that ensure uniform compliance in meeting mission objectives. Mandated procedures in Army regulations are required and authoritative instructions that contain the detail needed to make sure basic policies are carried out uniformly throughout the Army. These mandated procedures also ensure uniform implementation of public law, policy guidance, and instructions from higher headquarters or other government agencies, such as the OMB or DoD. Besides AR 50–7 (2016, 2025), examples relevant to the ARP include AR 385–10 *The Army Safety and Occupational Health Program* (Army 2023d), *Nuclear Surety* (Army 2018c), and AR 190–54, *Security of Nuclear Reactors and Special Nuclear Materials* (Army 2006).

Department of the Army Pamphlets provide guidance and procedures for implementing the policies outlined in ARs, offering more detailed, optional, or helpful methods for performing missions. Unless mandated by an AR (for example, the revised draft AR 50–7 (2025) includes specific language that identifies material in the associated draft DA PAM as required to implement policy in the AR), procedures established in a DA PAM are for guidance only. Besides the draft DA PAM developed specifically to support the revised AR 50–7, examples of DA PAMs relevant to the ARP include *DA PAM 385–25 (Army 2012) Occupational Dosimetry and Dose Recording for Exposure to Ionizing Radiation*, and *DA PAM 385–24 The Army Radiation Safety Program (Army 2015a)*.

Supporting Programs are the detailed policies, plans, and guidance written by Army commands responsible for Supporting Program execution. The Certification of Supporting Programs by ARO is one of the four regulatory instruments in the Army's regulatory framework described in Section 1.2.3 herein. Supporting Programs describe systematic methodologies, processes, procedures, and roles and responsibilities associated with key reactor safety activities (e.g., radiological health, criticality safety, physical security). These programs address the attributes listed in Appendix B of the DA PAM, thereby demonstrating the fundamental ARP program objectives are met and the operations of Army nuclear power plants are safe and reliable. Supporting Programs describe systematic methodologies, processes, procedures, and roles and responsibilities associated with key reactor safety activities (e.g., radiological health, criticality safety, physical security). The OCE maintains Supporting Programs and ensures they remain consistent with ARP policies and requirements. The regulatory bases for Supporting Programs are further described in Chapter 2 herein.

Army Reactor Office Guides (AROGs) are new document types in the Army Reactor Program's regulatory lexicon and are much like the general subject technical manuals described in DA PAM 25–40 (Army 2024a). AROGs provide additional guidance regarding the implementation of the Army's regulations, processes and approvals as they relate to the Army Reactor Program. AROGs are developed as needed to address ARO regulatory oversight responsibilities and to provide information to other Army organizations about ARO processes to facilitate obtaining regulatory approvals. Initial examples of AROGs could include:

- Safety Analysis Review Guide
- Basis for Dose and Reactor Safety Design Criteria for Army Regulation AR 50–7/DA PAM
- Form and Content of Permit Applications
- ARO Permit Review and Approval Processes.

AROGs are similar in concept to the NRC NUREG series. The NRC provides guidance to licensees and applicants by issuing NUREG-series publications regarding regulatory decisions, research results, results of incident investigations, and other technical and administrative information (NRC 2023a). NUREG-series publications disseminate scientific, technical, and administrative information dealing with licensing and regulation of civilian nuclear facilities and materials.

1.5 Army Reactor Program Regulatory Flexibility

The regulation of the ARP through the expanded AR 50–7 (2025) and the new draft DA PAM is designed to provide the Army regulatory flexibility in program execution in the following areas:

Flexible Framework for Permits and Approvals. The updated AR 50–7 (2025) specifies nine permits for approval and oversight of reactor life-cycle stages. The specific application of these permits and approvals and their review is flexible and is developed in the Regulatory Tailoring and Engagement stage of project permitting. Some permits can be combined as long as sufficient information is provided to allow ARO to confirm the ARP objectives will be met. Special permits are available for activities that fall outside the scope of the other defined permits.

Flexible Framework for Responsible Organization Designations. The draft revised AR 50–7 (2025) describes the process to issue permits to other Army organizations but does not designate which organizations would be responsible for individual permits. In the draft revised AR 50–7, Section 1-15, the Corps of Engineers also designates an organization as the Design Authority for each specific power reactor design and designates an organization responsible for applying for and receiving appropriate approvals for the transportation of mobile Army reactor systems. The revised AR 50–7 gives the Army Chief of Engineers (COE) the flexibility to designate these two roles. The roles and responsibilities of Army organizations are determined during the Regulatory Tailoring and Engagement stage.

Flexible Framework for Supporting Programs. The updated draft AR 50–7 (2025) defines Supporting Programs necessary to execute the ARP, but these programs are developed and implemented by other Army organizations. The OCE will provide oversight as the proponent for all engineering-related publications per AR 25–30 (Army 2021a). The draft DA PAM defines the attributes that the Supporting Programs need to meet to accomplish Army objectives and gives program proponents the flexibility to design and implement Supporting Programs that meet these attributes. The ARO certification of these programs is the regulatory instrument through which they are implemented.

Flexible Framework for Transportable Versus Mobile Versus Installation Reactors. Advance reactor designs include reactors that will be factory-fueled and transported to a base (transportable reactors), factory-fueled reactors that could be deployed and redeployed in multiple locations (mobile reactors), and reactors that are manufactured in modules with construction and assembly on site. The regulatory instruments defined in the draft revised AR 50–7 (2025) allow for flexibility in what Army organizations can be permitted and in the scope of the approvals required, whether for transportable, mobile, or installation reactors. The draft revised AR 50–7 and DA PAM have chapters that define regulatory requirements for the transport of fuel and fueled reactors. The updated regulation also includes a permit for the storage of mobile or transportable fueled reactors pending installation or deployment.

Flexible Framework for Power Production Versus Research and Test Reactors. The revised AR 50–7 (2025) will continue to define the regulatory framework for the oversight of research and test reactors, including the Fast Burst Reactor. Research and test reactors include demonstration reactors developed at

Army installations or at other locations and transitioned to Army installations, for example, the Pele demonstration reactor being developed at the Idaho National Laboratory (OUSD R&E 2025).

Flexible Framework for CONUS Installations Versus OCONUS Deployments. The Army may require advanced reactors to support mission needs both across the CONUS and OCONUS. The regulatory requirements for CONUS installations are defined in the draft revised AR 50–7 (2025) and DA PAM. This regulation and its associated pamphlet also provide flexibility for OCONUS deployments and have chapters that define regulatory requirements for deployments, redeployments, and transportation of fuel and fueled reactors.

Flexible Framework for Regulation. The draft updated AR 50–7 (2025) defines the ARP objectives and the regulatory instruments through which ARO confirms the objectives are met. A government-owned, government-operated reactor on an Army base could be fully regulated under this revised regulation. For a contractor-owned, contractor-operated reactor on an Army base regulated by the NRC, there would be shared regulatory oversight responsibilities between NRC and ARO. Alternatively, some regulatory functions such as safety reviews could be performed by DOE. The Army responsibility for permits and approvals, Supporting Programs, regulatory oversight, and reporting for a contractor owned, contractor operated (COCO) reactor regulated by the NRC, or regulated by the Army with DOE support, would be determined early in the Regulatory Tailoring and Engagement stage.

1.6 Design Authority and Design Agent

The draft updated AR 50–7 (2025), Section 1-15 describes the responsibility of the Army Corps of Engineers to designate an organization to act as the Design Authority. The responsibilities for the Design Authority described in the draft DA PAM are consistent with definitions of the Design Authority by other nuclear authorities. For example—

- The IAEA in INSAG-19 defines the Design Authority as “The designated entity that takes the overall responsibility for the design process, approval of design changes, and for ensuring that the requisite knowledge is established, preserved and extended with experience” (IAEA 2003b).
- The American Society of Mechanical Engineers in ASME NQA-1–2015 defines Design Authority as “The organization having the responsibility and authority for approving the design bases, the configuration, and changes thereto” (ASME 2015)
- The NRC in NUREG-1397 defines Design Authority as “The organization having responsibility for maintaining the design bases and ensuring that design output documents accurately reflect the design bases” (NRC 1991).

The draft DA PAM further defines the responsibilities of a Design Agent. The Design Agent is the organization responsible for developing the design output that implements the requirements established by the Design Authority.

- This relationship is consistent with DOE (2019a), Nuclear Facilities Commissioning, Design Agency concept. The responsibilities for the Design Agent serve as extensions of the Design Authority within the licensee or procurement authority, carrying out design-related duties under a qualified quality assurance program (also known as the quality program).

2.0 Supporting Programs

2.1 Overview

The 2016 version of AR 50–7 provides the requirements for operating research reactors and conducting decommissioning activities. The draft revised AR 50–7 (2025) provides additional detail and direction for the Army's nuclear generation program using regulations and guidance found in the NRC, DOE, Navy, and other regulatory structures. The concept of Supporting Programs is adopted to bring various aspects of operational regulation into single point programs.

In its existing regulatory structure, the Army has the fundamental foundations for certain nuclear programs, such as occupational safety, physical security, cybersecurity, and maintenance. In these cases, ARO Supporting Programs point to and incorporate by reference any existing applicable regulations, standards, or other references (i.e., AR 385–10 *The Army Safety and Occupational Health Program*). Additional requirements may be added to these programs as appropriate for an operating nuclear facility. In other cases, operational programs for a nuclear facility were nonexistent in the Army, and new guidance was needed to build a regulatory framework that mirrors operational programs in the commercial industry, DOE nuclear research landscape, or the Naval Nuclear Propulsion Program (Navy 2021). One example is the Deployment and Redeployment Program (see Section 2.20).

The number and scope of the Army's Supporting Programs are similar to programs developed by commercial nuclear power plants regulated by the NRC. Regardless of the starting point for a Supporting Program, each was benchmarked against current DoD, DOE, NRC, IAEA, Navy, and other applicable regulatory frameworks. Many topical areas are found to have "repeating" requirements throughout all platforms (e.g., configuration management is regulated the same in NRC, IAEA, and DOE spaces).

Some program areas have required new idea generation and expert industry knowledge using subject matter experts, best judgment, and multigroup collaboration. In these cases, no benchmark exists, and multiple frames of reference are used to develop novel solutions to program attributes. Accordingly, per AR 25–30 (Army 2021a), the COE, as the proponent for all engineering-related publications, will provide oversight on all engineering portions of technical, equipment, doctrinal, and training publications in collaboration with Army Materiel Command and U.S. Army Training and Doctrine Command (TRADOC). The OCE is responsible for the development of a number of programs related to the operations and management of nuclear power plants within the Army. Table 2-1 lists each Supporting Program, the primary basis documents used to develop the program, the regulations and standards incorporated by reference, and other resources. The next sections further describe these three categories of basis documents:

- **Regulations and Standards Incorporated by Reference**. Where Army or other regulations offer sufficient and appropriate guidance and oversight on a program, these references are used as a simple pointer and incorporated by reference. There is usually no additional need to expound on these references. In some cases, key concepts from these references are used to develop key attributes or topics, but they are not wholly repeated.
- **Primary Basis Documents.** These documents are the primary bases for the program attributes. In most cases, a brief discussion is given why the source is used and how it is related to the ARP.
- **Other Resources.** Other regulations are available or were evaluated for best practices for use in the Army's program. These references are employed at a minor scale, used as a secondary source for attributes, or simply noted as a backup benchmark for other regulations that covered the same topics.

The organized treatment of programs in nuclear power is approached differently by the various regulatory bodies (DOE, IAEA, NRC, DoD, etc.). In some cases, regulators have nearly identical models to build from for Supporting Programs. In other cases, regulators wholly pass over some of the ARP Supporting Programs, or the programs are interwoven into the main framework of regulation. If only one or two documents are used as the primary basis, this indicates the regulatory overseer of that document approached the program in a way that provides a clear and satisfactory approach for the ARP. In cases where multiple regulatory bodies and documents are referenced, this tends to indicate multiple complex and interwoven approaches are being adopted in the draft AR 50-7. The “Other Resources” column indicates there are other resources that were evaluated, and either matched the existing regulation or were deemed outside the scope of the ARP’s needs. A detailed analysis is not given of these references. For all references listed in this section, deeper substance and complexity exists depending on the needs and desires of non-ARO Army commands.

Table 2-1
Supporting Programs Resources Evaluated

Supporting Programs	Regulations and Standards Incorporated by Reference	Primary Basis Documents	Other Resources
Conduct of Operations	AR 385–10 NFPA 70E	DOE O 422.1	NRC NUREG-0800 Ch. 13
Personnel and Facility Safety	AR 385–10	INPO 12-012 DOE 440.1B Chg 1 DOE P 450.4 DOE-STD-3009-2014 DOE Order 420.1C Chg 3 DOE-HDBK-1220-2017 10 CFR 830.204 10 CFR 70.24 10 CFR 50 Appendix R	NRC NUREG-0800 Ch. 9 and Ch. 12 ANSI/ANS-8.1 ANSI/ANS-8.17 ANSI/ANS-8.19-2014 ANSI/ANS-8.20 ANSI/ANS-8.26 DOE-STD-3007-2017 ANSI/ANS-8.24 ANSI/ANS-8.3-2022
Training and Qualification of Operation and Support Personnel	AR 350–1 TRADOC TR 350-70 ANSI/ANS-3.1-2014	10 CFR Part 50.120 NRC NUREG-1021 NRC RG 1.8 DOE O 426.2A DOE-STD-1079-94	Interviews NRC Operator License Reqs ANSI/ANS-3.5-1998 NRC RG 1.149
Maintenance	AR 70–75 AR 702–19 AR 750–1 AR 750–43 DoDI 3150.02	DOE O 420.1C DOE O 422.1 DOE O 433.1B Chg 1 DOE-HDBK-1211-2014 10 CFR 50.65 NRC RG 1.160	10 CFR 50 Appendix J 10 CFR 830.204(b)(5) NRC RG 1.99 NRC RG 1.178 NUREG-1482 Rev3 IAEA-TECDOC-1400 IAEA SSR 2/1 Rev1
Quality Assurance	ASME NQA-1 AR 702–11 DA PAM 25-2-5	ASME NQA-1	10 CFR Part 50, Appendix B 10 CFR 830.120 ISO 9001 DOE O 414.1D NRC RG 1.28 IAEA-TECDOC-1910
Configuration Management	ASME NQA-1 EIA-649 MIL-HDBK-61B	DOE-STD-1073-2016 IAEA-TECDOC-1335 10 CFR 50-49	10 CFR Part 50 Appendix S NRC RG 1.100 TLR-RES/DE/REB-2022-06
Records Management	AR 25–400–2 ASME NQA-1	AR 25–400–2	10 CFR 50 10 CFR 830
Corrective Action	AR 702–11 AR 25–2	DOE O 414.1E ASME NQA-1 NRC NUREG-0800 Ch. 17 INPO 05-005	None
Lessons Learned	AR 702–11 AR 11–33	DOE O 414.1E	None

Table 2-1
Supporting Programs Resources Evaluated

Supporting Programs	Regulations and Standards Incorporated by Reference	Primary Basis Documents	Other Resources
Nuclear Personnel Reliability	AR 50–5 AR 380–67	AR 50–5 10 CFR 26 Privacy Act,1974 HIPPA, 1996	DoDM 5210.42
Physical Security	AR 190–54	DoDI O 5210.63 DoD 5200.08-R DoDD 5210.83	DOE O 473.1A DOE-STD-1194-2019
Emergency Management	AR 525-27 FEMA NIMS 2017	DoDI 6055.17	DOE O 151.1E DOE G 151.1-1B 10 CFR Part 50.47 10 CFR 50.160
Cybersecurity	NIST Cybersecurity Framework NIST SP 800-53 NIST SP 800-57 NIST SP 800-82 NIST SP 800-88 NIST SP 800-97 NIST SP 800-161 NIST SP 800-171 IEEE 802.11-2024 FIPS 140 series	DoDI 8500.01 DoDI 8510.01 AR 25-2 DFARS 252.204-7012	NRC RG 5.71 IAEA NSS No 17-T DOE Guide 2015, Jan 2015 DOE & DHS Report, Apr 2015 DHS CISA Infographic, Apr 2021 OEI Rqmnts for 3rd Party Energy DA PAM 25-2-2
Radiation Protection	AR 385–10	DOE-HDBK-1130-2002 DOE-STD-1098	DA PAM 385-10
Radioactive Waste Management	AR 385–10	DOE M 435.1-1 Chg 3 DOE O 435.1 Chg 2	49 CFR 173.1 DTR 4500.9-R-Part II 10 CFR 20 Subpart D 40 CFR Part 61 Subpart I DA PAM 385-10
Environmental Management	AR 200–1 AR 385–10	NRC RG 4.2 Rev 3 DOE P 451.1 DOE-HDBK-1216 Chg 1	None
Material Control and Accountability	10 CFR 74 AR 190–54 DOE-STD-1098-2017	10 CFR 74 AR 190–54 AR 50–5	DOE-STD-1194-2019 DOE O 474.2A

Table 2-1
Supporting Programs Resources Evaluated

Supporting Programs	Regulations and Standards Incorporated by Reference	Primary Basis Documents	Other Resources
Chemical, Biological, Radiological, and Nuclear Survivability	AR 70–75 DoDI 3150.09 MIL-STD-3056 MIL-STD-2169D MIL-STD-188-125	DoDI 3150.09 JP 3-11 MIL-STD-2169D ATP 3-11.32 ATP 3-11.36	DoDI 3020.52 DoDI 6055.07 DoDI 6055.17 DoDD 3150.02 2023 Strategy for Countering WMD JP 3-40 CJCSI 3214.01 AR 350-1 ADP 7-0
Deployment and Redeployment	TRADOC Pamphlet 19-0117 AR 190–13 AR 190–54 AR 525–27 AR 710–2 AR 600–20 FM 4-0 SECY-19-0117 NRC RG 1.233 NEI 18-04 10 CFR Part 50 10 CFR Part 52 10 CFR Part 73 10 CFR 20.1402 TG 31 Nuclear NPT IAEA Standards	AR 525–93 ATP 3-35 FORSCOM Regulation 500-3-3 JP 3-35 Commercial nuclear reactor safety and siting regulations Army ATP 3-34.45 Army ATP 4-16 Army ATP 4-16	DIA VOLT Report IAEA SSR-6, Rev 1 ANSI/ANS-3.11
Transportation Coordination	49 CFR 177.842, 49 CFR 177.843 49 CFR 177.848 49 CFR 397, Subpart D NRC RG 7.10 Rev3	DTR Part II DLAR (JP) 4145.08 DRT Part III App J AR 190–54 49 CFR 173 49 CFR 172 49 CFR 178 10 CFR 71	None
Transportation Safety	FM 4-0	DoDI 6055.04 AR 385–10 DTR Part II, Ch 204 DTR, Part III, App J 49 CFR 172 49 CFR 178 Subpart K (§178.350) 10 CFR Part 71	None
Training and Qualification of Transportation Teams	None	JP 4-01 Army ATP 4-16	None

2.2 Conduct of Operations

A Conduct of Operations Program consists of formal documentation, practices, and actions for implementing disciplined and structured operations that support mission success and promote worker, public, and environmental protection. The goal is to minimize the likelihood and consequences of human fallibility or technical and organizational system failures. Conduct of Operations is one of the safety management programs recognized in the Nuclear Safety Rule (10 CFR 830, *Nuclear Safety Management*), but it also supports safety and mission success for a wide range of hazardous, complex, or mission-critical operations.

2.2.1 Regulations and Standards Incorporated by Reference

In addition to the primary references in this regulatory basis document, the following regulations are incorporated by reference and remain in full force and effect for the Conduct of Operations Program:

- **AR 385–10, *The Army Safety and Occupational Health Program*.** This Army Regulation establishes the safety program for the U.S. Army, detailing the responsibilities, policies, and procedures for ensuring the safety of Army personnel, equipment, and operations across all activities, including risk management, safety training, and accident prevention (Army 2023d).
- **NFPA 70E, *Standard for Electrical Safety in the Workplace.*** This standard from the National Fire Protection Association (NFPA) provides guidelines and requirements for electrical safety in the workplace, focusing on protecting workers from electrical hazards by establishing safe work practices, risk assessment, and personal protective equipment requirements (NFPA 2024).

2.2.2 Primary Basis Documents

The Conduct of Operations Program is based on the following references:

- **DOE O 422.1 *Conduct of Operations*.** The objective of DOE O 422.1 is to define the requirements for establishing and implementing Conduct of Operations programs at DOE, including National Nuclear Security Administration (NNSA), facilities, and projects (DOE 2010a). This guidance was well suited to establish disciplined and structured operations for a nuclear facility.

2.2.3 Other Resources

The following resources were evaluated as secondary sources or minor basis references for the Conduct of Operations Program:

- **NRC NUREG-0800, Chapter 13 *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition — Conduct of Operations*.** Chapter 13 was evaluated for use in this program. Chapter 13 is a very broad chapter that covers training, physical security, emergency planning, and other operational programs. The vision for the ARP Conduct of Operations program was to be solely focused on ensuring safe, secure, and efficient operations. Chapter 13 provides greater scope than was needed in the ARP Conduct of Operations Program; however, it was used in several instances throughout these programs as a benchmark “backstop” for attributes, though it is not specifically called out in every instance (NRC 2016b).

2.3 Personnel and Facility Safety

A personnel and facility safety program is part of a defense-in-depth approach to nuclear power operations and is implemented through design, construction, monitoring, and emergency action. As implemented in the commercial nuclear industry and Navy nuclear program, robust personnel and facility safety programs promote a culture of improvement and excellence. The ARP Personnel and Facility

Safety Program is nearly fully covered by existing Army regulations but requires additional dedicated attributes to address the special and unique aspects of operating a nuclear power plant. The Institute of Nuclear Power Operations (INPO) 12-012 served as a resource for several attributes for this program (INPO 2012). Additional requirements were necessary for aspects of criticality safety, which were primarily derived from NRC requirements. Aspects of facility safety were primarily derived from DOE regulation. AR 385–10 forms the basis for Army safety, and these attributes are added as special and unique aspects related to nuclear power on which the ARP can build (Army 2023d).

2.3.1 Regulations and Standards Incorporated by Reference

In addition to the primary references in this regulatory basis document, the following regulation is incorporated by reference and remains in full force and effect for the Personnel and Facility Safety Program:

- **AR 385–10, *The Army Safety and Occupational Health Program.*** This Army Regulation establishes the safety program for the U.S. Army, detailing the responsibilities, policies, and procedures for ensuring the safety of Army personnel, equipment, and operations across all activities, including risk management, safety training, and accident prevention (Army 2023d).

2.3.2 Primary Basis Documents

The Personnel and Facility Safety Program is based on the following references:

- **INPO 12-012, *Traits of a Healthy Nuclear Safety Culture*.** This document provides guidelines for the development, implementation, and maintenance of training programs for nuclear power plant personnel, ensuring effective operational performance and safety. This document details the high-level attributes and characteristics needed for a healthy safety culture, and the Army would be wise to consider incorporating its ideas (INPO 2012).
- **DOE 440.1B Chg 4. *Worker Protection Program for DOE Federal Employees.*** This DOE directive outlines the policies and requirements for contractor personnel management, including workforce training, qualification, and performance standards in nuclear and other DOE facilities (DOE 2022c).
- **DOE P 450.4. *Integrated Safety Management Policy*.** This DOE policy establishes requirements for the safety management systems that ensure the protection of workers, the public, and the environment in DOE operations, including requirements for continuous safety improvement (DOE 2011b).
- **DOE-STD-3009-2014, *Preparation of Nonreactor Nuclear Facility Documented Safety Analysis*.** This standard provides guidance for preparing Safety Analysis Reports (SARs) for DOE facilities, detailing the safety analyses required to ensure facility operation complies with DOE regulations (DOE 2014b).
- **DOE Order 420.1C Chg 3, *Facility Safety*.** This DOE order sets forth requirements for ensuring the safety of facilities under the DOE's jurisdiction, including criteria for design, construction, and operation, with a focus on maintaining safety and reducing risk (DOE 2012).
- **DOE-HDBK-1220-2017, *Natural Phenomena Hazards Analysis and Design Criteria for Department of Energy Facilities*.** This DOE handbook provides guidance and procedures for developing and implementing emergency management programs at DOE sites, ensuring effective responses to incidents and hazards (DOE 2017b).
- **10 CFR Part 830.204 , *Documented safety analysis*.** This regulation outlines the quality assurance requirements for nuclear facilities, ensuring they meet safety, health, and environmental protection standards through rigorous control of operational processes.
- ***10 CFR Part 70.24* , *Criticality accident requirements.***
- **10 CFR Part 50 Appendix R , *Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979*.** This appendix to 10 CFR Part 50 establishes the fire

protection standards for nuclear power plants, ensuring the plant can maintain safety and operational integrity during fire emergencies.

2.3.3 Other Resources

The following resources were evaluated as secondary sources or minor basis references for the Personnel and Facility Safety Program:

- **NUREG-0800, Standard Review Plan Chapter 9, Section 9.1.1, *Criticality Safety of Fresh and Spent Fuel Storage and Handling*** (NRC 2007a).
- **NUREG-0800 Standard Review Plan Chapter 12, Sections 12.3–12.4, *Radiation Protection Design Features*** (NRC 2013b).
- **ANSI/ANS-8.1, *Nuclear Criticality Safety in Operations with Fissionable Material Outside Reactors*** (ANSI/ANS 2014b).
- **ANSI/ANS-8.17, *Criticality Safety Criteria for the Handling, Storage, and Transportation of LWR Fuel Outside Reactors*** (ANSI/ANS 2004).
- **ANSI/ANS-8.19-2014, *Administrative Practices for Nuclear Criticality Safety*** (ANSI/ANS 2014a).
- **ANSI/ANS-8.20, *Nuclear Criticality Safety Training*** (ANSI/ANS 1991).
- **ANSI/ANS-8.26, *Criticality Safety Engineer Training and Qualification Program*** (ANSI/ANS 2007).
- **DOE-STD-3007-2017, *Preparing Criticality Safety Evaluations at Department of Energy Nonreactor Nuclear Facilities*** (DOE 2017c).
- **ANSI/ANS-8.24, *Validation of Neutron Transport Methods for Nuclear Criticality Safety*** (ANSI/ANS 2017).
- **ANSI/ANS-8.3-2022, *Criticality Accident Alarm System*** (ANSI/ANS 2022).

2.4 Training and Qualification of Operation and Support Personnel

Operations training is an integral part of a robust nuclear power program. The ARP is recommended to adopt some of the aspects of NRC, DOE, and Navy training culture related to nuclear power operations. Nuclear power operation demands in-depth training and qualification for systems that require strict safety protocols, contain complex operational procedures, and hold potentially significant hazards of radiological release. Nuclear operators must be trained in safety and risk, regulatory compliance, hazard control, efficient operation, emergency response, and outstanding human performance. A culture must exist of scrupulous oversight, improvement, and feedback from equipment and system to classroom and simulator training. AR 350–1 (Army 2017b) and TR 350-70 (Army 2017a) form the basis for Army training, and these attributes are added as special and unique aspects related to nuclear power on which the ARP can build, particularly the NRC and DOE nuclear training documents listed below.

2.4.1 Regulations and Standards Incorporated by Reference

In addition to the primary references in this regulatory basis document, the following regulations are incorporated by reference and remain in full force and effect for the Training and Qualification of Operation and Support Personnel Program:

- **AR 350–1, *Army Training and Leader Development.*** This regulation provides policies for effective training including the development of training requirements, implementation, and evaluation procedures (Army 2017b).
- **TRADOC TR 350–70, *Army Learning Policy and Systems.*** This technical report focuses on the integration of learning, education, and leader development strategies within the U.S. Army. It serves as a framework for developing and sustaining training and leadership programs to enhance the effectiveness of Army personnel (Army 2017a).

- **ANSI/ANS-3.1-2014, *Selection, Qualification, and Training of Personnel for Nuclear Power Plants*.** This standard includes requirements for educational background, training, and experience to ensure that nuclear power plant staff possess the necessary qualifications to perform their duties safely and effectively (ANSI/ANS 2014c).

2.4.2 Primary Basis Documents

The Training and Qualification of Operation and Support Personnel Program is based on the following references:

- **10 CFR Part 50.120 , *Training and Qualification of Nuclear Power Plant Personnel.*** This regulation outlines the requirements for operator licensing and requalification programs for nuclear power plants, focusing on the training and certification of operators.
- **NUREG-1021, *Operator Licensing Examination Standards for Power Reactors*.** A guide published by the NRC, this document details the requirements for the operator licensing examinations for nuclear reactors, including the development and administration of exams (NRC 2021b).
- **NRC Regulatory Guide 1.8, *Qualification and Training of Personnel for Nuclear Power Plants*.** This guide provides recommendations on the qualifications and training of nuclear power plant personnel to ensure safety and effective operations (NRC 2019b).
- **DOE O 426.2A Chg1*, Personnel Selection, Training, and Qualification Requirements for DOE Nuclear Facilities***. This DOE Order establishes the requirements for the training and qualification of nuclear facility personnel, including the selection of operators and the development of training programs (DOE 2024c).
- **DOE-STD-1070-94, *Criteria for Evaluation of Nuclear Facility Training Programs.*** A standard issued by the DOE that specifies the qualifications and training requirements for nuclear facility operators and outlines the necessary performance-based competency requirements for the workforce.

2.4.3 Other Resources

The following resources were evaluated as secondary sources or minor basis references for the Training and Qualification of Operation and Support Personnel Program:

- **Interviews with personnel familiar with the training and qualification programs** used by the U.S. Navy's Naval Nuclear Propulsion Program. This included retired naval officers who served onboard nuclear-powered vessels at sea, as well as staff instructors who served at training commands throughout the program during their naval careers.
- **NRC Operator License Eligibility Requirements** (National Academy of Nuclear Training Guideline Summary) (NRC n.d.).
- **ANSI/ANS-3.5-1998, *American National Standard for Nuclear Power Plant Simulators for Use in Operator Training*.** Outlines the requirements for the design, construction, and operation of nuclear power plant simulators used for operator training, ensuring they provide a realistic and effective training environment (ANSI/ANS 1998).
- **NRC Regulatory Guide 1.149, *Nuclear Power Plant Simulators for Use in Operator Training.*** Provides recommendations for the use of nuclear power plant simulators in operator training programs, ensuring the simulators are capable of accurately replicating plant conditions and supporting effective training (NRC 2013a).

2.5 Maintenance

A rigorous maintenance program is crucial to ensure safe, reliable, and economic operation by maintaining the integrity of structures, systems, and components; preventing failures; and mitigating risks to workers, the public, and the environment. Nuclear power plants rely on complex systems and components that must function flawlessly to produce electricity safely and reliably. A well-structured maintenance program ensures that these systems and components are in optimal condition, minimizing the risk of failures that could lead to accidents or shutdowns. Other reasons for establishing a maintenance program include preventing equipment failure, extending plant life, maintaining design margins, and ensuring compliance with material and component standards. All nuclear power plants currently in operation rely on detailed regulatory requirements for the maintenance of nuclear power plant systems, structures, and components (SSCs). In some cases, large light-water reactor guidance and requirements do not fit the currently envisioned scope of the ARP, but they still form a good baseline for creating the initial structure.

As with the safety and training programs, the Maintenance Program points to Army regulations in Section 2.4.2, and the attributes are added as special and unique aspects related to nuclear power on which the ARP can build.

2.5.1 Regulations and Standards Incorporated by Reference

In addition to the primary references in this regulatory basis document, the following regulations are incorporated by reference and remain in full force and effect for the Maintenance Program:

- **AR 70–75, *Survivability of Army Personnel and Materiel*.** This regulation provides guidelines for testing and evaluating military equipment and systems under extreme environmental conditions, ensuring that materiel performs as required in a variety of scenarios (Army 2019e).
- **AR 702–19, *Reliability, Availability, and Maintainability*.** This regulation outlines the processes and responsibilities for managing technology development in the Army, ensuring that technological advancements meet the Army's operational needs (Army 2024e).
- **AR 750–1, *Army Materiel Maintenance Policy*.** This regulation establishes the policy for the maintenance of Army materiel, ensuring that equipment and systems are properly maintained to support operational readiness (Army 2023b).
- **AR 750–43, *Army Test, Measurement, and Diagnostic Equipment*.** This regulation provides the Army’s policy and procedures for maintenance management, covering areas such as preventive maintenance, corrective maintenance, and readiness reporting (Army 2024b).
- **DoDI 3150.02, *Nuclear Weapon Systems Surety Program*.** This DoD instruction provides the policy and procedures for the nuclear weapons surety program, which ensures the safety, security, and reliability of nuclear weapons in the DoD inventory (DoD 2024).

2.5.2 Primary Basis Documents

The Maintenance Program is based on the following references:

- **DOE O 420.1C, *Facility Safety*.** This order establishes the safety requirements for DOE nuclear facilities, focusing on maintaining and ensuring safety in the design, operation, and decommissioning of these facilities (DOE 2012).
- **DOE O 422.1, *Conduct of Operations*.** This order provides the policy and guidelines for the conduct of operations at DOE nuclear facilities, establishing expectations for safe and efficient facility operations (DOE 2010a).
- **DOE O 433.1B Chg 1, *Maintenance Management Program for Nuclear Facilities*.** This order provides the guidelines for the maintenance of nuclear facilities under the Department of Energy, ensuring their reliability and safety through effective maintenance practices (DOE 2010b).
- **DOE-HDBK-1211-2014, *Activity-Level Work Planning and Control Implementation*.** This handbook offers detailed guidelines and best practices for the maintenance and surveillance of nuclear facilities, supporting the DOE in maintaining safety and operational efficiency (DOE 2014a).

- **10 CFR 50.65, *Requirements for monitoring the effectiveness of maintenance at nuclear power plants.*** This regulation establishes requirements for the maintenance of nuclear power plant structures and systems, aiming to ensure their reliability and safety (10 CFR Part 50.65).
- **NRC RG 1.160, *Monitoring the Effectiveness of Maintenance at Nuclear Power Plants***. This guide outlines methods for monitoring and evaluating the effectiveness of maintenance programs at nuclear power plants to ensure that plant systems are operating reliably and safely (NRC 2018e).

2.5.3 Other Resources

The following resources were evaluated as secondary sources or minor basis references for the Maintenance Program:

- **10 CFR Part 50 Appendix J , *Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors*.** This appendix of the CFR specifies the testing and maintenance requirements for leakage rate testing of reactor containment structures to ensure their integrity and safety (10 CFR Part 50 Appendix J).
- **10 CFR Part 830.204 (b)(5), *Documented Safety Analysis*.** This section of the CFR specifies the quality assurance requirements for the management of nuclear facilities, focusing on maintaining high standards of quality in operations and activities.
- **NRC RG 1.99 Rev2, *Radiation Embrittlement of Reactor Vessel Materials.*** This regulatory guide provides methodologies for estimating heat loss in pressurized water reactors to ensure that reactors remain within safe operating conditions (NRC 1988).
- **NRC RG 1.178 Rev2, *Plant-Specific, Risk-Informed Decisionmaking for Inservice Inspection of Piping.*** This regulatory guide discusses the use of PRA in making risk-informed decisions regarding changes to the licensing basis of nuclear power plants (NRC 2021c).
- **NUREG-1482 Rev3, *Guidelines for Inservice Testing at Nuclear Power Plants: Inservice Testing of Pumps and Valves and Inservice Examination and Testing of Dynamic Restraints (Snubbers) at Nuclear Power Plants*.** This NUREG publication provides guidelines for the in-service testing of safety-related pumps and valves to ensure they perform their functions in the event of an emergency (NRC 2020b).
- **IAEA-TECDOC-1400, *Improvement of In-service Inspection in Nuclear Power Plants*.** This IAEA technical document provides guidance on the decommissioning process for nuclear power plants and related facilities, focusing on safety, environmental protection, and regulatory compliance (IAEA 2004a).
- **IAEA SSR-2/1 Rev1, *Safety of Nuclear Power Plants: Design*.** This document provides principles and guidelines for the safe operation of nuclear reactors, including their design, operation, and maintenance to ensure that they are safe for operators, the public, and the environment (IAEA 2016c).

2.6 Quality Assurance (QA)

The Quality Assurance Program addresses any relevant quality requirement contained within any Army Regulation required for use by this effort. Given the scope of requirements and activities contained within an ASME NQA-1-compliant Quality Assurance Program (ASME n.d.), several of the programs identified in this document are likely to be impacted using ASME NQA-1 and setting the expectations when established in the final approved Quality Assurance Program. Similarly, expectations (drivers) for the various programs identified within this document may also impact the requirements identified and executed within the approved quality program.

2.6.1 Regulations and Standards Incorporated by Reference

In addition to the primary references in this regulatory basis document, the following regulations are incorporated by reference and remain in full force and effect for the Quality Assurance Program:

- **ASME NQA-1, *Quality Assurance Requirements for Nuclear Facility Applications*** (ASME 2015).
    - The preferred edition of ASME NQA-1 used to establish compliance expectations for this Quality Assurance Program remains to be identified. The ASME NQA-1 edition selected by ARO should be ASME NQA-1-2012 or later, consistent with the analysis provided within the analysis of program attributes.
        - The approved Quality Assurance Program documents the evaluation used to determine the judicious application of the Standard or portions of the ARO-selected edition of the ASME NQA-1 Standard’s Parts I and II and the guidance in Parts III and IV, including any graded approach applied.
        - Applicable requirements of Parts I and II are implemented to ensure conformance with NQA-1. The application of this Standard, or portions thereof, is invoked by written contracts, policies, procedures, specifications, or other appropriate documents.
- **AR 702–11, *Army Quality Program.*** This regulation provides guidelines for managing the research and development (R&D) process for military equipment and materiel within the U.S. Army, ensuring that R&D efforts align with Army needs and operational requirements (Army 2023c).
- **DA PAM 25-2-5, *Software Assurance*.** This pamphlet provides detailed guidance on information assurance practices for the Army, including policies, procedures, and technical measures necessary to protect the Army’s information systems, networks, and data from unauthorized access, use, or disruption (Army 2021b).

2.6.2 Primary Basis Documents

The Quality Assurance Program is based on the following references:

- **ASME NQA-1, *Quality Assurance Requirements for Nuclear Facility Applications*.** This widely used nuclear standard establishes requirements for QA programs to ensure the safety, reliability, and compliance of nuclear facilities throughout their design, construction, operation, and decommissioning. It focuses on ensuring that nuclear facilities meet safety, reliability, and regulatory compliance by defining processes for quality management, document control, inspection, testing, and training (ASME 2015).

2.6.3 Other Resources

The following resources were evaluated as secondary sources or minor basis references for the Quality Assurance Program:

- **10 CFR Part 50, Appendix B, *Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants*.** This regulation from the NRC establishes QA requirements for nuclear power plants, specifying standards for design, construction, and operation to maintain safety (10 CFR Part 50 Appendix B).
- **10 CFR 830.120, *Quality Assurance Requirements*.** This regulation applies to the DOE and outlines QA requirements for the management of nuclear facilities, focusing on aspects like documentation, inspections, and audits to ensure quality in DOE-operated nuclear facilities (10 CFR Part 830.120-122).
- **ISO 9001, *Quality Management Systems*.** While not specific to nuclear power, ISO 9001 is a widely recognized standard for quality management systems. It is sometimes used in the nuclear industry as part of broader QA programs to ensure continuous improvement and compliance with

safety standards. As a stand-alone document, ISO 9001 would not meet the needs of an approved nuclear quality program such as one being developed for this effort. However, providing for the use of potential vendors/manufacturers with ISO 9001-based quality programs may be necessary. Considerations should be given in the creation of this Quality Assurance Program on how to address potential vendors/manufacturers with ISO 9001-based quality programs to meet the expectations of the NRC- and ARO-selected ASME NQA-1 editions (ISO 2015).

- **DOE O 414.1D, *Quality Assurance*.** This order specifies QA requirements for managing nuclear facilities operated by the DOE and ensures work is performed to high standards of safety, reliability, and regulatory compliance. Note that the most current approved edition of this Order is DOE O 414.1E; however, this edition of the order had not been approved when the original analysis was conducted (DOE 2011c).
- **NRC RG 1.28, *Quality Assurance Program Criteria (Design and Construction).*** This regulatory guide from the NRC provides detailed recommendations on implementing a QA program for nuclear power plants, covering areas such as management responsibilities, employee qualifications, and documentation (NRC 2018g).
- **IAEA-TECDOC-1910, *Quality Assurance and Quality Control in Nuclear Facilities and Activities*.** The IAEA document provides relevant practices and lessons to provide information on the implementation of QA and quality control as a part of the management system of nuclear facilities and activities (IAEA 2020b).

2.7 Configuration Management (CM)

CM is a three-pronged approach of ensuring consistency between the following:

- design requirements
- physical configuration
- documentation updates.

Nuclear facilities (e.g., power plants) operate in a highly regulated and sensitive environment where safety is paramount. CM ensures that all systems, components, and procedures are properly documented, controlled, and maintained. It helps ensure that safety-critical systems are consistently and reliably configured, reducing the risk of accidents. CM helps demonstrate compliance with approved standards by providing a clear record of the plant's design, modifications, and maintenance activities.

CM can be applied similarly during design control and nuclear facility operation, as outlined in the selected attributes. The NQA-1 version selected and approved for the ARP Quality Assurance Program influences the fulfillment of the Configuration Management Program.

Consideration should be given to CM as well as the approval and permitting of the nuclear reactor design and its manufacture separate from the nuclear facility site permit(s) that would include the nuclear reactor as a preapproved item (system/component) that is part of the permitting of a nuclear facility site design(s) and site operations.

The Design Authority is responsible for approving the design bases, the configuration, and changes to both the design requirements and design (see Section 1.6).

2.7.1 Regulations and Standards Incorporated by Reference

In addition to the primary references in this regulatory basis document, the following regulations are incorporated by reference and remain in full force and effect for the Configuration Management Program:

- **ASME NQA-1, *Quality Assurance Requirements for Nuclear Facility Applications*** (as adopted in Section 2.6). This widely used nuclear standard establishes requirements for QA programs to ensure the safety, reliability, and compliance of nuclear facilities throughout their design, construction, operation, and decommissioning. It focuses on ensuring that nuclear facilities meet safety, reliability, and regulatory compliance by defining processes for quality management, document control, inspection, testing, and training (ASME 2015).

- **EIA-649, *Configuration Management Standard*.** EIA-649 provides the standards for CM, which involves systematically managing the configuration of a product or system throughout its life cycle. The goal is to ensure that a product's configuration is defined, documented, and consistently maintained to meet the desired functional, performance, and safety requirements (SAE 2019).
- **MIL-HDBK-61B, *Configuration Management Guidance*.** This handbook provides detailed guidance on implementing CM practices in military and defense systems. It outlines procedures for controlling changes to equipment, systems, and processes to ensure that configurations are correctly identified and managed, reducing the risk of errors and ensuring that systems meet performance and safety standards (DoD 2020a).

2.7.2 Primary Basis Documents

The Configuration Management Program is based on the following references:

- **DOE-STD-1073-2016, *Configuration Management*.** This standard provides the criteria and objectives for developing a CM process for design, construction, operation, and post-operation of a DOE facility or activity. The criteria and objectives presented in this Standard are based on industry practice and CM experience at DOE facilities (DOE 2016).
- **IAEA-TECDOC-1335, *Configuration Management in Nuclear Power Plants.*** This document provides guidance for ensuring that the design, systems, and components of a nuclear power plant are properly controlled and maintained throughout the plant's operational life (IAEA 2003a).
- **10 CFR 50.49, *Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants*.** This regulation requires that electric equipment used in nuclear power plants be qualified to function safely and reliably in the environment expected during normal operation, anticipated operational occurrences, and postulated accidents (10 CFR Part 50.49).

2.7.3 Other Resources

The following resources were evaluated as secondary sources or minor basis references for the Configuration Management Program:

- **10 CFR Part 50 Appendix S, *Earthquake Engineering Criteria for Nuclear Power Plants*.** Appendix S is crucial for ensuring that nuclear plants are designed to withstand seismic events, safeguarding the plant's structures, systems, and components, which are vital to preventing accidents during earthquakes (10 CFR Part 50 Appendix S).
- **NRC RG 1.100, *Seismic Qualification of Electric and Active Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants*.** This guide provides recommendations for the seismic qualification of electrical and mechanical equipment used in nuclear power plants, ensuring that equipment can withstand seismic events and continue to perform their safety functions (NRC 2020c).
- **TLR-RES/DE/REB-2022-06, *Regulatory Considerations for Nuclear Energy Applications of Digital Twin Technologies*** (Yadav et al. 2022).

2.8 Records Management

Records management is a foundational requirement that is applied to all federal agencies. Additionally, for this specific effort, the Records Management Program is a key Supporting Program to the development and approval of an ASME NQA-1 Quality Assurance Program and supporting the execution of the nuclear reactor and nuclear facility licensing process. Therefore, the management of records in both the ARO-approved Records Management Program and Quality Management Program should address the delegation of specific QA-supporting records requirements to the Records Management Program for this effort.

As such, the Records Management Program is a key Supporting Program to the development and approval of an ASME NQA-1 Quality Assurance Program and supporting the execution of the nuclear reactor and nuclear facility licensing process. Specifically, an approved Quality Assurance Program (Section 2.6) based on ASME NQA-1 introduces various requirements including a unique records requirement for the identification, management, and final disposition of QA records (e.g., ASME NQA-1, Part I, Requirement 17, *Quality Assurance Records*) as they apply to nuclear reactors and other nuclear facilities. These include unique requirements in the form of setting the requirements for "lifetime quality records" (NQA-1, Part I, Requirement 17, paragraph 401, *Lifetime Records*) (ASME 2015).

The specific designation of "lifetime quality records" as they are applied to nuclear quality programs are not generally addressed in generic record management regulations or requirements. However, these general records management requirements do address identifying various types of records and how they should be managed and maintained so that they can be adapted to address "lifetime quality records." The most significant accommodation that needs to be addressed by the Records Management Program is the concept of and retention of records identified as "lifetime quality records." Specifically, the retention of "lifetime quality records" is event-based (e.g., records are required to be maintained for the life of the item while it is installed in the nuclear facility or stored for future use.) versus the more common time-based retention periods identified in general records management requirements. However, once a record no longer meets the requirements of a "lifetime quality record," its designation may change to what ASME NQA-1 calls a "nonpermanent record" (NQA-1, Part I, Requirement 17, paragraph 402, *Nonpermanent Records*) that is maintained for the identified retention period. This NQA-1-identified "nonpermanent record" would meet the requirement for a "record" that needs a specified (time-based) records retention period in a traditional records management file plan, as described in an approved Records Management Program (ASME 2015).

2.8.1 Regulations and Standards Incorporated by Reference

In addition to the primary references in this regulatory basis document, the following regulations are incorporated by reference and remain in full force and effect for the Records Management Program:

- **AR 25–400–2, *The Army Records Management Program*.** This regulation outlines the policies and procedures for managing records within the U.S. Army, ensuring that records are properly created, maintained, and disposed of in accordance with legal and regulatory requirements (AR 25–400–2 2022).
- **ASME NQA-1, *Quality Assurance Requirements for Nuclear Facility Applications*** (as adopted in Section 2.6)**.** Part 1, Criteria 4, 5, 6, and 17 of ASME NQA-1 describe the control and recordkeeping requirements associated with quality records (ASME 2015).

2.8.2 Primary Basis Documents

The Records Management Program is based on the following references:

- **AR 25–400–2, *The Army Records Management Program*.** This regulation outlines the policies and procedures for managing records within the U.S. Army, ensuring that records are properly created, maintained, and disposed of in accordance with legal and regulatory requirements (AR 25–400–2 2022).

2.8.3 Other Resources

The following resources were evaluated as secondary sources or minor basis references for the Records Management Program:

- 1**0 CFR 50, *Domestic Licensing of Production and Utilization Facilities*** (10 CFR Part 50).

- **10 CFR 830, *Nuclear Safety Management*** (10 CFR Part 830).

2.9 Corrective Action

Commercial nuclear power plants use INPO 05-005 for guidance on corrective action programs, though it is not required or endorsed by the NRC. A corrective action program is vital for nuclear power operations because it helps maintain a safe working environment, ensures regulatory compliance, drives continuous improvement, reduces operational disruptions, enhances efficiency, and promotes accountability and transparency. By systematically addressing problems and preventing recurrence, the program helps maintain the integrity of the plant and ensures that nuclear power generation remains safe, reliable, and efficient (INPO 2005).

The Army needs a robust corrective action program to develop a strong safety culture, where problems are addressed systematically and thoroughly, personnel are encouraged to report issues without fear of retribution, and systems and equipment are operated and maintained efficiently. Accountability and transparency are crucial in nuclear power to ensure problems are addressed in a timely and effective manner. Investigations and root cause analyses, which are part of a corrective action program, play a part in preventing future similar incidents, identifying vulnerabilities, and learning from close calls.

2.9.1 Regulations and Standards Incorporated by Reference

In addition to the primary references in this regulatory basis document, the following regulations are incorporated by reference and remain in full force and effect for the Corrective Action Program:

- **AR 702–11, *Army Quality Program*.** This regulation establishes the Army's quality program policies, ensuring that QA and continuous improvement are applied across all Army operations to meet performance, safety, and compliance standards (Army 2018a).
- **AR 25–2, *Army Cybersecurity*.** This Army Regulation provides policies and responsibilities for ensuring the security and integrity of Army information systems, protecting sensitive data, and maintaining cybersecurity across all Army networks and IT systems (Army 2019a).

2.9.2 Primary Basis Documents

The Corrective Action Program is based on the following references:

- **DOE O 414.1E, *Quality Assurance.*** The QA order from the DOE establishes requirements for QA programs across DOE nuclear facilities, ensuring the safety, reliability, and performance of nuclear operations and activities.[1] One of the criteria of QA programs relates to corrective action assessments and planning (DOE 2024d).
- **ASME NQA-1, *Quality Assurance Requirements for Nuclear Facility Applications*** (as adopted in Section 2.6). Part 1, Criterion 16 for ASME NQA-1 describes the process of corrective action (ASME 2015).
- **NUREG-0800 Chapter 17, *Standard Review Plan: LWR Edition - Quality Assurance.*** This chapter of the NRC's Standard Review Plan (SRP) provides guidance on the review of QA programs for nuclear power plants, outlining the requirements for ensuring the integrity and safety of plant operations through effective quality control measures (NRC 2015b).
- **INPO 05-005, *Guidelines for Performance Improvement at Nuclear Power Stations.*** This reinforces the underlying concept that high-performing nuclear stations seek to continually improve the quality of their operation by identifying and closing important performance gaps (INPO 2005).

[1] This edition of the order had not been approved when the original analysis was conducted.

2.9.3 Other Resources

The following resources were evaluated as secondary sources or minor basis references for the Corrective Action Program:

- None.

2.10 Lessons Learned

The Lessons Learned Program is comparable to the Corrective Action Program and is intended to be an important piece of a large, mature Army Reactor Program with multiple operational technologies and locations. As a broad organization, it is important to pull together operating experience and lessons learned to share with and evaluate for other similar platforms.

2.10.1 Regulations and Standards Incorporated by Reference

In addition to the primary references in this regulatory basis document, the following regulations are incorporated by reference and remain in full force and effect for the Lessons Learned Program:

- **AR 702–11, *Army Quality Program.*** This regulation establishes the Army's quality program policies, ensuring that QA and continuous improvement are applied across all Army operations to meet performance, safety, and compliance standards (Army 2018a).
- **AR 11–33, *Army Lessons Learned Program.*** AR 11–33 provides the foundation for the Army to maximize the benefit of experiential learning to change behavior and improve readiness. The intent is to systematically improve operations while integrating the lessons to drive change within Army concepts, doctrine, organization, training, materiel, leadership and education, personnel, facilities, and policy (AR 11–33 2022).

2.10.2 Primary Basis Documents

The Lessons Learned Program is based on the following references:

- **DOE O 414.1E, *Quality Assurance.*** The QA order from the DOE establishes requirements for QA programs across DOE nuclear facilities, ensuring the safety, reliability, and performance of nuclear operations and activities (DOE 2024d).

2.10.3 Other Resources

The following resources were evaluated as secondary sources or minor basis references for the Lessons Learned Program:

- None.

2.11 Nuclear Personnel Reliability Program

The Nuclear Personnel Reliability Program (NPRP) equips leaders with a framework to ensure that only the most reliable individuals handle or have access to special nuclear material (SNM). AR 50–5 (Army 2018c) and 10 CFR Part 26 provide a detailed approach to assess the trustworthiness and reliability of personnel involved in nuclear operations. AR 50–5 outlines the necessary policies and procedures to evaluate individuals' suitability for access to nuclear materials. Part 26 of 10 CFR establishes standards for managing and monitoring human performance, focusing on safeguarding public health and ensuring mission success. The NPRP integrates essential elements such as initial screening, background checks, continuous evaluation, and certification, along with defined procedures for removing and reinstating personnel from NPRP duties.

2.11.1 Regulations and Standards Incorporated by Reference

In addition to the primary references in this regulatory basis document, the following regulations are incorporated by reference and remain in full force and effect for the NPRP:

- **AR 50–5, *Nuclear Surety*.** AR 50–5 establishes the nuclear personnel reliability requirements for personnel supporting SNM operations for the ARP (Army 2018c).
- **AR 380–67, *Personnel Security Program.*** This regulation establishes policies and procedures for the protection of personally identifiable information (PII) held by the Department of the Army, ensuring compliance with privacy laws and safeguarding individual privacy rights within Army operations (Army 2025b).

2.11.2 Primary Basis Documents

The NPRP is based on the following references:

- **AR 50–5, *Nuclear Surety*.** AR 50–5 establishes the nuclear personnel reliability requirements for personnel supporting SNM operations for the ARP (Army 2018c).
- **10 CFR Part 26, *Fitness for Duty Programs*.** This NRC regulation aims to ensure that individuals performing safety-sensitive duties are mentally and physically fit to do so, including requirements for drug and alcohol testing, to help maintain a safe working environment and minimize risks to plant operations and safety (10 CFR Part 26).
- ***Privacy Act of 1974*.** This U.S. federal law governs the collection, maintenance, use, and dissemination of personal information by federal agencies. It ensures that individuals have the right to access and correct their personal records held by government agencies and sets limits on the types of information that can be collected and how it can be shared (Privacy Act 1974).
- ***Health Insurance Portability and Accountability Act (HIPAA) of 1996*.** HIPAA is a U.S. federal law that mandates the protection and confidential handling of individuals' health information. It establishes standards for electronic health care transactions, sets rules for safeguarding patient data (protected health information, or PHI), and ensures patients' privacy rights, while also promoting the portability of health insurance coverage (HIPAA 1996).

2.11.3 Other Resources

The following resources were evaluated as secondary sources or minor basis references for the NPRP Program:

- **DoDM 5210.42, *Nuclear Weapons Personnel Reliability*.** This DoD Manual was evaluated for insights applicable to programs not involving nuclear weapons. While it may not directly apply, it underscores a structured approach that contributes to the success of the DoD Nuclear Weapons Reliability Program. However, excessive regulation can lead to significant personnel challenges and divert focus from the program's intended purpose. It is important to exercise caution when developing the program and is worthwhile to take into account lessons learned from the 2014 DoD Nuclear Enterprise Review led by General(R) Welch and Admiral(R) Harvey, directed by the Secretary of Defense (DoD 2022a).

2.12 Physical Security

The ARP Physical Security Program equips leaders with practical strategies to deter, detect, delay, and deny unauthorized access to SNM. When these security measures fall short, the program highlights the need to swiftly regain control. AR 190–54 stresses the importance of a comprehensive Physical Security Program that uses physical barriers, surveillance systems, and access control to safeguard Army assets (Army 2006). By directly addressing vulnerabilities from espionage, terrorism, and other criminal threats, the program plays a key role in protecting public safety and preventing the misuse of sensitive material.

The Physical Security Program, together with the Material Control and Accountability (MC&A) program, forms a robust defense against threats to SNM. The MC&A program ensures meticulous tracking and management of all material, significantly reducing the risk of theft or diversion. By enforcing strict accounting practices and inventory controls, these programs provide enhanced protection for SNM and support personnel.

2.12.1 Regulations and Standards Incorporated by Reference

In addition to the primary references in this regulatory basis document, the following regulations are incorporated by reference and remain in full force and effect for the Physical Security Program:

- **AR 190–54, *Security of Nuclear Reactors and Special Nuclear Materials*.** This Army Regulation establishes security protocols to protect nuclear reactors and SNMs from unauthorized access, theft, or sabotage, which is crucial for ensuring the safe and secure operation of nuclear facilities (Army 2006).

2.12.2 Primary Basis Documents

The Physical Security Program is based on the following references:

- **DoDI 5210.63, *DoD Procedures for Security of Nuclear Reactors and Special Nuclear Materials*.** This instruction provides security procedures to protect DoD nuclear reactors and SNMs from threats, ensuring the safety and integrity of these critical assets within military operations (DoD 2006).
- **DoD 5200.08-R, *Physical Security Program*.** This regulation outlines the physical security measures for DoD facilities, including nuclear facilities, to prevent unauthorized access, theft, or sabotage, which is essential to maintaining the safe and secure operation of nuclear power infrastructure (DoD 2020e).
- **DoDD 5210.83, *DoD Unclassified Controlled Nuclear Information*.** This directive establishes procedures for handling unclassified controlled nuclear information (UCNI), ensuring its protection and preventing the unauthorized dissemination of sensitive information vital to nuclear safety and security (DoD 2020c).

2.12.3 Other Resources

The following resources were evaluated as secondary sources or minor basis references for the Physical Security Program:

- **DOE O 473.1A, *Physical Protection Program*.** This order establishes requirements for the physical protection of nuclear facilities, including measures to safeguard against unauthorized access, theft, and sabotage, ensuring the security and safety of nuclear materials and operations (DOE 2021).
- **DOE-STD-1194-2019, *Nuclear Materials Control and Accountability*.** This standard provides guidelines for the control and accountability of nuclear materials, ensuring that they are securely tracked and managed to prevent loss, theft, or diversion, which is critical for both safety and regulatory compliance in nuclear operations (DOE 2019b).

DOE Order 473.1A and DOE-STD-1194-2019 were assessed for their applicability to the program. Both documents outline technical requirements for various SNM categories and proved useful in identifying overlooked elements. However, the Army Regulation was found to be more appropriately aligned with the specific environment and resources requiring protection.

2.13 Emergency Management

Emergency management is critical for the ARP because it ensures that there are well-established plans, procedures, and resources in place to respond swiftly and effectively to potential accidents, natural disasters, or security threats. Given the high-risk nature of nuclear materials, proper emergency management helps minimize the impact of incidents, protects public safety, prevents environmental contamination, and ensures that nuclear facilities can recover and continue operations safely after an event.

The Army's emergency management program is guided by AR 525–27, which provides comprehensive instructions and responsibilities for managing emergencies effectively (Army 2019c). This regulation encompasses the preparation, response, recovery, and mitigation phases of emergency management, aiming to ensure robust and resilient capabilities across the Army. It aligns the Army's strategies with other federal frameworks, thereby supporting integrated and coordinated approaches to incidents that may affect operations. The goal of the program is to enhance readiness and ensure continuity of operations, safeguarding personnel, assets, and operations against potential threats and hazards.

2.13.1 Regulations and Standards Incorporated by Reference

In addition to the primary references in this regulatory basis document, the following regulations are incorporated by reference and remain in full force and effect for the Emergency Management Program:

- **AR 525–27, *Army Emergency Management Program*.** This regulation outlines the policies, procedures, and responsibilities for managing emergency situations within the U.S. Army, including preparedness, response, recovery, and mitigation efforts to ensure that the Army is ready to respond to various emergencies, including natural disasters, accidents, and incidents involving nuclear materials (Army 2019c).
- ***National Incident Management System (NIMS), 3rd ed*.** The Federal Emergency Management Agency's (FEMA's) NIMS provides a standardized approach to incident management and response, ensuring that federal, State, local, and tribal agencies work together efficiently during emergencies, including those involving nuclear power (FEMA 2017).

2.13.2 Primary Basis Documents

The Emergency Management Program is based on the following references:

- **DoDI 6055.17, *DoD Emergency Management (EM) Program*.** This directive outlines the DoD's emergency management policies and procedures, ensuring a coordinated response to all hazards, including nuclear events, to protect military personnel, assets, and facilities (DoD 2019b).

2.13.3 Other Resources

The following resources were evaluated as secondary sources or minor basis references for the Emergency Management Program:

- **DOE O 151.1E, *Comprehensive Emergency Management System*.** This order establishes the DOE's policies and procedures for emergency management, ensuring a coordinated response to all hazards, including nuclear events, to protect DOE facilities, personnel, and the public (DOE 2024a).
- **DOE G 151.1-1B, *Comprehensive Emergency Management System Guide*.** This guide provides detailed guidance on implementing emergency management programs at DOE facilities, supporting the development of effective emergency response plans and systems to handle potential nuclear or radiological incidents (DOE 2022a).

- **10 CFR 50.47, *Emergency plans,* and Appendix E to 10 CFR Part 50.** These regulations outline the requirements for nuclear power reactors' emergency plans, ensuring that operators are prepared to respond to accidents or incidents in a manner that protects public safety and minimizes radiation release (10 CFR Part 50.47 ; 10 CFR Part 50 Appendix E).
- **10 CFR 50.160, *Emergency preparedness for small modular reactors, non-light-water reactors, and non-power production or utilization facilities*.** This regulation establishes the emergency preparedness requirements for small modular reactors (SMRs) and other reactors that could be of interest to the Army, ensuring that operators of the reactors are prepared to respond to emergencies effectively and protect public health and safety in the event of an incident (10 CFR Part 50.160).

DOE O 151.1E (DOE 2024a), DOE G 151.1-1B (DOE 2022a), and 10 CFR Part 50 provide essential elements for an emergency management plan. Although not specifically tailored to AR 525–27 (Army 2019c), they provide valuable context and benchmarks for refining the Army's emergency management practices in similar environments. These documents offer detailed guidance on developing and implementing effective emergency management plans, especially within hazardous operations such as nuclear reactors. The consideration of 10 CFR Part 50, focused on licensing and regulatory requirements for nuclear reactors, highlights important dependencies on external organizations vital for a successful Emergency Management Program.

2.14 Cybersecurity

Threats facing the energy industry and DoD's unclassified information have dramatically increased, as power generation systems rely on digital assets, information technology, and operational technology, such as industrial control systems. DoD needs to protect its information, whether it resides on DoD networks and systems or on an industry partner's system so that capabilities are not exploited, misdirected, countered, or cloned. Development of a cybersecurity program provides guidance on defending networks, systems, and the information that resides in them. For nuclear power plants, the Cybersecurity Program describes the requirements to protect digital assets, systems, and networks associated with nuclear safety functions and important to safety functions, security functions, emergency preparedness functions, and support systems, which could adversely impact safety, security, or emergency preparedness.

2.14.1 Regulations and Standards Incorporated by Reference

In addition to the primary references in this regulatory basis document, the following regulations are incorporated by reference and remain in full force and effect for the Cybersecurity Program:

- ***National Institute of Standards and Technology (NIST) Cybersecurity Framework* (NIST 2024a).**
- **NIST Special Publication (SP) 800-53, *Security and Privacy Controls for Information Systems and Organizations* (NIST 2020b).**
- **NIST SP 800-57, *Recommendations for Key Management* (NIST 2019b, 2020a).**
- **NIST SP 800-82, *Guide to Operational Technology (OT) Security* (NIST 2023).**
- **NIST SP 800-88, *Guidelines for Media Sanitization* (NIST 2014).**
- **NIST SP 800-97, *Establishing Wireless Robust Security Networks: A Guide to IEEE 802.11i* (NIST 2007).**
- **NIST SP 800-161, *Cybersecurity Supply Chain Risk Management Practices for Systems and Organizations (NIST 2022)*.**
- **NIST SP 800-171, *Protecting Controlled Unclassified Information in Nonfederal Systems and Organizations* (NIST 2024b).**

- **IEEE standard 802.11-2024, *IEEE Approved Draft Standard for Information Technology -- Telecommunications and Information Exchange Between Systems Local and Metropolitan Area Networks -- Specific Requirements - Part 11: Wireless Local Area Network (LAN) Medium Access Control (MAC) and Physical Layer (PHY) Specifications* (IEEE 2024).**
- **Federal Information Processing Standards (FIPS) *Security Requirements for Cryptography* (FIPS 140 series) (NIST 2019a)*.***

2.14.2 Primary Basis Documents

DoD's policy is to implement a multitiered cybersecurity risk management process to protect U.S. interests, DoD operational capabilities, DoD individuals, organizations, and assets from cyber threats to DoD information systems. The ARP's cybersecurity program was written to mirror these requirements and benchmark against those imposed by the NRC for advanced reactors.

The Cybersecurity Program is based on the following references:

- **DoDI 8500.01, *Cybersecurity*.** This directive establishes the DoD's cybersecurity policy, ensuring that DoD systems and networks are protected from cyber threats to maintain national security and mission continuity (DoD 2019a).
- **DoDI 8510.01, *Risk Management Framework for DoD Systems*.** This instruction provides the framework for managing risk to DoD information systems through security controls and continuous monitoring, ensuring the confidentiality, integrity, and availability of critical systems and data (DoD 2022b).
- **AR 25–2, *Army Cybersecurity*.** This Army Regulation provides policies and responsibilities for ensuring the security and integrity of Army information systems, protecting sensitive data, and maintaining cybersecurity across all Army networks and IT systems (Army 2019a).
- **Defense Federal Acquisition Regulation Supplement (DFARS) 252.204-7012, *Safeguarding Covered Defense Information and Cyber Incident Reporting*.** This regulation requires defense contractors to protect covered defense information and report cyber incidents, ensuring the security of sensitive defense information throughout the supply chain (DFARS 2025).

2.14.3 Other Resources

The following resources were evaluated as secondary sources or minor basis references for the Cybersecurity Program:

- **IAEA Nuclear Safety and Security publications, such as NSS No 17-T, *Computer Security Techniques for Nuclear Facilities* (IAEA 2021a).**
- **DOE *Energy Sector Cybersecurity Framework Implementation Guidance*, January 2015 (DOE 2015a).**
- **DOE and Department of Homeland Security (DHS) Energy Sector Control Systems Working Group (ESCSWG) report, *Cybersecurity Procurement Language for Energy Delivery Systems*, April 2014 (DOE and DHS 2014).**
- **DHS Cybersecurity and Infrastructure Security Agency (CISA) *Cybersecurity in the Nuclear Sector Infographic*, April 2021 (DHS 2021).**
- **DA PAM 25–2–2, *Army Cybersecurity Tools Unified Capabilities Approved Products List Process*.** This pamphlet provides guidance for the vetting, approval, acquisition, and use of cybersecurity tools (cybersecurity and cybersecurity-enabled products) within the DA and leverages applicable DoD and DA publications (Army 2019b).

2.15 Radiation Protection

2.15.1 Regulations and Standards Incorporated by Reference

The following regulations are incorporated by reference and remain in full force and effect for the Radiation Protection Program:

- **AR 385–10, *The Army Safety and Occupational Health Program*.** This regulation establishes the safety program for the U.S. Army, detailing the responsibilities, policies, and procedures for ensuring the safety of Army personnel, equipment, and operations across all activities, including risk management, safety training, and accident prevention. DoDI 6055.08, *Occupational Ionizing Radiation Protection Program*, instructs the DoD to comply with NRC regulations for radiation exposure state in 10 CFR Part 20. The Army meets this instruction by implementing a radiation safety program (Army 2023d).

This AR includes Chapter 16, titled *Army Radiation Safety and Occupational Health Program—Ionizing Radiation*. This AR is supplemented by guidance found in DA PAM 385–10, *Army Safety and Occupational Health Program Procedures (Army 2023e).*

2.15.2 Primary Basis Documents

The rules and guidance supplied in AR 385–10 (Army 2023d) and DA PAM 385–10 (Army 2023e) are targeted at sealed sources and radioactive commodities (radioactive material). Radioactive commodities and radiation-generating devices are stated to be controlled through obtaining NRC licensees. These licenses are limited to quantities of byproduct material typically found in a 10 CFR Part 30 license (10 CFR Part 30). The risk profile of materials licenses do not typically incorporate criticality concerns or neutron activation as a secondary source of contamination. DOE complies with the requirements stated in 10 CFR 835, *Occupational Radiation Protection* (10 CFR Part 835). The requirements are met through the application of the DOE hierarchy of documents described in Section 1.3.1.3. These documents are references that are leveraged to identify attributes to expand a radiation protection program to apply to nuclear power facilities. These are based on the following two references.

The Radiation Protection Program is based on the following references:

- **DOE-HDBK-1130-2002, *Radiological Worker Training* (DOE 2022b).**
- **DOE-STD-1098, *DOE Standard: Radiological Control* (DOE 2017d)**.

2.15.3 Other Resources

The two primary basis documents identified above contain radiological training and controls that an Army reactor permittee should consider in addition to those found in AR 385–10 (Army 2023d). This regulation includes Chapter 16, titled *Army Radiation Safety and Occupational Health Program—Ionizing Radiation*. This AR is supplemented by guidance found in DA PAM 385–10, *Army Safety and Occupational Health Program Procedures (Army 2023e).*

Other documents authored by DoD organizations were reviewed during the generation of the attributes but did not provide significant contribution to the identified program attributes.

2.16 Radioactive Waste Management

DoDI 4716.27, *DoD Low-Level Radioactive Waste (LLRW) Program*, instructs the DoD to establish a low-level radioactive waste disposal program (DoD 2017b). The Army meets this instruction by implementing a disposal program that is assigned to Army Materiel Command in AR 200–1, *Environmental Protection and Enhancement* (Army 2007).

2.16.1 Regulations and Standards Incorporated by Reference

The following regulations are incorporated by reference and remain in full force and effect for the Radioactive Waste Management Program:

- **AR 385–10, *The Army Safety and Occupational Health Program*.** This Army Regulation establishes the safety program for the U.S. Army, detailing the responsibilities, policies, and procedures for ensuring the safety of Army personnel, equipment, and operations across all activities, including risk management, safety training, and accident prevention (Army 2023d).

This AR includes Chapter 16, titled *Army Radiation Safety and Occupational Health Program—Ionizing Radiation*. This AR is supplemented by guidance found in DA PAM 385–10, *Army Safety and Occupational Health Program Procedures* (Army 2023e).

2.16.2 Primary Basis Documents

The LLRW management program in AR 200–1 (Army 2007) is targeted at environmental remediation, not active management of continuously generated radioactive wastes. AR 385–10 (Army 2023d) identifies the requirements for waste disposal but not operational collection and storage.

DOE complies with the requirements stated in DOE Order 435.1, *Radioactive Waste Management* (DOE 1999a). The requirements are met through the application of the DOE hierarchy of documents described in Section 1.3.1.3. These documents are references that are leveraged to identify attributes to expand a radioactive waste program for nuclear power facilities.

The Radioactive Waste Management Program is based on the following references:

- **DOE M 435.1-1 Chg 3, *Radioactive Waste Management Manual* (DOE 1999b).**
- **DOE O 435.1 Chg 2, *Radioactive Waste Management* (DOE 1999a).**

2.16.3 Other Resources

In addition, nuclear reactors may be located in dispersed areas. Packaging and shipping radioactive waste may require additional training for reactor or ancillary support staff. Individual training for the transportation of radioactive material is based on the requirements found in (49 CFR Part 173.1)(b) and DTR 4500.9-R-Part II (USTRANSCOM 2024b).

The two primary basis documents above identify radiological waste management training and controls that an Army reactor permittee should consider in addition to those found in AR 385–10 (Army 2023d) and DA PAM 385–10 (Army 2023e). Other documents authored by DoD organizations were reviewed during the generation of the attributes but did not provide significant contribution to the identified program attributes.

2.17 Environmental Management

Army Regulation 200–1, *Environmental Quality Environmental Protection and Enhancement,* implements federal, State, and local environmental laws and DoD policies for preserving, protecting, conserving, and restoring the quality of the environment (Army 2007). The establishment of a radioactive emission and effluent monitoring program is not specifically addressed in AR 200–1; however, emissions are required to be limited.

2.17.1 Regulations and Standards Incorporated by Reference

In addition to the primary references in this regulatory basis document, the following Army regulations are incorporated by reference and remain in full force and effect for the Environmental Management Program:

- **AR 200–1, *Environmental Protection and Enhancement* (Army 2007).**
- **AR 385–10, *Safety Program* (Army 2023d).**

When combined, these references identify the actions needed to actively monitor and report the environmental impacts from the operations of a nuclear reactor.

2.17.2 Primary Basis Documents

The NRC published 10 CFR Part 50 Appendix I to identify amounts of LWR effluents that meet the definition of ALARA. This appendix requires a licensee to submit a report annually to demonstrate that they comply with the regulation. DOE also requires annual site environmental reports to identify how a DOE facility complies with DOE Order 458.1, *Radiation Protection of the Public and the Environment* (DOE 2011d). DOE complies with a number of requirements found in DOE Order 458.1. Examples are 40 CFR Part 61 , *National Emission Standards for Hazardous Air Pollutants*, and 40 CFR Part 141 , *National Primary Drinking Water Regulations*.

The Environmental Management Program is based on the following references:

- **NRC Regulatory Guide 4.2 Rev 3. *Preparation of Environmental Reports for Nuclear Power Plants*** (NRC 2018f).
- **DOE P 451.1, *NEPA Compliance Program*** (DOE 2017a).
- **DOE Handbook 1216 Chg 1, *Environmental Radiological Effluent Monitoring and Environmental Surveillance*** (DOE 2015b).

The attributes for the Environmental Management Program are intended to be used to show compliance with the requirements in AR 200–1.

2.17.3 Other Resources

Other documents authored by DoD organizations were reviewed during the generation of the attributes but did not provide significant contribution to the identified program attributes.

2.18 Material Control and Accountability

The ARP MC&A Program is designed to offer leaders a robust framework for the accounting and control of nuclear materials, focusing on physical security, prompt detection and response, and maintaining records that can be audited to ensure loss prevention and deter theft or diversion of SNM. The documents outlined below specify the requirements and methodologies necessary for the effective management and protection of nuclear materials. The ultimate goal of the MC&A program is to ensure a secure and accountable environment for SNM, protecting national security and public safety through meticulous oversight and management.

2.18.1 Regulations and Standards Incorporated by Reference

In addition to the primary references in this regulatory basis document, the following regulations are incorporated by reference and remain in full force and effect for the MC&A Program:

- **10 CFR Part 74, *Material Control and Accounting of Special Nuclear Material*.**
- **AR 190–54, *Security of Nuclear Reactors and Special Nuclear Material* (Army 2006).**

- **DOE-STD-1098-2017, *Radiological Control* (DOE 2017d).**

2.18.2 Primary Basis Documents

The MC&A Program is based on the following references:

- **10 CFR Part 74 , *Material Control and Accounting of Special Nuclear Material*.**
- **AR 190–54, *Security of Nuclear Reactors and Special Nuclear Material (Army 2006)*.**
- **AR 50–5, *Nuclear Surety (Army 2018c)*.**

Part 74 of 10 CFR provides detailed criteria for controlling and accounting for materials at every stage of handling, ensuring precise tracking and safeguarding against unauthorized access or diversion. AR 190–54 and AR 50–5 establish comprehensive operational guidelines to uphold the secure custody and management of these materials within military and defense contexts.

2.18.3 Other Resources

The following resources were evaluated as secondary sources or minor basis references for the MC&A Program. DOE-STD-1194-2019 (DOE 2019b) and DOE O 474.2A were examined and informed aspects of policy and procedure. DOE-STD-1194-2019 offers a nuanced understanding of nuclear MC&A practices, providing technical standards that support tracking and verification. DOE O 474.2A outlines directives for nuclear material consolidation and disposition, crucial for optimizing asset management and reducing potential security risks (DOE 2024b).

2.19 Chemical, Biological, Radiological, and Nuclear Survivability (CBRN-S), Including Protection from the Effects of Electromagnetic Pulses (EMPs)

Chemical, biological, radiological and nuclear survivability including EMPs refers to the ability of military systems and personnel to withstand and continue their mission in environments contaminated or impacted by these hazards. The following is a summary of the effects and abbreviated protection strategies related to these hazards.

2.19.1 Chemical Hazards

Exposure to chemicals can cause immediate symptoms ranging from skin irritation and blisters (vesicants like mustard agent) to respiratory distress and convulsions (nerve agents like sarin). Chemical exposure on equipment; Command, Control, Communications, Computers and Intelligence (C4I); or critical mission systems can limit the operational function from degraded functions related to the requirement for surface and internal component decontamination.

Chemical survivability principles involve the use of special personal protective equipment (PPE) for personnel and enhanced material coatings and sealants for equipment to protect against hazardous chemical contamination.

2.19.2 Biological Hazards

Exposure to biological agents such as bacteria (e.g., anthrax), viruses (e.g., smallpox), and toxins (e.g., botulinum) can cause widespread infectious diseases affecting people, plants, and animals. The onset of symptoms from biological agent exposure can vary, ranging from hours (in the case of toxins) to weeks (for bacteria and viruses). Such exposure can significantly impact the performance of personnel and the operation of mission-critical equipment. Biological agents can also contaminate surfaces, air filters, and ventilation systems, thereby posing a risk to the personnel operating the equipment.

Biological survivability principles involve the early detection of exposure, the effective use of PPE, and contamination removal processes such as removing and replacing air filtration and detailed decontamination processes.

2.19.3 Radiological Hazards

Exposure to high doses of radiation can cause symptoms like nausea, vomiting, and fatigue and can be fatal depending on the dose. Equipment exposed to high levels of radiation can cause the deterioration of mission-critical equipment. Radiation can also induce electromagnetic interference, thus affecting the function of essential systems.

Radiation protection measures for personnel and equipment involve the principle of reduction exposure through a variety of solutions. For personnel, practice involves the effective use of medical countermeasures, PPE including respiratory protection equipment, and monitoring and detecting radiation levels for contamination avoidance and adhering to time, distance, and shielding principles. Equipment protection involves shielding and hardening design to protect against the effects of gamma and neutron radiation.

Nuclear Hazards or Effects: Nuclear hazards are related to the initial blast and thermal effects, which can cause massive destruction and acute thermal burns with immediate casualties from the blast wave. The initial blast and thermal effects can also have catastrophic impact on equipment and critical systems, causing physical damage from the blast wave as well as structural deformation related to thermal effects.

Nuclear survivability involves sheltering and blast protection of personnel and equipment. Similar personnel protection measures, as previously mentioned, related to reducing the impacts from radiation fallout exposure and contamination are essential. Shielding and hardening from EMPs should be conducted in accordance with MIL-STD-2169D, *High Altitude Electromagnetic Pulse (HEMP) Environment* (DoD 2021d).

Chemical, biological, radiological, and nuclear (CBRN) (EMP) hazards and effects pose severe and varied threats to human health and cause immediate and sustained impacts to mission-critical performance. Effective CBRN/EMP survivability relies on adherence to regulation, standards, guides, plans, and procedures. These topics are contained in but not limited to the following primary basis documents below.

2.19.4 Regulations and Standards Incorporated by Reference

In addition to the primary references in this regulatory basis document, the following regulations are incorporated by reference and remain in full force and effect for the CBRN-S Program:

- **AR 70–75, *Survivability of Army Personnel and Materiel***. The purpose of AR 70–75 is to set the policies and guidelines for enhancing the survivability of Army personnel and equipment in various threat environments. The document establishes measures and requirements for survivability to include performance criteria, testing, and evaluation (Army 2019e).
- **DoDI 3150.09, *The Chemical, Biological, Radiological, and Nuclear Survivability Policy***. This policy describes the framework for ensuring the survivability of DoD personnel, equipment, and mission-critical systems in CBRN and EMP environments. The instruction focuses on resiliency in operations through assigning responsibilities to various DoD offices and lays out the survivability requirements and standards. The document also enforces the integration of CBRN survivability into planning, acquisition, and life-cycle management of defense systems (DoD 2015).
- **MIL-STD-3056, *Design Criteria for Chemical, Biological, and Radiological System Contamination Survivability.*** The standard outlines criteria and procedures for evaluating and ensuring the survivability of military systems in CBRN events. The standard is designed to guide

the development of testing, evaluation, and maintenance of systems to withstand and function effectively in CBRN conditions (DoD 2021b).

- **MIL-STD-2169D, *High Altitude Electromagnetic Pulse (HEMP) Environment* (Classified Secret).** MIL-STD-2169 establishes threat levels and test procedures for assessing the survivability of military equipment and systems under EMP conditions. The standard sets the guidelines for understanding and mitigating the effects of HEMP on military systems. The document enables effective planning, design, and acquisition of systems to protect and mitigate against HEMP. This includes protection and mitigation, design considerations, and operational procedures (DoD 2021d).
- **MIL-STD-188-125, *High Altitude Electromagnetic Pulse (HEMP) Protection for Ground-Based C4I Facilities Performing Critical, Time-Urgent Missions***. MIL-STD-188-125 is a standard providing guidelines and requirements for protecting ground-based C4I facilities from the effect of HEMPs. The standard ensures that a critical military communications system can continue to operate or quickly recover after a HEMP event (DoD 1998, 1999).

2.19.5 Primary Basis Documents

The CBRN-S Program is based on the following references:

- **DoDI 3150.09, *The Chemical, Biological, Radiological, and Nuclear Survivability Policy***. DoDI 3150.09 outlines the policy for ensuring the survivability of DoD personnel, equipment, and operations in environments contaminated by CBRN threats. The policy establishes the roles and responsibilities, requirements, and standards related to CBRN survivability. Additionally, the document provides guidance on training, readiness, integration, and coordination within defense planning strategy and operations (DoD 2015).
- **JP 3-11, *Operations in Chemical, Biological, Radiological, and Nuclear (CBRN) Environments***. Joint Publication 3-11 is a comprehensive document for planning, conducting, and assessing military operations in CBRN environments. It outlines necessary practices for maintaining operational effectiveness under CBRN conditions. The publication outlines the unique challenges to military operations, the detailed characteristics of CBRN effects, and their impacts to personnel, equipment, and operational capabilities. The publication also details protection measures for individuals and units including PPE, collective protection systems, and decontamination procedures (JCS 2013b).
- **MIL-STD-2169D, *High Altitude Electromagnetic Pulse (HEMP) Environment*** (DoD 2021d).
- **ATP 3-11.32, *Multiservice Tactics, Techniques, and Procedures for Chemical, Biological, Radiological, and Nuclear Protection*.** ATP 3-11.32 provides detailed tactics, techniques, and procedures (TTPs) for executing CBRN defensive measures. The focus is on practical and tactical implementation including hands-on techniques and tools (Army 2024d).
- **ATP 3-11.36, *Multi-Service Tactics, Techniques, and Procedures for Chemical, Biological, Radiological, and Nuclear Planning*.** ATP 3-11.36 provides detailed guidance on TTPs for response to CBRN incidents. The publication is designed to enhance the capability of military units to conduct effective CBRN response operations and ensure mission continuity and command and control while operating in a contaminated environment (Army 2018b).

2.19.6 Other Resources

The following resources were evaluated as secondary sources or minor basis references for the CBRN-S Program:

- **DoDI 3020.52, *DoD Installation Chemical, Biological, Radiological, Nuclear, and High-Yield Explosive (CBRNE) Preparedness Standards*.** DoDI 3020.52 establishes policy and procedures to ensure DoD installations are prepared to effectively respond to CBRN incidents. The key focus is on the resilience and readiness of DoD installations (DoD 2017a).

- **DoDI 6055.07, *Mishap Notification, Investigation, Reporting, and Record Keeping*.** DoDI outlines the policies and procedures for notifying, investigating, reporting, and keeping records of mishaps within DoD. This outlines timely and accurate handling of investigations to improve or prevent future incidents from happening (DoD 2011).
- **DoDI 6055.17, *DoD Emergency Management Program*.** This instruction sets the framework for DoD EM program, with the goal to safeguard personnel, resources, and operational capabilities against natural and man-made disasters (DoD 2019b).
- **DoDD 3150.02, *DoD Nuclear Weapons Surety Program*.** This instruction emphasizes the prevention of nuclear weapons accidents by establishing polices and responsibilities to ensure safe and secure control of nuclear weapons (DoD 2024).
- ***Strategy for Countering Weapons of Mass Destruction*** This strategy of countering weapons of mass destruction (WMDs) outlines the U.S. approach to prevent, deter, and respond to the proliferation and use of WMDs to ensure national security and global stability (DoD 2023a).
- **JP 3-40, *Joint Countering Weapons of Mass Destruction*.** This Joint Publication outlines the comprehensive approach to combating threats posed by CBRN weapons. The doctrine emphasizes integrated intelligence, operations, and interagency efforts. It also provides guidelines for the detection, interdiction, and elimination of WMD threats (JCS 2019).
- **CJCSI 3214.01E, *Defense Support for Chemical, Biological, Radiological, and Nuclear Incidents on Foreign Territory*.** The purpose of this Chairman of the Joint Chiefs of Staff Instruction (CJSCI) is to provide guidance, policy, and direction to the Joint Chiefs of Staff, Combat Commanders, and other DoD components. This document provides detailed guidance on the DoD's support to consequence management operations for incidents involving CBRN and high-yield explosives. It focuses on rapid response, resource allocation, and operational effectiveness (CJCSI 2015).
- **AR 350–1, *Army Training and Leader Development*.** The purpose of AR 350–1 establishes the policy and procedures for training and developing Army leaders, ensuring a proficient and capable force. The doctrine emphasizes the roles and responsibilities of commanders in training and leader development training strategy (Army 2017b).
- **ADP 7-0, *Training*.** Army Doctrine Publication (APD) 7-0 outlines the Army's approach to training, ensuring that soldiers and units are ready to perform their mission effectively. This doctrine provides a framework for planning, conducting, and assessing training. This is emphasized through joint, multinational, and interagency training (Army 2024h).

2.20 Deployment and Redeployment

The deployment and redeployment of a mobile nuclear power plant (MNPP) introduce a unique challenge for the U.S. Army, as there is no historical precedent for moving or operating this type of capability in any military theater. The nature of a nuclear power system, combined with the complexity of expeditionary energy needs, required the need to create an entirely new framework that could meet the operational demands while upholding the highest standards of nuclear safety and security. This framework could not be modeled on any single source. Instead, it was carefully developed through a deliberate review of a wide range of military regulations, technical manuals, and civilian nuclear safety guidelines. In addition to requirements in the draft AR 50–7, the Army framework includes a Deployment and Redeployment Supporting Program with attributes defined in Appendix B of the draft DA PAM.

The foundation for the Supporting Program draws from traditional Army mobility doctrine *Army Deployment and Redeployment* in AR 525–93 (Army 2023a) and ATP 3-35 (Army ATP 2023), as well as broader joint deployment guidance outlined in Joint Publication 3-35, *Deployment and Redeployment Operations* (JCS 2007). Operational-level detail was further informed by U.S. Army Forces Command (FORSCOM) Regulation 500-3-3, *FORSCOM Mobilization and Deployment System (FORMDEPS) Vol. III, Reserve Component Unit Commander's Handbook, (RCUCH)* (Army 1999), and transport-focused resources such as FM 4-0, *Sustainment Operations* (Army 2024g). Because of the nuclear nature of MNPPs, safety and regulatory requirements were also shaped by civilian nuclear guidance including

NEI's *Risk-Informed Performance-Based Technology. Inclusive Guidance for Advanced Reactor Licensing Basis Development (NEI 2019b)*, NRC Policy Issue *Technology-Inclusive, Risk-Informed, and Performance-Based Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Non-Light-Water Reactors* SECY-19-0117 (NRC 2019c), and ANSI/ANS-3.11 (ANSI/ANS 2024). These references helped ensure the integration of risk-informed decision-making, safety oversight, site-specific environmental assessment, and robust emergency planning throughout each phase of deployment.

2.20.1 Regulations and Standards Incorporated by Reference

In addition to the primary references in this regulatory basis document, the following regulations are incorporated by reference and remain in full force and effect for the Deployment and Redeployment Program:

- **TRADOC Pamphlet 525-3-1, *The U.S. Army in Multi-Domain Operations*,** which defines Strategic Support Areas (SSAs) and Operational Support Areas (OSAs), restricting the deployment of MNPPs to these locations unless otherwise approved (Army 2018d).
- **AR 190–13, *The Army Physical Security Program*,** which governs security requirements for Army facilities, including nuclear reactors (Army 2019d).
- **AR 190–54, *Security of Nuclear Reactors and Special Nuclear Materials*,** detailing physical security requirements for reactors and SNMs (Army 2006).
- **AR 525–27, *Army Emergency Management Program,*** which sets policies for emergency planning, including nuclear-related incidents (Army 2019c).
- **AR 710–2, *Secondary Item Policy and Retail Level Management*,** which may influence logistics and supply chain requirements for MNPPs (Army 2024f).
- **AR 600–20, *Army Command Policy* (Army 2025a).**
- **FM 4-0, *Sustainment Operations*,** outlining the logistics and transport planning considerations for MNPP movement (Army 2024g).
- **SECY-19-0117, *Technology-Inclusive, Risk-Informed and Performance-Based Methodology to Inform Licensing Basis and Content of Applications for Licenses, Certifications and Approvals for Non-Light Water Reactors.*** NRC's risk-informed performance-based licensing framework for advanced reactors, relevant for assessing MNPP safety (NRC 2019c).
- **NRC RG 1.233, *Guidance for a Technology-Inclusive, Risk-Informed, and Performance-Based Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Non-Light Water Reactors.*,** providing regulatory guidance on reactor licensing and risk management (NRC 2020a).
- **NEI 18-04, *Risk-Informed Performance-Based Technology. Inclusive Guidance for Advanced Reactor Licensing Basis Development*,** which outlines safety evaluations, risk-informed decision-making, and regulatory assessments for advanced reactors (NEI 2019b).
- **10 CFR Part 50, *Domestic Licensing of Production and Utilization Facilities*,** covering nuclear facility licensing, which informs Army nuclear safety protocols.
- **10 CFR Part 52, *Licenses, Certifications, and Approvals for Nuclear Power Plants*,** used as a regulatory benchmark for MNPP certification considerations.
- **10 CFR Part 73, *Physical Protection of Plants and Materials*,** detailing security measures for nuclear facilities, which influence MNPP security protocols.
- **10 CFR Part 20.1402 , *Radiological criteria for unrestricted use*.**
- **TG 31, *Operational Washdown and Agricultural Inspection Preparation for Military Conveyances and Equipment*,** ensures safe transport, including any required agriculture inspections (DoD AFPMB 2021).

- ***Nuclear Non-Proliferation Treaty (NPT)*****,** an international treaty governing the use of nuclear materials, relevant for international MNPP deployments (UNODA 1970).
- **IAEA Standards.** Various safety and security standards that influence Army reactor safety policies.

2.20.2 Primary Basis Documents

The Deployment and Redeployment Program is based on the following references:

- **AR 525–93, *Army Deployment and Redeployment* and ATP 3-35, *Army Deployment and Redeployment*,** for general mobility procedures (Army 2023a).
- **ATP 3-35, *Army Deployment and Redeployment*,** a tactical publication providing operational guidance on the movement of Army assets in theater (Army ATP 2023).
- **FORSCOM Regulation 500-3-3**, ***FORSCOM Mobilization and Deployment Planning System (FORMDEPS)*,** outlines mobilization and deployment planning, providing a structured approach to the movement of Army assets (Army 1999).
- **JP 3-35, *Deployment and Redeployment Operations*,** which offers doctrine on deployment and redeployment, ensuring MNPP integration into larger force projection strategies (JCS 2007).
- **Army ATP 3-34.45, *Electric Power Generation and Distribution* (Army and USMC 2024).**
- **Army ATP 4-16, *Movement Control* (Army 2024c).**
- **Commercial nuclear power reactor safety and siting regulations**, adapted to meet military operational needs. For examples, see Section 1.3 for a discussion of some applicable NRC Regulatory Guides and international approaches.

2.20.3 Other Resources

The following resources were evaluated as secondary sources or minor basis references for the Deployment and Redeployment Program:

- ***Command Post Integrated Infrastructure Validated Online Lifecycle Threat (VOLT)* (DoDI 5000.02 2020).**
- **IAEA SSR-6 (rev. 1), *Regulations for the Safe Transport of Radioactive Material (IAEA 2016a)*.**
- **ANSI/ANS-3.11, *Determining Meteorological Information at Nuclear Facilities*.** Provides guidance for gathering, assembling, processing, storing, and disseminating meteorological information (ANSI/ANS 2024).

2.21 Transportation

A Transportation Program outlines two critical elements in the transportation process, which includes "coordination and safety." The program provides general transportation safety requirements for shipping transportable nuclear reactors (unirradiated) during deployment, as outlined in the draft revised AR 50–7, *Army Reactor Program.* It also follows safety procedures identified in AR 385–10, *Army Safety Program*. The coordination aspects of transportation are achieved when multiple organizations work together to ensure the timely delivery of personnel and equipment to meet critical timelines set by the Army. Strategic transportation in the DoD is managed through a joint process and adheres to guidance outlined in the Defense Transportation Regulation (DTR) and Joint Publications (JPs).

2.21.1 Regulations and Standards Incorporated by Reference

In addition to the primary references in this regulatory basis document, the following regulations are incorporated by reference and remain in full force and effect for the Transportation Coordination Program:

- **49 CFR Part 177.842 , 177.843, and 177.848** contain requirements for the loading and segregation of packages of Class 7 (radioactive) materials and the contamination of vehicles.
- **49 CFR 397, Subpart D** contains requirements for the routing of Class 7 (radioactive) materials, including requirements for motor carriers and drivers (49 CFR Part 397.101) and requirements for State routing designations (49 CFR Part 397.103).
- **NRC Regulatory Guide 7.10, Revision 3, *Establishing Quality Assurance Programs for Packaging Used in Transport of Radioactive Material* (NRC 2015a).**

2.21.2 Primary Basis Documents

The Transportation Coordination Program is based on the following references:

- **DTR Part II, Cargo Movement, Chapter 204, *Hazardous Material*,** provides guidance to the DoD on the movement of hazardous material (HAZMAT) to include radiological material (USTRANSCOM 2025).
- **DLAR (JP) 4145.08, *Radioactive Commodities in the Department of Defense Supply System,*** provides additional guidance for the acquisition, accountability, identification, possession, handling, storage, shipment, transfer, and disposal of radioactive material by the DoD (DLA 2018).
- **DRT Part III, *Mobility*, Appendix J,** provides guidance to the DoD and supporting personnel to be familiar with transportation of HAZMAT when deploying OCONUS (USTRANSCOM 2024a).
- **AR 190–54, *Security of Nuclear Reactors and Special Nuclear Materials*,** prescribes the physical security policy, criteria, and standards for securing reactor facilities and SNM used as fuel by these reactors (Army 2006).
- **49 CFR 173, *Shippers–General Requirements for Shipments and Packagings*, Subpart I, *Class 7 (Radioactive) Materials*.**
- **49 CFR 172, *Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements*.**
- **49 CFR 178, *Specifications for Packagings*, Subpart K (§178.350), *Specifications for Packagings for Class 7 (Radioactive) Materials*.**
- **10 CFR Part 71, *Packaging and Transportation of Radioactive Material.*** NRC has promulgated regulations for the packaging and transportation of radioactive material. This includes the approval of fissile material packages and Type B packages, which would be most applicable to the transport of a microreactor before and after irradiation.

2.21.3 Other Resources

The following resources were evaluated as secondary sources or minor basis references for the Transportation Coordination Program:

- None.

2.22 Transportation Safety

The Transportation Safety Program is focused on the safe relocation and transportation of MNPPs by developing and implementing policy related to the safe transportation of MNPPs. These are used to develop and implement transportation procedures that will be followed to ensure the safety of MNPP equipment and personnel as it relates to reactor safety during transportation, the protection of equipment, and the provision of emergency preparedness enroute. The Transportation Safety Program is conducted in accordance with the following standards and regulations.

2.22.1 Regulations and Standards Incorporated by Reference

In addition to the primary references in this regulatory basis document, the following regulations are incorporated by reference and remain in full force and effect for the Transportation Safety Program:

- **FM 4-0, *Army Sustainment Operations*,** emphasizes the contested logistics environment and identifies the challenges and planning considerations for sustainment operations to set the theater and enable power projection, deployment, and echelon sustainment for distributed operations (Army 2024g).

2.22.2 Primary Basis Documents

The Transportation Safety Program is based on the following references:

- **DoDI 6055.04, *DoD Motor Vehicle and Traffic Safety*,** implements policy, assigns responsibilities, and prescribes procedures for administering the DoD Motor Vehicle Safety Program (DoD 2021c).
- **AR 385–10, *Army Safety and Occupational Health Program*,** provides policy on Army safety management procedures with special emphasis on responsibilities and organizational concepts (Army 2023d).
- **DTR Part II, Cargo Movement, Chapter 204, *Hazardous Material*,** provides guidance to the DoD on the movement of hazardous material to include radiological material (USTRANSCOM 2025).
- **DTR, Part III, *Mobility*, Appendix J,** provides guidance to the DoD and supporting personnel to be familiar with transportation of HAZMAT when deploying OCONUS (USTRANSCOM 2024a).
- **49 CFR 172, *Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans.***
- **49 CFR 178, *Specifications for Packagings*, Subpart K (§178.350), *Specifications for Packagings for Class 7 (Radioactive) Materials*.**
- **10 CFR Part 71, *Packaging and Transportation of Radioactive Material*.** NRC has promulgated regulations for the packaging and transportation of radioactive material. This includes the approval of fissile material packages and Type B packages, which would be most applicable to the transport of a microreactor before and after irradiation.

2.22.3 Other Resources

The following resources were evaluated as secondary sources or minor basis references for the Transportation Safety Program:

- None.

2.23 Training and Qualification of Transportation Teams

The Training and Qualification of Transportation Teams Program is based on **JP 4-01, *Joint Doctrine for the Defense Transportation System* (JCS 2013a)**. This standardization allows transportation forces to train during times of peace in the same manner in which they would operate during war or a contingency and provides the inherent flexibility to effectively and quickly support any type of military operation. **ATP 4-16, *Movement Control***, defines the movement control process and identifies the roles and responsibilities of organizations at the theater, corps, and division echelon in their support of large-scale combat operations. Movement control enables commanders at all levels to better execute the control of ground movements in support of large-scale combat operations (Army 2024c).

3.0 Permits and Approvals

3.1 Overview

The ARP's Regulatory Framework draws heavily from established NRC regulations, particularly 10 CFR Parts 50 and 52, which govern the licensing and permitting of commercial nuclear power reactors. These regulations define the types of permits and licenses required, the contents of applications, and the process for submission, review, approval, and issuance of regulatory authorizations. By aligning with the NRC's licensing framework, the Army ensures that its regulatory approach remains consistent with regulatory best practices and maintains the continuity of regulations for existing Army reactors.

Under the draft revised AR 50–7, the permitting framework allows for the flexible combination of permit types—including design, site, construction, and operational permits—into a single integrated application. This streamlined approach, based on the authorities in the AEA enables applicants to incorporate by reference previously submitted information, reducing the administrative burden and conserving resources by avoiding redundant reviews of the same technical and safety documentation across multiple applications.

This approach ensures that each permit is issued only after a thorough review confirms that the proposed activity meets rigorous standards for safety, security, and environmental protection. By adopting a risk-informed, performance-based, and efficiency-driven permitting process, the Army enhances regulatory effectiveness while maintaining the highest levels of nuclear safety and operational readiness.

3.2 Application and Approval Process

The application and approval process defined in Section 3.2 of the draft revised AR 50–7 (2025) and Section 3.2 of the draft DA PAM establishes a robust regulatory framework that integrates statutory authority, a rigorous multilevel review, and built-in flexibility for amendments and consolidation. This ensures that nuclear facility operations under the ARP are conducted safely, efficiently, and fully compliant with applicable regulations. The regulatory basis for the permitting process is founded on established federal and Army authorities that ensure a consistent, transparent, and rigorous approach to managing nuclear facility activities.

Legal and Regulatory Authority. The process is anchored in the statutory authority granted by the AEA and reinforced by Army regulations (see Section 1.1.2 herein). This dual authority empowers the ARO to review, approve, and, if necessary, suspend or terminate permits for nuclear facilities and activities.

Structured Review and Approval Process. Section 3-2 of the draft DA PAM delineates a stepwise process where an applicant submits a complete permit application—including design details, safety analyses, and supporting documentation—to the ARO. The application is then thoroughly reviewed by the Army Reactor Committee (ARC), which may issue Requests for Additional Information to resolve any deficiencies. The results of this review are documented in a Permit Evaluation Report, which must be approved by key authorities (such as the Director of Army Safety (DASAF) and Deputy Chief of Staff (DCS) G-3/5/7) before final issuance of the permit. This multitiered review ensures that each permit meets stringent safety, security, and operational standards. This process can be compared to NRC's multitiered review which includes a requirement for a safety review by the independent Advisory Committee on Reactor Safeguards prior to issuance of a new reactor license (NRC 2025a).

Flexibility Through Consolidation and Amendment. To enhance efficiency and reduce redundancy, the process allows for the consolidation of multiple permit applications into a single submission, with provisions for referencing previously submitted documentation. Moreover, the process distinguishes between major amendments—which require a full review—and minor amendments, which may be approved by the ARO without further higher-level authorization. This flexibility is critical for adapting to evolving conditions and maintaining operational continuity.

Ongoing Compliance and Enforcement. The regulatory framework mandates that permits become effective immediately upon issuance and remain in force for a set period (typically 10 years), unless renewed or otherwise modified. This permit duration is consistent with the AR 50–7 (2016), which notes that a new permit is typically issued every ten years following an annual operations review (Section 2–3 Permit changes). The proposed regulatory framework also provides clear criteria for termination or suspension of permits when applications fail to meet established requirements, safety issues arise, or other risk conditions develop. This ensures that any deviations from the approved plans are promptly addressed to protect Army personnel and public safety.

3.3 Regulatory Tailoring and Engagement

The Regulatory Tailoring process is consistent with DoDI 5000.02, *Operations of the Adaptive Acquisition Framework*, change 1, Section 4.1, "General Procedures." In the DoDI, the program managers (PMs) will "'tailor in' the regulatory information requirements that will be used to describe the management of the program. In this context, 'tailoring-in' means that the PM will identify, and recommend for [Milestone Decision Authority (MDA)/Decision Authority (DA)] approval, the regulatory information that will be employed to document program plans and how that information will be formatted and provided for review by the MDA/DA" (DoDI 5000.02 2020).

The regulatory engagement process complies with other nuclear regulators' requirements or expectations.

- Although not a requirement, the NRC encourages prospective applicants to confer with NRC staff (10 CFR Part 51.40 ; NRC 2024a).
- CNSC requires a pre-licensing review of a vendor's reactor design (CNSC 2025b)(REGDOC-3.5.4).
- United Kingdom's Office for Nuclear Regulation sets out the licensing requirements of nuclear installations as "Pre-application advice" in paragraph 30 of the *Licensing Nuclear Installations* (ONR 2021).

Regulatory Engagement is designed to establish a proactive, risk-informed framework that ensures applicants and the ARO are fully aligned on expectations before a formal permit application is submitted.

3.3.1 Process

The Army's Regulatory Tailoring and Engagement process has the following goals:

Early and Continuous Engagement. The process mandates early interaction between the applicant and the ARO—typically during the design development phase—so that the ARO becomes familiar with the technical solutions being proposed. This early dialogue enables both parties to discuss and resolve potential issues well before the formal submission.

Clear Expectations and Documentation. The process clarifies expectations regarding permit application format, content, and quality. It requires that all regulatory requirements and exemptions be identified and documented. This ensures that the application will address all necessary safety analyses, design criteria, and supporting documentation outlined in Army regulations.

Identification of Technical Gaps. A critical function of this engagement is to identify and document major technical needs or information gaps that could hinder the review of subsequent permit applications. By addressing these gaps early, the process helps to ensure that the formal application is complete and ready for a timely review. The technical needs or information gaps can be addressed by using topical reports.

Defined Review and Approval Timelines. The engagement process establishes acceptance criteria, review durations, and timelines for permitting and supporting activities. This structured approach is intended to streamline the overall review process and keep the project on schedule, mirroring the preapplication readiness review practices employed by the NRC.

Tailored Guidance for Safety and Compliance. The regulatory engagement includes a comprehensive review of applicable regulations, a detailed analysis of the safety design strategy, and a technology readiness assessment. This ensures that all aspects of the reactor's design—from hazardous materials management to significant safety systems—are rigorously evaluated and meet the Army's stringent safety and regulatory standards.

This framework ensures that nuclear facility permit applications are robust, thoroughly vetted, and fully compliant with all regulatory and safety requirements before formal submission, thereby reducing review delays and promoting a more efficient permitting process.

3.3.2 Topical Reports

Based on the draft DA PAM and established NRC practices, the regulatory basis for using topical reports in the Army Reactor Program is twofold:

- Topical reports serve as supplemental technical documents that help fill gaps in information or technology. As outlined in the draft DA PAM, these reports—whether presented as white papers, peer-reviewed scientific reports, or other supplemental materials—provide the ARO with additional insights into a topic, system, or condition that may not be fully addressed in the initial permit application. This approach ensures that any uncertainties or emerging issues related to safety, design, or analysis are thoroughly evaluated before a permit is issued.
- The use of topical reports mirrors the established practices of the NRC, which uses such reports to streamline the permitting process by incorporating detailed technical analyses into the overall review. By adopting this method, the Army can reduce redundancy, enhance its technical understanding, and make more informed decisions, thereby upholding the high standards of safety and compliance required by the draft revised AR 50–7.

The regulatory basis for topical reports rests on their ability to supplement permit applications with comprehensive, expert-reviewed technical data, ensuring that all aspects of a nuclear facility's design and operation are rigorously evaluated and meet established safety and compliance standards.

3.4 Fuel Qualification Review

The Fuel Qualification Review is fully aligned with established nuclear industry and regulatory practices, such as those employed by the NRC in 10 CFR Part 50.34 and 10 CFR Part 50.43 (NUREG-0800, Section 4.2 (NRC 2007b); NUREG-2246 (NRC 2022b)), to ensure that nuclear fuel behavior is rigorously characterized and controlled.

Under the draft revised AR 50–7, the ARO reviews the fuel qualification documentation—including the specification, plan, and supporting test data—as part of the reactor design permit application. This oversight is similar to the NRC's practice of evaluating fuel behavior through extensive preapplication reviews, including direct observation of the manufacturing process when needed. Such measures ensure that any deviations are identified and addressed promptly.

The integration of Nuclear Reactor Fuel Qualification into the design permit application is not only a regulatory requirement under the draft revised AR 50–7 and associated DA PAM but also reflects the nuclear regulators best practices. This ensures that the fuel's behavior is thoroughly understood, safely managed, and reliably meets performance standards under all expected conditions, thereby providing a robust foundation for reactor safety and operational success.

3.5 Reactor Design Permit

The Design Permit within the ARP establishes a structured, phased approach for the approval of reactor designs before full-scale construction and operation. This framework is informed by the NRC regulations under 10 CFR Part 52, Subparts B and E, as well as 10 CFR Part 50 requirements for Construction Permit design information. Relevant NRC guidance, including Regulatory Guide 1.206 (NRC 2018a) and NUREG-0800 (NRC 2017), provides the technical foundation for the review and approval of design permits.

3.5.1 Two-Tiered Design Permit Approach

To provide flexibility in the design review process, the ARO divides the Design Permit into two distinct states:

1. **Preliminary Design Permit**—Issued at approximately 40% design completion, the Preliminary Design Permit allows for an early-stage regulatory review that enables applicants to
    a. establish compliance with fundamental safety, security, and environmental requirements
    b. identify and address potential design risks before completion
    c. support applications for a Construction Permit by demonstrating sufficient design maturity
    d. proceed with long-lead procurement and limited work activities if authorized.
2. **Final Design Permit**—Issued based on a final design or as part of an Operational Permit for an installed design. The Final Design Permit aligns closely with
    a. the Construction Permit and Operating License requirements in 10 CFR Part 50
    b. the Final Safety Analysis Report (FSAR) requirements, ensuring all SSCs are fully defined and meet regulatory standards
    c. the necessary design baseline for a Manufacturing License, making a Final Design Permit a prerequisite for a Manufacturing Permit approval.

3.5.2 Flexibility in Application Pathways

Applicants can choose from multiple regulatory pathways based on the project needs:

- **Direct Final Design Permit.** Applicants may bypass the Preliminary Design Permit and apply directly for a Final Design Permit, provided that the design is reasonably complete and meets all the final permitting requirements.
- **Construction Permit Applications.** Applicants may apply for a Construction Permit with either a Preliminary Design Permit or a Final Design Permit, allowing for early engagement with the ARO.
- **Manufacturing Permit Requirement.** Any applicant pursuing a Manufacturing Permit must obtain a Final Design Permit, ensuring that the design meets all safety, reliability, security, and environmental compliance requirements before production begins.

By adopting a phased permitting approach, the ARO allows for risk-informed decision-making, supports efficient regulatory engagement, and ensures design maturity before major project commitments.

3.6 Site Permit

The Army's Site Permit framework closely aligns with the NRC regulations found in 10 CFR Part 52 Subpart A (*Early Site Permits*), which provides a risk-informed approach to evaluating safety for nuclear facility sites. The framework also integrates guidance from NUREG-0800 (*Standard Review Plan for Nuclear Safety Analysis Reports for Nuclear Power Plants: LWR Edition*) (NRC 2017) and Regulatory Guides 1.70 (*Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants: LWR Edition*) (NRC 1978), 1.206 (*Applications for Nuclear Power Plants*) (NRC 2018a), 1.233 (*Guidance for a Technology-Inclusive, Risk-Informed, and Performance-Based Methodology to Inform the Licensing Basis* *and Content of Applications for Licenses, Certifications, and Approvals for Non-Light Water Reactors*) (NRC 2020a), to ensure a comprehensive and structured site safety evaluation process.

The Army's Site Permit enables early evaluation of site suitability before committing to full facility design and construction. This risk-informed approach allows for regulatory engagement and environmental assessments to be completed before a Construction Permit or Operational Permit is issued, reducing uncertainty in the permitting process.

Other additional regulations that the draft revised AR 50–7 relies upon are AR 385–10, *Army Safety and Occupational Health Program (Army 2023d)*; AR 525–27, *Army Emergency Management Program (Army 2019c)*; AR 190–13, *The Army Physical Security Program (Army 2019d)*; AR 190–54, *Security of Nuclear reactors and Special Nuclear Materials (Army 2006)*; and AR 200–1 *Environmental Protection and Enhancement (Army 2007)*.

A Site Permit modification may be required when site characterization determines that a reactor location does not fully conform to the criteria established in the Final Design Permit. In such cases, site-specific mitigation measures need to be identified and communicated to ARO before reactor startup to assure that safety, environmental protection, and security requirements are maintained. This process provides the necessary flexibility to adapt reactor siting to real-world conditions while upholding rigorous regulatory oversight.

Site preparation for a manufactured reactor includes the construction of safety- or security-related SSCs. The review of those SSCs would not be done as a Construction Permit but must be done at the Site Permit. Therefore, a Site Permit modification would be required. The Operating Permit may have been issued predicated on the Site and Manufacturing Permits, but once the reactor is at the site, the necessity to modify a permit may be needed.

A formal modification request is submitted to the ARO for review and approval, including

- a description of the required site modification
- justification for the change and proposed control measures to maintain reactor safety
- the anticipated duration of the mitigation strategy.

Examples of site-specific modifications are:

- **Floodplain Mitigation.** If a planned reactor site is within a flood-prone area, measures such as elevated foundations, reinforced barriers, and improved drainage systems may be implemented.
- **Access Distance Restrictions.** If deployment constraints prevent required restricted access distances, additional radiation shielding may be implemented to ensure compliance with exposure limits.
- **Seismic Hazard Adaption.** If updated surveys indicate higher-than-expected seismic activity, structural reinforcements such as base isolators and shock-absorbing foundations may be necessary.
- **Security and Cyber Threat Adjustments**. If intelligence assessments reveal elevated security risks, additional physical security enhancements and cybersecurity protections may be incorporated.

3.7 Limited Work Authorization (Special Reactor Study)

The Limited Work Authorization (LWA) using a Special Reactor Study provides a structured regulatory mechanism that enables certain preliminary activities to proceed before the full issuance of a required permit. This approach aligns with the NRC regulations (10 CFR Part 50.10), which govern limited construction activities prior to obtaining a full Construction Permit, and DOE regulations (10 CFR Part 830.206), which allow for limited construction and procurement actions while maintaining compliance with safety authorization requirements.

By using an LWA, the ARP ensures that necessary site preparation, procurement, other early-stage activities can be conducted, or long-lead-time components ordered without compromising safety, security, or environmental protection. This flexibility allows for early risk identification and mitigation, ensuring that potential design, engineering, or operational challenges are addressed before full-scale construction or operation begins.

A Special Reactor Study plays a key role in evaluating LWA requests by assessing

- safety and security implications of early-stage activities
- environmental compliance and impact mitigation strategies
- technical feasibility and design considerations
- regulatory alignment between the draft revised AR 50–7 and other regulations.

Upon completion of the Special Reactor Study, the ARO may recommend that an LWA be issued, ensuring that all preliminary work remains within regulatory bounds while allowing for efficient project execution. This process provides the necessary oversight and flexibility to advance mission-critical reactor projects while upholding the highest standards of nuclear safety and regulatory compliance.

3.8 Construction Permit

The Construction Permit authorizes all construction-related activities up to but not including the receipt and loading of nuclear reactor fuel. It ensures that the nuclear facility, once constructed, will meet ARP objectives, reactor safety principles, and design criteria. The Construction Permit also establishes regulatory oversight and hold points to verify that the safety SSCs are built in accordance with approved design requirements. Similar to the NRC's regulations in 10 CFR Part 50 and their Construction Permit process, the Construction Permit process integrates best practices from NRC's 10 CFR Parts 50 and 52, Subpart C, *Combined Licenses*, and relevant regulatory guidance in NUREG-1537 (NRC 1996), NUREG-0800 (NRC 2017), and RG 1.206 (NRC 2018a), requiring a structured Construction Permit Application, independent safety assessments, and continuous oversight while adapting to Army-specific mission requirements. This process creates a risk-informed, phased approach to using nuclear reactors. Table 3-1 compares ARP Construction Permit requirements with NRC requirements.

Table 3-1
Construction Permits: Comparison of ARP and NRC Requirements

ARP Construction Permit Requirement	NRC Equivalent Requirement
Construction Permit authorizes nuclear facility construction	10 CFR 50.10: Prohibits construction before Construction Permit approval
Construction Permit Application requires an approved Preliminary Design Permit and Site Permit	10 CFR 50.33(f) and 10 CFR 50.34: Requires site approval and preliminary design information
Preliminary Safety Analysis Report (PSAR) required	10 CFR 50.34(a): PSAR required for Construction Permit Application
Construction oversight, inspections, and hold points	10 CFR 50.55: NRC inspection and quality assurance oversight required
Performance-based testing and verification before operation	10 CFR 52.79: Inspections, Tests, Analyses, and Acceptance Criteria required

In addition, NUREG-1537 and NUREG-0800 provide a methodology for evaluating a Preliminary Safety Analysis Report (PSAR), which the ARP integrates into its Construction Permit evaluation process. RG 1.206 outlines structured application requirements, aligning the ARP's Construction Permit Application documentation requirements.

3.9 Manufacturing Permit

The Manufacturing Permit within the ARP provides a structured regulatory framework for the manufacture of one or more nuclear reactors of the same design. The process ensures that reactors are produced in accordance with an approved Final Design Permit; verified against safety, security, and QA standards; and subject to regulatory oversight throughout the manufacturing process. The ARP's Manufacturing Permit framework is modeled after the NRC's 10 CFR Part 52, Subpart F (*Manufacturing Licenses*) and integrates guidance from NUREG-0800 (NRC 2017) and RG 1.206 (NRC 2018a) to ensure alignment with nuclear industry best practices. Table 3-2 compares ARP Manufacturing Permit requirements with NRC requirements.

Table 3-2
Manufacturing Permit: Comparison of ARP and NRC Requirements

ARP Manufacturing Permit Requirement	NRC Equivalent Requirement
Manufacturing Permit authorizes the production of one or more identical reactors	10 CFR 52.153: NRC Manufacturing License allows the manufacture of multiple reactors without site-specific permitting
Manufacturing Permit Application requires an approved Final Reactor Design Permit	10 CFR 52.153 and 52.157: NRC requires either the design of the reactor be included in the Manufacturing License application or reference a certified design or a standard design (10 CFR Part 52, Subparts B and E)
Site and Operational Permits required for fuel handling and low-power testing	10 CFR 52.167: NRC requires that the manufactured reactor only be moved to a site that holds either a Construction Permit issued under 10 CFR Part 50 or a Combined License under 10 CFR Part 52 and has either an Operating License issued under 10 CFR Part 50 or after a 103(g) finding under 10 CFR Part 52
ARO Oversight includes inspections, fabrication releases, and hold points	10 CFR 52.157: NRC ensures compliance through quality assurance and inspection programs
Manufacturing Permit ensures reactors meet design and safety criteria before deployment	10 CFR 52.153: NRC requires that the applicant provide design information within the application or to reference either a certified standard design issued under 10 CFR Part 52, Subpart B, or a standard design approved under 10 CFR Part 52, Subpart E.

The Manufacturing Permit framework provides a structured, risk-informed approach to reactor manufacturing, ensuring that all nuclear reactors are produced in compliance with approved design, safety, and QA standards. By aligning with the NRC's 10 CFR Part 52, Subpart F process, the ARP ensures early verification of quality and safety before reactor emplacement.

3.10 Operational Permit

The Operational Permit provides a risk-informed regulatory framework to authorize the safe operation of nuclear reactors in accordance with the specified permit conditions. The permit process ensures that the reactor is constructed, verified, and meets all safety requirements before full-power operation is authorized. The Operational Permit enables graded regulatory oversight of nuclear operations, incorporating phased authorization for key operational milestones including fuel receipt, fuel loading, low-power testing, and full-power operations.

The regulatory basis for the Operational Permit is derived from Army-specific nuclear safety requirements while leveraging best practices and regulatory frameworks established by the NRC in 10 CFR Part 50 (*Licensing of Production and Utilization Facilities*) and 10 CFR Part 52 (*Licenses, Certifications, and*

Approvals for Nuclear Power Plants) and guidance from NUREG-1537 (*Guidelines for Research and Test Reactors*) (NRC 1996), NUREG-0800 (*Standard Review Plan for Nuclear Power Plants: LWR Edition*)(NRC 2017), and regulatory guides, such as RG 1.206 (*Applications for Nuclear Power Plants*) (NRC 2018a). The permit requirements align with these NRC regulations and guidance documents while addressing the ARP objectives and the mission-critical needs of the Army.

The permit establishes initial operation conditions to

- restrict operations to controlled conditions during early operational phases
- validate reactor and fuel performance through staged testing—fuel receipt, fuel loading, and low-power operation
- ensure that all inspections, tests, and analyses required for safe operation are completed before full-power authorization.

This phased approach aligns with NRC requirements in 10 CFR Parts 50 and 52, ensuring that operational safety is demonstrated incrementally before full-power reactor operation authorization.

A fuel loading and reactor system test plan is required to

- validate the proper installation and configuration of fuel assemblies
- ensure controlled and safe initial criticality
- confirm that reactor systems perform as designed under low-power conditions
- demonstrate operational readiness before power ascension.

The Safety Analysis Report

- establishes the technical basis for reactor safety
- describes facility design, systems, and anticipated operating conditions
- evaluates severe accidents, design extension conditions, and public radiation exposure risks
- provides the analytical foundation for determining compliance with acceptance criteria.

The technical specifications further ensure that

- The facility operates within approved safety margins.
- Key safety systems remain operable to prevent and mitigate design-basis accidents.
- Clear operating limits are established for normal and off-normal conditions.

These requirements are consistent with NRC regulations under 10 CFR Parts 50 and 52, ensuring that military nuclear reactors align with proven safety principles.

A Fuel Loading and Reactor System Test Plan is required to

- validate the proper installation and configuration of fuel assemblies
- ensure controlled and safe initial criticality
- confirm that reactor systems and fuel perform as designed under low-power conditions
- demonstrate operational readiness before power ascension.

Supporting Programs must be examined to verify their effectiveness before operations commence. An Operational Readiness Assessment (ORA) further ensures that

- Personnel, procedures, and management systems are fully prepared for safe reactor operation.
- Facility operations are conducted within the approved safety envelope (technical specifications).
- The facility’s support organizations are adequately prepared to implement all necessary safety protocols.

These assessments mirror NRC requirements for startup testing and operator readiness evaluations before full-power operation is granted.

A Nuclear Facility Verification ensures that

- The facility's SSCs are constructed and configured per design and permit requirements.
- All inspections, tests, and analyses required to validate safety and operability are complete.

This verification process is essential for confirming that the facility meets all operational safety requirements before reactor startup.

The Operational Permit requirements outlined in the draft revised AR 50–7 and draft DA PAM establish a structured, safety-focused regulatory framework for nuclear reactor operations. By incorporating best practices and relying on NRC regulations, the permit ensures compliance with proven safety and risk management principles. The permit structure aligns with both Army-specific needs and established civilian safety practices, ensuring the secure and responsible operation of Army nuclear reactors.

3.11 Storage Permit

The Storage Permit provides a regulatory framework for the receipt, storage, and sustainment of transportable nuclear reactors or fuel at a nuclear facility. While it does not authorize nuclear power plant operation, it enables the implementation of graded regulatory requirements necessary for ensuring the safety and security of stored radioactive material. The permit process ensures compliance with ARP objectives and provides a structured pathway to demonstrate facility readiness for storage activities.

The regulatory basis for the Storage Permit requirements is founded on the need to establish adequate controls for the safe storage of nuclear materials, in line with best practices in nuclear safety, defense-in-depth strategies, and risk-informed regulatory principles. Unlike commercial nuclear power plant licenses issued under the NRC, this permit is tailored to Army-specific needs and requirements for transportable nuclear reactors, ensuring that safety is maintained during nonoperational periods.

The Storage Permit is intended to allow for temporary placement of nuclear fuel. This could be as fresh fuel, fuel contained within a nonfunctioning nuclear reactor, or spent nuclear fuel that has been removed from a reactor and is not collocated with an operating reactor. The NRC regulates this through spent fuel pools licensed as part of an operational license issued via 10 CFR Part 50 or a Combined License via 10 CFR Part 52 and then subsequently as a general or specific license for a reactor or away from reactor storage on an interim spent fuel storage installation (ISFSI). ISFSI licenses are issued under 10 CFR Part 72 .

This permit is intended to be used for short-term storage. For example, this permit may be issued to an Army organization for storage of spent nuclear fuel or fueled reactors with used fuel at the operational site prior to transfer to an off-site location. Without a Storage Permit, there would be insufficient regulatory oversight to ensure that transportable reactors and fuel are stored under conditions that prevent radiological hazards, unauthorized access, and environmental contamination.

A Storage Permit is only issued for locations with an active Site Permit, ensuring that

- The site has undergone a thorough evaluation for suitability to support reactor or fuel storage.
- The safety analysis for the site adequately addresses potential storage-related risks.
- The infrastructure and security measures are in place to mitigate potential hazards.

The requirement that a Storage Permit is not necessary for locations with an approved Operational Permit (if storage is addressed) ensures that regulatory redundancy is minimized while maintaining a robust safety framework.

The SAR and technical specifications are critical components of the Storage Permit Application as they

- evaluate hazards associated with storage and define safety-related SSCs
- establish administrative controls necessary to prevent radiological release and protect personnel
- ensure compliance with ARP objectives by demonstrating adherence to storage safety requirements.

The Supporting Program Certification process allows for a systematic examination of personnel, procedures, and management control systems necessary to verify that

- Storage facility personnel have the necessary qualifications and training.
- Operational procedures align with safety requirements and best practices.
- Management systems are in place to enforce compliance and maintain safety integrity.

This requirement is essential to ensure that reactor and fuel storage activities are conducted by trained and competent personnel in accordance with approved procedures.

An ORA is a critical validation step to confirm that

- The storage facility is prepared to operate within its safety envelope.
- Personnel, equipment, and procedures are ready for the safe execution of storage activities.
- The facility's support organizations are adequately prepared to implement safety policies and programs.

Conducting an ORA prior to permit approval ensures that all elements required for safe storage are in place and functioning as intended, reducing the risk of operational failures.

To ensure that the facility's SSCs meet design and operational criteria, a Nuclear Facility Verification (NFV) process is required to

- validate that the design, fabrication, and construction of SSCs align with permit requirements
- verify the completion of inspections, tests, and analyses necessary to demonstrate safety and operability.

The NFV provides assurance that the storage facility has been constructed and configured in accordance with approved safety and design specifications, reducing the likelihood of structural or system failures.

Each Storage Permit will have permit conditions that indicate the requirements specific to each use case and location.

The Storage Permit requirements provide a structured regulatory framework for the safe storage of transportable nuclear reactors and fuel. The permit ensures compliance with safety analysis and reduces the risks associated with nuclear material storage. These requirements are essential for maintaining radiological safety, security, and environmental protection.

3.12 Deactivated Nuclear Facility Possession Permit

The Deactivated Nuclear Facility Possession Permit (DNFPP) provides a structured regulatory framework for the continued oversight and management of nuclear facilities that no longer contain nuclear reactor fuel but have not yet transitioned to active decommissioning activities. This permit ensures that essential safety programs remain in place, that radioactive materials are properly controlled, and that the facility is maintained in a condition that supports future decommissioning activities. The requirements align and are in harmony with NRC regulations, particularly 10 CFR 50.82, and guidance in NUREG-1757 Vol. 2 (*Consolidated Decommissioning Guidance: Characterization, Survey, and Determination of Radiological Criteria—Final Report (Revision 2)*) (NRC 2022a) and NUREG-1628 (*Staff Responses to Frequently*

Asked Questions Concerning Decommissioning of Nuclear Power Reactors)(NRC 2000b). Table 3-3 compares ARP DNFPP requirements with NRC requirements.

Table 3-3
Deactivated Nuclear Facility Possession Permit: Comparison of ARP and NRC Requirements

ARP DNFPP Requirement	NRC Requirement
DNFPP applies to nuclear facilities that no longer contain fuel but are not yet decommissioned	10 CFR 50.82: Termination of license
DNFPP application requires a safety analysis report evaluating residual hazards and required controls	10 CFR 50.82(a)(9) NUREG-0586: Site characterization and radiological hazard assessment
Facility must maintain a limited set of required programs for radiation safety and physical security	NUREG-1628: Safe management of radioactive materials at shutdown reactors
Facility modifications and SSC changes must be reviewed and documented	10 CFR 50.59: Changes, tests, and experiments at nuclear facilities
Facility must maintain operational readiness for required programs until decommissioning begins	NUREG-1757 Vol. 2, *Consolidated Decommissioning Guidance: Characterization, Survey, and Determination of Radiological Criteria—Final Report (Revision 2)*

The DNFPP requirements outlined in the draft revised AR 50–7 and draft DA PAM establish a structured, safety-focused regulatory framework for deactivated nuclear facilities. By incorporating best practices and harmonizing with NRC regulations and guidance, the permit ensures compliance with proven safety and risk management principles. The permit structure aligns with both Army-specific needs and established civilian safety practices, ensuring the secure and responsible operation of Army nuclear reactors.

This is a long-term storage strategy similar to the NRC's Safe Storage regulations, or SAFSTOR. This is considered as deferred dismantlement. However, this version of the AR allows for the reuse of a location and facility after a period of nonuse. This is analogous to the current restart of Palisades Nuclear Plant.

These are processes allowed by NRC regulations in 10 CFR 50.82.

3.13 Decommissioning Permit

The Decommissioning Permit provides the regulatory framework for the safe and compliant removal of a nuclear facility from service once it is no longer required for Army use. The permit ensures that decommissioning activities restore the site to an acceptable condition, remove residual radioactivity, and prepare the facility for release from regulatory oversight. The ARP framework is informed by the NRC decommissioning regulations, particularly 10 CFR 50.82, *Termination of license*, and 10 CFR Part 20, Subpart E, *Radiological Criteria for License Termination*.

Additionally, the ARP framework uses guidance from NUREG-1575, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (NRC 2000a)*, and NUREG-1757, *Consolidated Decommissioning Guidance (NRC 2022a)*, to ensure alignment with industry best practices and harmonization with other agency regulations for facility closure, radiation survey methods, and site remediation. Table 3-4 compares ARP Decommissioning Permit requirements with NRC requirements.

Table 3-4
Decommissioning Permit: Comparison of ARP to NRC Requirements

ARP Decommissioning Permit Requirements	NRC Equivalent Requirement
Decommissioning Permit required for facilities no longer needed	10 CFR 50.82, *Termination of license*

Facility must be decontaminated and prepared for site release	10 CFR 20.1402, *Radiological Criteria for Unrestricted Use*
Decommissioning Permit Application contains a site-specific decommissioning plan	10 CFR 50.82(a)(9)
Radiological surveys and site investigations required	10 CFR 50.82(a)(9)(ii)
Environmental Report supplement	10 CFR 50.82(a)(9)(ii)(G)

The Decommissioning Permit provides for continuous oversight throughout the decommissioning process, ensuring that the site meets ARO Objectives. The oversight consists of the review and approval of the decommissioning plans, verification of radiation surveys and site cleanup activities, approval of waste management and disposal plans, and the final site inspection and documentation to confirm compliance with the release criteria.

The Decommissioning Permit provides a structured, risk-informed approach to reactor decommissioning, ensuring that nuclear facilities are safely removed from service, decontaminated, and prepared for site release.

3.14 Special Reactor Study

The Special Reactor Study is a feature of the permitting process to address any activity that may arise during the lifetime of the ARP needing ARO review or approval that is not specifically addressed with another permit. The Special Reactor Study provides a structured approach to evaluate safety concerns, deviations, operational changes and other conditions, and they support regulatory decision-making by assessing risk, security, reliability, and environmental compliance. As a result of the Special Reactor Study, the ARO may issue a special permit or another permit following the process as outlined in the draft revised AR 50–7 and the guidance in the draft DA PAM.

Examples of circumstances or conditions that may be the subject of a Special Reactor Study are:

- safety concerns
- deviations or changes to technical specifications
- modifications, alterations, or other changes that could affect reactor safety or security
- physical tests that may impact reactor safety or security
- significant changes or modifications in the operational concept that affect reactor safety or security
- any other condition that could affect reactor safety, security, reliability, or environmental compliance
- limited work or procurement activities requested prior to receipt of any required permit.

The “affect reactor safety, security, reliability, or environmental compliance” and similar wording should be taken broadly to mean any disturbance, condition, event, mishap, occurrence, or incident that could diminish margins or otherwise compromise safe, secure, reliable, and environmentally compliant activities.

Since the Special Reactor Study is intended to be used rarely and for potentially unforeseen circumstances, providing strict requirements and guidance about the content of an application to the ARO to conduct a Special Reactor Study is not possible. The following are examples of what could be provided to ARO to support the Special Reactor Study and for ARO to issue a special permit for the requested activity:

- Technical analysis reports or calculations that detail an assessment of the proposed activity or change, including the impacts to safety, security, reliability, and environmental compliance.
- Risk assessments identifying the potential hazards, vulnerabilities, and consequences associated with the activity.

- Change management documentation that describes the proposed deviations or modifications to the existing technical specifications, system configurations, or operations. Justification for the change should also contain the anticipated benefits and the potential risks associated with the activity.
- Safety and security evaluations of the activity.
    - SARs, including the PRA and the failure modes and effects analysis.
    - Security assessments considering the potential vulnerabilities and mitigation strategies.
- A verification and validation plan using testing and inspection, testing, and analysis processes and the respective acceptance criteria to verify the integrity and effectiveness of modifications. The results of the tests and simulations should be included.
- Compensatory, contingency, or mitigation action descriptions, milestones, and schedules that address potential conditions resulting from the proposed activity or minimize their adverse impacts on safety, security, or environment compliance.
- Regulatory and compliance information that demonstrates compliance with existing regulations and identification of any regulatory exemptions or amendments that may be required because of the activity.
- Operational readiness reviews containing the checklists; review results confirming the unit's ability and readiness to implement the proposed changes or activity.
- Personnel training and qualification reports and records to support the safe, secure, reliable, and environmentally compliant implementation of the activity.
- Historical data and precedent documentation of relevant case studies, incidents, and performance data that provide further context or lessons learned applicable to the proposed activity.

The inclusion of these documents supports a comprehensive evaluation of the conditions and circumstances associated with the activity. However, the list is not intended to be exhaustive or impose a requirement to submit documentation that is not relevant to the activity. Prior to submitting a request for a special reactor study, the unit should conduct regulatory engagement with the ARO as outlined in the draft revised AR 50–7.

3.15 Changes to Design, Configuration, and Documentation

The ARP employs an integrated regulatory framework to management design, configuration, and permitting basis document changes, ensuring safe, consistent, and controlled operations across all reactor life-cycle phases. The framework is built upon three key, interdependent supporting programs:

1. design and configuration management
2. records management
3. change control and permitting basis management.

This integration ensures that any change to design requirements, physical configuration, or controlled documents is properly evaluated, documented, and implemented in accordance with ARP objectives. This approach aligns with the NRC requirements under 10 CFR 50.54, 50.55a, 50.59, and 50.90, and guidance from RG 1.187 (NRC 2021a), NEI 96-07 (NEI 2000), and NEI 06-02 (NEI 2010).

Changes covered under this integrated framework include temporary or permanent modifications that affect the safety basis or permitting bases of a nuclear facility. These include

- design modifications in hardware, software, and systems
- controlled document changes in procedures, drawings, and safety analyses
- new tests or identified deficiencies in the design or configuration.

The goal is to maintain alignment between the nuclear facility physical plant, its safety basis, and the supporting documentation while ensuring traceability, regulatory compliance, and operational safety. Table 3-5 compares ARP requirements for changes to design, configuration, and documentation with NRC requirements.

Table 3-5
Design, Configuration, and Documentation: Comparison of ARP and NRC Requirements

ARP Requirement	NRC Regulation/Guidance
Evaluate safety impacts before implementing changes	10 CFR 50.59
Require permit amendments for significant changes	10 CFR 50.90
Controlled documents and QA-driven records retention	10 CFR 50.54(a), (p), (q), RG 1.187 (NRC 2021a), ASME NQA-1 (ASME 2015)
Security Plan changes	10 CFR 50.54(p), NEI 06-02 Rev 2 (NEI 2010)
Emergency Plan changes	10 CFR 50.54(q), RG 1.219 (NRC 2016a)
Design and SSC changes consistent with ASME Code	10 CFR 50.55a
Change process implementation	NEI 96-07 (NEI 2000)

The change control process, embedded within the Configuration Management Program and supported by Records Management Program, includes

1. **Identification and Evaluation**
   - Changes are evaluated to determine if they increase accident probability and severity, introduce new failure modes, or reduce safety margins.
   - Changes meeting these thresholds are submitted to the ARO for prior approval and may require a permit amendment.
2. **Technical and Management Review**
   - Change packages include design impact analyses, affected SSCs, documentation updates, and post-modification testing plans.
   - Technical reviews involve design, operations, QA, maintenance, and safety organizations, ensuring a multidisciplinary evaluation.
3. **Approval and Implementation**
   - Upon approval, the ARO issues permit amendments or safety study updates.
   - Changes are implemented with post-modification testing and personnel training.
   - All supporting documents are updated, controlled, and archived using the Records Management Program.
4. **Reporting**—Changes not requiring prior approval are reported annually.

3.16 Permit Changes

The ARP permit change or amendment process ensures that changes affecting the scope, technical content, or safety basis of a permit are properly evaluated and either approved as a new permit, typically at the end of the 10-year permit life, or processed as a permit amendment, with the level of review based on the nature and significance of the change.

Permit amendments are required for

- change in permit holder, such as organizational control or authority
- approval of an updated safety analysis report or technical specifications
- site-specific modifications for deployed reactors
- acceptance of special reactor studies for unique conditions.

Section 2-3 in the current version of AR 50–7 (2016) outlines this process. Draft updates to AR 50–7 address the level of the permit amendment approval.

3.17 Suspension of Permits

The suspension of permits is a key regulatory mechanism within the ARP that ensures reactor operations can be promptly halted if conditions arise that threaten or could challenge safety, security, or regulatory compliance. Permit suspension authority serves to protect Army personnel, the public, and the environment while ensuring that deficiencies are identified, reviewed, and resolved before operations resume.

Suspension of a permit allows the ARO or operational chain of command to cease reactor activities when permitted operations fail to meet required safety or technical standards or when ongoing conditions pose an unacceptable risk. Suspension ensures that any nonconformance or hazard is immediately mitigated, followed by formal review and resolution before operations resume.

The ARP's suspension process outlined in the draft revision of AR 50–7 is aligned with the NRC enforcement and licensing authority under 10 CFR 50.100, 10 CFR 50.54(f), and 10 CFR 2.202 and is supported by guidance on safety assessment, enforcement, and corrective action processes.

4.0 Regulatory Oversight

4.1 Overview

Regulatory Oversight is one of the instruments of the overarching regulatory framework described in Section 1.2.3 herein and is consistent with the practices of other nuclear regulators. Regulatory Oversight means that a regulator has unrestricted access to organizations and facilities, as well as certain records and other documents, to evaluate whether overall program objectives are being met. In terms of the Army Reactor Program, this means that the Army Reactor Office is granted unrestricted access to all organizations and facilities conducting activities in support of the program, and based on this unrestricted access the regulator is able to determine whether those activities are meeting the Army Reactor Program Objectives.

Beyond ensuring compliance, the Regulatory Oversight instrument codifies a culture of self-assessment within the ARP. Ideally, individual stakeholders can identify and correct issues, making reports as required, without regulator involvement or intervention. The required Internal Reactor Audit and Internal Training Audit are a first step in creating a culture of rigorous self-assessment within the ARP. Finally, the draft DA PAM provides background discussion on the role oversight plays within the ARP. Oversight of Organizations Conducting Reactor Operations

In the 2016 AR 50–7, there is a regulatory oversight activity called an “Annual Operational Review.” This concept has been retained in the draft AR 50-7 and DA PAM but significantly expanded upon. The draft AR 50–7 provides detailed information on the areas evaluated during oversight. The draft DA PAM provides a description of the purpose and philosophy of regulatory oversight in general.

4.2 Oversight of Organizations Conducting Training and Qualification Activities

In the field of nuclear operations, safety is achieved in part by mitigating risks before issues arise. Since many, if not most, nuclear facility issues involve human error, minimizing human factor errors is a priority. This is accomplished by implementing a comprehensive and thoughtful program for recruiting, accessing, training, qualifying, and retaining highly qualified personnel. It also requires maintaining a high level of knowledge throughout their service and periodically validating their performance. The training and qualification program must be rigorous to ensure all nuclear-trained personnel understand the consequences of every action they perform.

The 2016 AR 50–7 describes a process by which the regulator certifies and issues certification letters to each qualified nuclear-trained operator. This includes Reactor Operators (ROs), Reactor Leaders (RLs), and presumably any other nuclear-trained operating position. For the draft AR 50–7, the envisioned scope of the ARP is much larger and includes more operating reactors and many more nuclear-trained personnel. To support such a program, the regulatory approach for training and qualifications was adjusted to meet this larger scope.

Instead of certifying and issuing certification letters to each nuclear-trained operator, the regulator performs the following actions:

- Reviews and certifies the “Training and Qualification of Operation and Support Personnel” supporting program.
- Reviews changes to the supporting program as required.
- Conducts regulatory oversight of training organizations to ensure that they remain in compliance with the supporting program.
- Conducts regulatory oversight of operating organizations to ensure that nuclear-trained operators conduct safe reactor plant operations and maintain a high level of knowledge.

- Provides requirements for the maintenance of qualifications for nuclear-trained personnel (draft DA PAM, Chapter 7). This includes the requirement for a continuous training program, periodic examination and performance evaluations, and biennial requalification. It also provides a process for decertifying operating personnel (temporarily or permanently) when necessary.
- Additionally, the regulator should maintain close alignment with the Army Human Resources Command (HRC) and Office of Personnel Management (OPM) with respect to recruitment and accession requirements for nuclear-trained personnel. The investments made to train and qualify nuclear operators is significant, and the regulator has a vested interest in the community management of these personnel.

This broader approach to personnel management for nuclear operations personnel, which includes training and qualification, allows the regulator to validate that ARP objectives are met without the need to certify each individual operator. This approach is consistent with other nuclear regulatory frameworks.

4.3 Oversight of Army Organizations Providing Supporting Functions

In addition to providing oversight of reactor operations and training, the ARO is authorized to provide Regulatory Oversight to a variety of supporting functions. As the program grows and evolves, new areas will be identified that will necessitate regulatory oversight, and this section provides a place to list those additional areas. This is consistent with the practices of other nuclear regulators, who must oversee a broad scope of facilities, organizations, and contributing functions.

4.4 Theater ARO Representative Office

With the vision of a worldwide-deployable fleet of mobile nuclear power plants, in addition to fixed installation-energy power reactors, the regulator may often need to be in many places at once. Similar to NRC resident inspectors (NRC 2024o) and the Naval Reactors Representative Office, the ARO is authorized to develop “forward deployed” regulatory elements.

One method to “send regulators forward” is to leverage the existing system of Geographic and Functional Combatant Commanders and assign ARO representatives to those Commanders as necessary. This is the method described in the draft AR 50–7 and draft DA PAM.

An alternate method would be to simply assign ARO representatives to the installations and deployed locations where the Army is operating reactors. If a specific battalion is chartered to maintain, train, and equip personnel to conduct power reactor operations, then an ARO representative could be stationed on the installation where this battalion resides.

5.0 Required Reports

5.1 Overview

Required Reports facilitate early identification and awareness of safety problems or problems that other nuclear power plant units or facilities might experience. Defining Required Reports as one of four regulatory instruments is an approach that is novel in the realm of nuclear power, giving reports the same standing as programs, permits and regulatory oversight. The overall goal of this regulatory instrument is to pool as many operational reports as possible into one section, reducing the need for field operators to manage the various reporting requirements of different programs, permits, and other regulatory instruments. Using commercial and Naval nuclear operating experience, these requirements are assembled to create an overall picture of annual, quarterly, and more frequent reports related to the operation of equipment and conduct of personnel. The advantage of this focused approach to reporting is to take the burden out of real-time decision-making and streamline plant operating procedures.

Effective operational reporting for the ARP is crucial to ensure safety, compliance, and operational efficiency. With consistent and clear reporting, the comparability of operational routines and practices can be evaluated over time. There are three main reasons for reporting: 1) feedback of equipment, system, and personnel during operation; 2) administrative communication; and 3) informing the regulator of your status.

The dynamic nature of nuclear operations demands real-time monitoring and sometimes immediate or automatic feedback. Data accuracy and integrity are critical to monitor and alert for unsafe conditions, violations, or inefficiencies. Establishing effective reporting requirements promotes potential improvements to plant design, long-term trending, predictive maintenance, human factors, and corrective action. In many cases, reporting processes must adhere to Army and national standards and requirements, including for worker safety, radiation safety, environmental control, and emergency preparedness. Reporting requirements set an important tone in communicating to other Army audiences and other outside organizations and regulating bodies.

5.2 Primary References

The NRC's reporting process is primarily contained within the reactor oversight process. Performance is monitored and tracked through the use of performance indicators (PIs) and guidance contained in NEI 99-02 Rev. 7, *Regulatory Assessment Performance Indicator Guideline* (NEI 2013). PIs are "a quantitative measure of a particular attribute of licensee performance that shows how well a plant is performing when measured against established thresholds. Licensees submit their data quarterly; the NRC regularly conducts inspections to verify the submittals and then uses its own inspection data plus the licensees' submittals to assess each plants performance." The general approaches of data collection, monitoring, and reporting are similar to those found in this joint NRC/NEI guidance for the reactor oversight process.

6.0 Nuclear Safety Design Criteria and Requirements

6.1 Overview

This chapter outlines the basis for the nuclear safety design criteria and requirements essential for nuclear facilities to achieve the objectives detailed in Section 1–32 of the revised AR 50–7.

Global nuclear regulators establish general or principal design criteria as foundational safety and performance requirements that guide the overall design of a nuclear facility and the totality of the criteria to ensure safe operating conditions and prevent or mitigate the consequences of accidents, thereby protecting workers, the public, and the environment from radiation hazards.

Most existing regulation frameworks focus on large, thousands-of-megawatts nuclear power plants, primarily LWRs in the United States, with some international emphasis on heavy water and gas-cooled reactors. For advanced microreactors, the Nuclear Safety Design Criteria have been derived from existing NRC requirements and adaptable guidance for new technologies. This includes established industry positions, NRC regulations and white papers, the IAEA requirements, and guidelines from national regulators such as those in Canada and the UK.

Due to the evolving nature and volume of relevant documents, not all can be individually listed here. However, the subsequent sections will further identify the specific documents considered in the development of the revised draft AR 50–7 and associated DA PAM. The size limitation of 50 megawatts electric in AR 50–7 and draft DA PAM aligns with the regulation of microreactors as defined in various statutes and is consistent with the authorized power levels of research and testing reactors operating worldwide (~100 MWth).

The following key documents have been integral to the development of this regulation:

- **NRC Regulations 10 CFR Part 50 and Part 52**
- **Regulatory Guide 1.232, *Guidance for Developing Principal Design Criteria for Non-Light-Water Reactors* (NRC 2018d)**
- **IAEA SF-1, *Fundamental Safety Principles: Safety Fundamentals* (IAEA 2006)**
- **IAEA's Specific Safety Requirements (SSR) No. SSR-2/1 (Rev. 1) (IAEA 2016c)**
- **IAEA's SSR No. SSR-3**, which establishes requirements for the safety of research reactors (IAEA 2016d)
- **IAEA-TECDOC-1570, *Proposal for a Technology-Neutral Safety Approach for New Reactor Designs* (2007)**
- **ANSI/ANS 53.1-2011, *Nuclear Safety Design Process for Modular Helium-Cooled Reactor Plants* (ANSI/ANS 2011)**
- **Canadian Nuclear Safety Commission RD-367:** *Design of Small Reactor Facilities* 3.1-3 **(CNSC 2014)**
- **United Kingdom's Office for Nuclear Regulations, Technical Assessment Guides, Design Safety Assurance and Licensing Nuclear Installation Documents (ONR 2025).**

6.2 Reactor Safety Objective

Nuclear regulators play a critical role in ensuring that nuclear plants are operated safely by the licensee and that their designs are thoroughly vetted and approved. Central to a regulator's mission is the protection of people and the environment. By reviewing plant designs, regulators verify that SSCs are appropriately implemented and will remain functional during and after design-basis accidents, thus preventing or mitigating accident consequences. Key references supporting these principles include the

NRC Mission Statement, the IAEA's SF-1, *Fundamental Safety Principles,* Chapter 2, "Safety Objective" (IAEA 2006); and the CNSC's RD-367, *Design of Small Reactor Facilities* (CNSC 2014).

Nuclear regulators and regulatory groups worldwide emphasize reactor safety objectives, ensuring that all nuclear reactor designs meet three fundamental safety functions during significant abnormal events: halting the fission chain reaction, maintaining adequate cooling of the nuclear fuel, and preventing the release of radioactive materials into the environment. For Army-based microreactors, an additional key function is protection against direct radiation hazards, reinforcing the objective of radiation protection. These principles align with advanced reactor safety goals, as detailed in *Approaches for Expediting and Establishing Stages in the Licensing Process for Commercial Advanced Nuclear Reactors (NRC 2019a)*, and are consistent with the IAEA's SF-1 (IAEA 2006), as well as IAEA SSR-2/1, *Safety of Nuclear Power Plants: Design (IAEA 2016c)*.

The Nuclear Energy Innovation and Modernization Act of 2019 (P.L. 115-439) and the Consolidated Appropriations Act of 2021, Public Law 116-260, Division D—Energy and Water Development and Related Agencies Appropriations Act, 2021, Title III—Department of Energy (commonly referred to as the "Energy Act of 2020") (P.L. 116-260) define "advanced nuclear reactors" as fission reactors offering significant improvements over reactors operating at the time of their enactment, including additional inherent safety features. The IAEA characterizes advanced designs as those demonstrating substantial improvements over existing commercial power reactors. Furthermore, the NEI document *Micro-reactor Regulatory Issues* (NEI 2019a) underscores the integration of passive features and the minimization of reliance on electric power and operator actions to achieve higher safety levels, which are expected to be standard in advanced reactor designs.

The concept of analyzing severe accidents and design extension conditions is addressed in IAEA and Canadian regulations and parallels the NRC's approach to Severe Accident Mitigation Design Alternatives. This methodology is used to minimize the potential for very low probability severe accidents.

Primary materials and references evaluated during the development of the Reactor Safety Design Criteria and requirements included:

- ***Why the Unique Safety Features of Advanced Reactors Matter* (National Academy of Engineering Website) (Reyes et al. 2020)**
- ***Advanced Nuclear Reactors: Technology Overview and Current Issues*, (CRS 2023)**
- ***Safety of Nuclear Power Reactors*, World Nuclear Association (WNA 2024)**
- **NEI 18-04, *Risk-Informed Performance-Based Guidance for Non-Light Water Reactor Licensing Basis Development (NEI 2019b)*.**

6.3 Normal Operations and Anticipated Operational Occurrences

In reactor design, normal operations and anticipated operational occurrences (AOOs) are expected events that designs must withstand without causing significant damage or leading to accidents. The rationale for developing and selecting the radiological dose acceptance criteria for these conditions is detailed in the *Basis for Dose and Reactor Safety Design Criteria for Army Regulation AR 50–7/DA PAM* (Lowry and Thomas 2025).

6.4 Design-Basis Accident Dose to Receptors

In reactor design, design-basis accidents are postulated events used to establish the safety boundary for reactor operation. The Army's safety approach emphasizes that the reactor must meet dose limits using passive and inherent design features. This ensures a high degree of reliability in accident mitigation, independent of operator intervention, consistent with modern safety design principles and minimizing reliance on human performance during high-stress conditions.

The regulations ensure that Army nuclear facilities are designed to withstand design-basis accidents without exceeding established radiation dose thresholds for any identified receptor group. The use of passive and inherent safety features, the exclusion of operator actions from a credited safety response, and the alignment with other regulatory bodies' dose criteria reflect a rigorous, conservative approach to reactor safety and public and worker protection.

The rationale for developing and selecting the radiological dose acceptance criteria for these conditions is detailed in the draft *Basis for Dose and Reactor Safety Design Criteria for Army Regulation AR 50–7/DA PAM*.

6.5 Beyond Design-Basis Accident Dose to Receptors

The dose criteria outlined in the draft DA PAM for beyond design-basis accidents represent a higher tier of exposure thresholds relative to the design-basis accidents and AOOs while acknowledging the low likelihood but potentially higher consequences of these events. These criteria ensure that even under severe conditions, radiation doses remain within ranges that protect public health and support emergency response planning.

The requirement to practically eliminate conditions that could lead to large, early releases of radioactive materials is a fundamental expectation in global regulatory frameworks. This principle ensures that even severe accidents unfold slowly enough to allow for the implementation of protective actions, such as sheltering or evacuation, and that the risk of prompt, uncontrollable radiological release is minimized to a vanishingly small level.

The reactor design must provide sufficient time and flexibility for protective measures to be effective without requiring extensive or immediate interventions. This reinforces the Army's commitment to safeguarding public health while maintaining manageable emergency response postures.

The rationale for developing and selecting the radiological dose acceptance criteria for these conditions is detailed in the draft *Basis for Dose and Reactor Safety Design Criteria for Army Regulation AR 50–7/DA PAM*.

6.6 Nuclear Defense in Depth

Nuclear plants are designed under a defense-in-depth safety approach to prevent and mitigate accidents and releases of radiation. The key is creating multiple independent and redundant layers of defense to compensate for potential human and mechanical failures so that a single layer, no matter how robust, is exclusively relied upon. A defense-in-depth approach includes the use of access controls, physical barriers, redundant and diverse safety equipment, and emergency response measures.

Nuclear defense in depth is demonstrated through a combination of conservative design and analyses, redundancy, independence, and diversity.

The NRC's regulatory framework incorporates defense in depth as a core concept, with many regulations designed to support it. An extensive NRC report reviews the history of this concept within NRC regulations, highlighting the absence of explicit defense-in-depth characterization as found in SSR-2/1, Rev 1 (IAEA SSR-2/1 2016). The Three Mile Island (TMI) lessons learned report, NUREG-0578, notes that the General Design Criteria in Appendix A to 10 CFR Part 50 specify the systems' functions and general characteristics to ensure defense in depth (NRC 1979). Supplementary materials considered during development included:

- **INSAG-10, *Defence in Depth in Nuclear Safety* (Nuclear Safety Advisory Group) (IAEA 1996).**
- **NRC definition and Practice.**

- **Regulatory Guide 1.174 Rev. 3, *An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis* (NRC 2018b).**
- **Branch Technical Position 7-19, *Digital Instrumentation and Control Systems for Defense-in-Depth and Diversity (D3)*.** This document assists in assessing the adequacy of D3 measures to address potential common-cause failures due to latent design defects (NRC 2024c)(ML24005A115).
- ***Safety and Security Defense-in-Depth for Nuclear Power Plants* (Clark and Rowland 2021)**.
- ***Implementation of Defense-in-Depth at Nuclear Power Plants* (NEA 2016)**.

6.7 Key Safety Functions

Key Safety Functions (also called Fundamental Safety Functions) are generally agreed upon expectations required to provide comprehensive coverage of the nuclear facility functions for a spectrum of reactor types and technologies under normal operations and accident conditions. A safety evaluation of a specific technology may identify the need to revise the definitions or add to the list of Key Safety Functions. The need for and bases of the changes or additions to these functions would be clearly documented in the safety analysis and accepted in a Safety Evaluation Report.

Key Safety Functions employ engineered safety features, natural phenomena, and accident procedures to shield the public and the environment from ionizing radiation. Designers must implement measures to

- prevent abnormal operations and system failures
- control abnormal operations and detect failures to avert worsening plant conditions
- manage accidents within the design basis
- limit core damage and maintain confinement of fuel and fission products
- minimize radionuclide release to ensure doses to individuals remain within acceptable limits.

The Key Safety Function “Control of Reactivity” addresses the need that reactor designers incorporate systems to control the core reactivity under normal, abnormal, and emergency conditions. The use of control rods, coolant flow control systems, reactor protection systems, poison/neutron absorbers, core geometry, and other physical, mechanical, and electrical support systems contributes to the performance of the Key Safety Function.

The Key Safety Function “Cooling of Radioactive Materials (Core Heat Removal)” addresses the need that reactor designers incorporate systems to provide cooling to the core under normal, abnormal, and emergency conditions. The inherent nature of nuclear reactors requires the cooling of the core even when the reactor is not generating electricity or process heat. The use of additional or a different coolant driven by natural phenomena or electromechanical systems to remove heat generated by fission or radioactive decay contributes to the performance of the Key Safety Function.

The Key Safety Function “Confinement of Radioactive Materials” addresses the need that reactor designers incorporate systems or leverage natural phenomena to prevent the release of radioactive materials under normal, abnormal, and emergency conditions.

The Key Safety Function “Shielding Against Radiation” addresses the need that reactor designers incorporate SSCs to provide shielding against radiation exposures to members of the public and Army personnel under normal, abnormal, and emergency conditions.

Additional sources used to support the development of the requirements were:

- **SSR-2/1 Rev. 1, *Safety of Nuclear Power Plants: Design* (IAEA 2016c)**
- **SECY 18-0096: *Functional Containment Performance Criteria for Non-Light-Water-Reactors* (NRC 2018c)**

- ***Technology Inclusive Content of Application Project for Non-Light Water Reactors: Definition of Fundamental Safety Functions for Advanced Non-Light Water Reactors* (DOE 2019c)**.

6.8 Design Criteria

Nuclear regulators require demonstration that the design and subsequent operation of the facility can meet the safety requirements, dose acceptance criteria, and safety goals.

Design criteria and requirements are established to demonstrate these objectives:

- As part of implementing DoDI 5000.88, *Engineering of Defense Systems (DoD 2020d),* SSCs are required to be designed to meet reliability, availability, and maintainability program requirements developed in accordance with AR 702–19, P*roduct Assurance Reliability, Availability, and Maintainability* to maximize operational readiness and assure mission accomplishment while minimizing maintenance manpower cost and logistic support cost (Army 2024e).
- As part of implementing DoDD 5000.1, *The Defense Acquisition System* (DoD 2020b), human systems integration is required to be implemented in accordance with AR 602–2, *Human Systems Integration in the System Acquisition Process* (Army 2022), to optimize total system performance and ensure that the system is designed, operated, and maintained consistent with mission requirements.

All nuclear regulators mandate safety assessments, which can be deterministic or probabilistic. These assessments must show that key safety functions are achieved, with SSCs classified by their importance. Various SSC classification methods have been proposed based on regulatory frameworks. The classifications provided align with MIL-STD-882E, *System Safety* (DoD 2023b), where SSCs are categorized by their importance to safety and risk. Nonetheless, other methodologies agreed upon in the Regulatory Tailoring process may also be utilized.

Where indicated, SSC safety classifications within the Reactor Safety Design Criteria (RSDC) apply to that level and all higher classifications. For instance, if a design criterion specifies "Safety-Significant SSCs," it applies to SSCs classified as Safety-Significant, Safety-Related, and Safety-Critical.

The following references informed the development of the dose criteria and RSDCs:

- **AR 385–10, *Army Safety and Occupational Health Program* (Army 2023e)**
- **NRC Regulations in 10 CFR Part 20**
- **NRC Regulations in Appendix A to 10 CFR Part 50, *General Design Criteria***
- **Regulatory Guide 1.232, *Guidance for Developing Principal Design Criteria for Non-Light-Water Reactors*,** which applies the GDC to modular high-temperature gas-cooled reactors (MHTGRs) (Advanced Reactor Design Criteria [ARDC] and MHTGR design criteria (MHTGR-DC)) (NRC 2018d)
- **SSR-2/1 Rev. 1, *Safety of Nuclear Power Plants: Design* (IAEA 2016c)**
- **IAEA-TECDOC-1936, *Applicability of Design Safety Requirements to Small Modular Reactor Technologies Intended for Near Term Deployment Light Water Reactors: High Temperature Gas Cooled Reactors* (IAEA 2020a)**
- **ANSI/ANS 53.1-2011, *Nuclear Safety Design Process for Modular Helium-Cooled Reactor Plants* (ANSI/ANS 2011).**

7.0 Standard Operating Requirements

7.1 Overview

As one of the prominent life-cycle functions within the ARP, safe day-to-day operations require special regulatory attention. This chapter provides consistent, foundational, program-wide regulations for all Army reactors. This ensures that all reactors are operated in a manner that is familiar to anyone associated with the ARP. Regardless of whether the reactor is being used for installation power or expeditionary energy, there is a common set of day-do-day operating requirements for these systems. Senior Army leaders will be able to read Chapter 7 of the draft revised AR 50–7 and draft DA PAM and immediately understand the fundamental requirements for these systems. This is consistent with the day-to-day requirements of other nuclear regulatory programs.

7.2 Ultimate Responsibility for Safe Operations

Safe reactor plant operations are the cornerstone of any nuclear operations program. To achieve this objective, clear and unambiguous responsibility for reactor safety is a foundational principle found in all nuclear regulatory frameworks. For the Army Reactor Program this principle is upheld through a defined chain of command or authority in which the Senior Reactor Leader (SRL) holds the ultimate responsibility and operational authority for reactor safety at all times. This model ensures that the person with direct operational control is also the individual accountable for maintaining safety, consistent with military command doctrine and nuclear regulatory standards.

By establishing the SRL as the ultimate authority for reactor safety and the ARO as the regulatory oversight body, the ARP reflects global regulatory norms and core military principles of clear command responsibility, operational discipline, and safety ownership. This structure supports both the technical rigor and leadership accountability needed to maintain nuclear safety across divers Army missions and reactor platforms.

7.3 Administrative Command Organization

A clearly defined and disciplined administrative command organization is essential to the safe, secure and effective operation of Army nuclear reactors. The ARP assigns responsibilities for key reactor functions—safety, radiation protection, training, deployment, and continuous oversight—to designated personnel within the chain of command to ensure operational control, regulatory compliance, and mission alignment. The administrative command organization ensures that these personnel are qualified with clear authority and accountability, consistent with global nuclear regulatory expectations and military leadership doctrine.

This organizational structure reflects the best practices among global nuclear regulators, including the NRC, DOE, IAEA, CNSC, and Naval Reactors (NR), which all require well-documented and resource management systems for nuclear facilities. These systems demand that roles, responsibilities, authorities, and reporting relationships be established and maintained throughout the life of a nuclear facility.

The ARP administrative command organization requirements mirror the traditional military command structures, where responsibility is clearly distributed, and each role contributes to mission execution, discipline, and accountability. The Commander or Facility Director maintains ultimate responsibility, much like a unit command holds responsibility for combat readiness and troop safety.

7.4 Operating Command Organization

The operating command organization of the ARP established a clear, hierarchical structure of authority, responsibility, and technical oversight for the day-to-day operation, maintenance, radiation safety, and power production of Army reactors. Each position within this structure from the SRL to the RO is defined by specific duties and reporting relationships, ensuring that nuclear operations are conducted with precision, accountability, and safety ownership.

This organizational model aligns with the expectations from global nuclear regulatory bodies, including the NRC in NUREG-0800 Chapter 13.1 *Operating Organization* (NRC 2016b), DOE O 422.1, *Conduct of Operations* (DOE 2010a), IAEA SSR-2/1 *Safety of Nuclear Power Plants, Requirement 3* (IAEA 2016c), CNSC REGDOC-2.1.1 *Management System* (CNSC 2019), and the UK Office for Nuclear Regulation (ONR 2025). These organizations emphasize that safe and reliable nuclear operations require a well-defined and competent operating staff, with roles, qualifications, authorities, and responsibilities clearly established and embedded in the operational licensing framework.

The operating command organization is rooted in the core principles of Army leadership and mission command. This structure reflects:

- **Unity of Command:** Every operator has a clear reporting path from RO to RL to SRL to Commander.
- **Disciplined Initiative:** Reactor personnel are trained to respond swiftly and correctly in accordance with their roles and procedures.
- **Defined Accountability:** Like military unit structures, each position has mission-critical duties, contributing to safe, secure, compliant, and effective use of nuclear technology.

The operational command organization ensures that each reactor system is operated, maintained, and overseen by a qualified, disciplined, and accountable team, reflecting both global nuclear safety expectations and Army command principles.

7.5 Supporting Teams

The ARP establishes specialized supporting teams to execute key technical, logistical, and environmental responsibilities in support of reactor siting, operation, transport, and closeout. These teams provide subject matter expertise and operational support across the full life cycle of Army reactor operations.

This team-based approach reflects global best practices among nuclear regulatory bodies, such as the NRC, DOE, IAEA, CNSC, and ONR. These regulators emphasize that safe and compliant nuclear programs require not only operator-level responsibilities, but also dedicated expert support for radiological protection, environmental monitoring, transportation, decommissioning, and emergency preparedness.

The creation of centralized, deployable technical support teams is consistent with long-standing Army doctrine for technical enablers. These teams provide:

- reach back support for fielded units
- dedicated subject matter expertise that cannot be sustained at the unit level
- standardized processes and response coordination across Army command.

This structure ensures that Army reactor operations can be conducted anywhere in the world, with technical depth and regulatory confidence, while maintaining accountability, mission alignment, and life-cycle stewardship across every phase of Army nuclear activity.

7.6 Operating Modes

The designation and control of operating modes is a foundational element of the technical specifications governing the safe and compliant operation of Army reactors. Operating modes define the distinct operational states of a nuclear facility, with each mode having tailored safety, staffing, monitoring, containment, shielding, and decay heat management requirements. This framework ensures that reactor systems are operated within clearly defined safety envelopes, consistent with their design basis for each operational state.

The ARP aligns this approach with other regulatory bodies and uses limiting conditions for operation (LCOs) and operating modes, and guidance issued by regulatory agencies (e.g., 10 CFR 50.36, *Technical Specifications* and NUREG-1431, *Standard Technical Specifications - Westinghouse Plants*, Revision 5, Vol 1 (ML21259A155).

The operating modes are defined in the design permit application based on the design-specific safety parameters. Each mode is mutually exclusive and clearly delineated to avoid any overlap. The use of modes allows for variations in and graded approaches for:

- **Staffing:** Defines the minimum personnel, qualifications, and responsibilities for each mode.
- **Monitoring:** Specifies parameters to be tracked and limits for safe operation.
- **Containment:** Mode-dependent requirements for integrity and isolation systems.
- **Shielding:** Adjusts physical barriers to reflect radiation levels in each mode.
- **Decay heat management:** Ensures cooling systems are configured to remove residual heat post-shutdown.

A graded approach for applying security and emergency management measures ensures appropriate readiness without unnecessary burden.

7.7 Nuclear Reactor Accidents

The ARP employs a structured framework for the transition from standard operations to emergency operations using emergency operating procedures (EOPs) to ensure prompt, safe, and effective response to reactor transients and accidents. This transition is guided by pre-established entry conditions, ensuring that key safety functions are preserved or restored and that the reactor is brought to a safe and stable state. International and national standards considered for this section include:

- SRS-48 *Development and Review of Plant Specific Emergency Operating Procedures* (IAEA)
- NRC 10 CFR 50.34(b)(6)(ii), *Final safety analysis report*
- DOE O 422.1, Ch 4, *Conduct of Operations*

The EOPs are plant-specific procedures (design-specific) to guide the operating staff's actions during transients and accident conditions, ensuring

- protection of the reactor core and containment
- restoration and maintenance of key safety functions
- minimization of consequences to personnel, the public, and the environment.

The transition from standard operating procedures (SOPs) to EOPs is a formal, criteria-based process that begins when reactor conditions indicate that a transient or accident is apparent or imminent. This early transition approach aligns with symptom-based response strategies, enabling operators to arrest degradation and prevent escalation.

SOPs govern routine reactor operations under normal and AOOs. The SOPs include procedures for alarm response, abnormal events, and surveillances and are tailored to each reactor's design, systems, and technical specifications.

The transition to EOPs from SOPs is triggered when conditions exceed or threaten to exceed safety limits or protective system set points, and the EOPs provide step-by-step actions to prevent core damage, maintain containment, and manage decay heat. Operators continue to use EOPs until exit criteria are met or directed by the EOPs and may require complementary actions from other procedures as directed from the EOPs.

The transition is based on real-time monitoring of safety parameters, such as the reactor protection system status, system pressures, and radiation levels. Proactively transitioning helps preserve control and prevent safety margin erosion.

All SOPs and EOPs are developed, reviewed, and maintained under the configuration management, record management, and QA programs. These programs and the use of other supporting programs provide consistency with technical specifications and safety analyses, as well as training and qualification of operators on EOP use and transition criteria.

The ARP framework for EOPs ensures disciplined, timely responses to reactor upsets, aligns with other regulatory bodies' requirements, and provides accident management and safety assurance. By defining clear transition criteria, maintaining procedural quality, and focusing on key safety function restoration, the ARP upholds operational readiness, safety, and regulatory alignment across all reactor sites.

(Note: The draft AR 50–7 Chapter 7 ends with the Transition to Emergency Operations. The following section provides a regulatory basis for additional considerations important to the safe operation of a nuclear facility that appear in the draft DA PAM).

7.8 Continuous Training Program Elements for Army Reactor Units

This section of the draft DA PAM is distinct from the supporting programs described in Chapter 2. The "Training and Qualification of Operation and Support Personnel Program" described in Section 2.4 is specifically for initial training and qualification. Following initial recruitment, accession, and indoctrination, personnel assigned to the ARP will complete initial training and qualification as specified by the supporting program.

The information in Chapter 7 is specific to continuous training and maintenance of qualifications during operations. Once personnel have completed initial training and qualification, and are assigned to an operating reactor (either a fixed installation power reactor or an organization that operates deployable reactor systems), they will follow the requirements as specified in Chapter 7 of the draft DA PAM.

The ARP approach to continuous or continuing training ensures that nuclear facility personnel remain:

- current with their qualifications
- capable of responding to plant transients and abnormal events
- aligned with updated procedures, safety basis documentation, and mission objectives.

The purposes of continuing training are to

- maintain and strengthen personnel competencies
- address changes in plant design, procedures, regulations, or mission
- prepare staff for abnormal events, transients, and emergencies
- ensure compliance with safety and operational expectations over time.

The ARP requires that all permitted nuclear facility operations be conducted safely, reliably, and compliant with environmental regulations. Hence, all permitted certified operators, maintenance personnel, and key support staff participate in a structured continuing training program that includes refresher modules, performance-based drills, and recertification assessments.

Similar requirements for the continuous training and qualification program appear in other DA regulations and other national level regulatory frameworks, including DOE, NRC, IAEA, CNSC, and Navy.

The continuous training program elements integrate with other Supporting Programs:

- the Training and Qualifications of Operations and Support Personnel
- the Configuration Management Program, to track and train on physical and procedural changes
- the Records Management Program, to maintain documentation of training activities and qualifications
- the Quality Assurance Program, to ensure systematic delivery, evaluation, and improvement of training processes.

The regulatory bases for these programs also provide the basis for continuous training program elements.

8.0 Refueling, Decommissioning, and Termination of Permits

8.1 Overview

The end point of an operational cycle can lead to several outcomes such as defueling, refueling, deactivation, or decommissioning. Chapter 8 of this version of the revised draft AR 50–7 is intended to provide direct or supplemental requirements for each of these end points that do not specifically fall into other chapters.

8.2 Deactivated Nuclear Facility Possession Permit

The Army currently regulates two deactivated reactors, SM-1 at Fort Belvoir and SM-1A at Fort Greely. The current version of AR 50–7 (2016) applies to these two reactors and the Fast Burst Reactor, operated by the Army Testing and Evaluation Center at White Sands Missile Range. SM-1 and SM-1A ceased operations in the early 1970s and were held under deactivated reactor facility possession permits prior to initiating decommissioning activities. These reactors have since transitioned to decommissioning permits, but the previous permitting of "deactivated" locations remains pertinent to the current version of the AR.

The concept of deactivation has been considered by other regulatory bodies. Both the IAEA and NRC define a concept of deferred dismantlement. This concept, defined as SAFSTOR by the NRC, is a long-term storage condition for a shutdown nuclear reactor that has had nuclear fuel removed. This allows a decrease in the safety posture for the location but allows for retention of facility control prior to a decision to begin decommissioning. Ultimate decommissioning of a nuclear facility and its related operational location will always occur when it has been determined that a location is surplus to energy requirements or the facility has reached the end of its designed operation.

This concept is directly applicable to locations that use modular, mobile, or transportable reactors that can have some or all of the power plant be removed or replaced from an operational location without full radiological release of the location. Downgrading requirements when nuclear material is not present, but continuing monitoring and other programs does not preclude reverting requirements to higher levels when a new reactor is delivered to the location for operations.

Additional discussion for the basis of this permit can be found in Section 3.12.

8.3 Decommissioning Permit

The SM-1 and SM-1A reactors are currently undergoing various stages of decommissioning. The requirements stated in Chapter 8 of the draft revised AR 50–7 are intended to be consistent with current decommissioning activities and decommissioning best practices. These are informed by NUREG-1575, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* (NRC 2000a), and NUREG-1757, *Consolidated Decommissioning Guidance* (NRC 2022a).

Additional details on the process for confirming readiness for the termination of permits was included due to potential changes in Army reactor use parameters. The potential for use of multiple reactors at a location, either parallel use at multiple sites or serial use at a single site, identified the need to provide additional detail on the type of information needed to provide a technically defensible summary of use at the location.

Additional discussion for the basis of this permit can be found in Section 3.13.

8.4 Disposal of Low-Level Radioactive Waste

The requirement for the disposal of low-level waste is defined in DoDI 4715.27, *DoD Low-Level Radioactive Waste (LLRW) Program* (DoD 2017b). The responsibility for the disposal of Army-generated LLRW is delineated in AR 385–10 as the responsibility of U.S. Army Joint Munitions Command, within the U.S. Army Materiel Command. The waste storage and disposal requirements stated in AR 385–10 should be sufficient for any amount of LLRW generated by the operation of an Army nuclear power reactor.

8.5 Defueling and Refueling

The process of defueling and refueling is covered by operational permits as required in 10 CFR Part 50. These are part of standard operating requirements for stationary nuclear power plants. The inclusion of additional requirements for these activities is intended to identify the required actions for both stationary and transportable reactors.

8.6 Additional Topics in Chapter 8

Requirements related to site closure actions are also stated within Chapter 8. Included are specifics for a site closure report, the disposition of transportable reactors to either a vendor or non-Army organization, and the termination of permits.

The requirements for site closure and the termination of permits are taken from words and actions in the 2016 version of AR 50–7 and actions currently being performed by U.S. Army Permittees. The two reactors being decommissioned are required to submit documentation as part of the decommissioning process that ARO can review and use as justification for approval for releasing radiological controls at a site. The addition of requirements for a site closure report is intended to supply flexibility for the application of requirements at a larger stationary facility and at smaller transportable reactor operational locations.

The addition of requirements related to disposition is due to the potential for a transportable reactor to temporarily leave Army control for refueling or to depart for final decommissioning. Disposition requirements are intended to ensure that complete documentation is available in the event that a transportable reactor is returned to Army regulatory authority. These requirements are similar to the documentation requirements for the disposition of radioactive material licensed by NRC under 10 CFR Part 30, Part 40, or Part 70.

9.0 Transportation System Licensing and Certifications

9.1 Overview

Transportation planning is the consideration of how the Army will move, ship, and deploy a transportable microreactor to support any unknown contingency operation. Transportation planning requires coordination on multiple levels and with additional federal agencies. Chapter 9 in the revised draft AR 50–7 provides details on how the Army should gain approval to transport reactors with the appropriate regulating authority. This chapter also provides considerations for shipping a reactor domestically and internationally using a Transportation Competent Authority.

9.2 Scope of Transportation Systems to be Approved

This section further describes the scope of transportation systems that would be approved and discusses the transport of unirradiated/irradiated fuel, the transport of reactors containing their unirradiated and irradiated fuel, and the storage of radioactive material in transportation containers.

9.2.1 Unirradiated and Irradiated Fuel

The transport of unirradiated and irradiated fuel would entail transportation package approval by the NRC and compliance with U.S. Department of Transportation (DOT) regulations in 49 CFR. DOT regulations include specific requirements for the transport of hazardous material contained in the DOT Hazardous Materials Regulations (49 CFR Parts 171–185) . NRC and DOT regulations contain transportation-mode-specific requirements. For example, shipments of irradiated fuel would likely require compliance with 49 CFR 172.820, colloquially known as the Rail Routing Rule, and air transport of plutonium would require compliance with 10 CFR 71.64 and 10 CFR 71.88. DoD transportation regulations (e.g., DTR 4500.9-R), typically reference NRC and DOT regulations.

Compliance with State transportation regulations may also be required, specifically for oversize or overdimension shipments made by truck, which would require State permitting.

9.2.2 Reactors with Unirradiated Fuel

The transport of reactors containing unirradiated fuel would require transportation package approval by the NRC (see 10 CFR Part 71, especially 10 CFR 71.55, *General Requirements for Fissile Material Packages* and 10 CFR 71.73, *Hypothetical Accident Conditions*), and shipments would be made in compliance with DOT regulations contained in 49 CFR, including the Hazardous Materials Regulations (40 CFR Parts 171–185).

The specific regulatory pathway used for NRC transportation package approval has not been established, and several regulatory pathways could be feasible (e.g., see 10 CFR 71.41(c), 10 CFR 71.41(d), and 10 CFR 71.12).

As mentioned previously, DTR 4500.9-R references NRC and DOT regulations.

9.2.3 Reactors with Irradiated Fuel

The transport of reactors containing irradiated fuel would require transportation package approval by the NRC (see 10 CFR Part 71, especially 10 CFR 71.55, *General Requirements for Fissile Material Packages*; 10 CFR 71.51, *Additional Requirements for Type B Packages*; and 10 CFR 71.73, *Hypothetical Accident Conditions*), and shipments would be made in compliance with DOT regulations contained in 49 CFR, including the Hazardous Materials Regulations (49 CFR Parts 171–185).

The specific regulatory pathway used for NRC transportation package approval has not been established, and several regulatory pathways could be feasible (e.g., see 10 CFR 71.41(c), 10 CFR 71.41(d), and 10 CFR 71.12). A DOT Special Permit may also be required depending on the specific regulatory pathway.

As mentioned previously, DTR 4500.9-R references NRC and DOT regulations.

9.2.4 Storage (in Transport Casks, Staging)

In general, the storage of unirradiated or irradiated fuel in transportation packages would require compliance with 10 CFR Part 71 and 10 CFR Part 72. For example, when a transportation cask is stored, impact limiters are often removed. As a consequence, the transportation cask is no longer in its transport condition, and compliance with 10 CFR Part 72 may be required. In addition, transportation casks are often quite expensive, so storage in transportation casks is often not cost effective.

When transportation casks are staged prior to shipping, it is usually of short duration, and the transportation cask remains in its transport configuration, e.g., with impact limiters installed, and does not pose a regulatory issue.

9.3 Regulatory Structure

9.3.1 Army

DTR 4500.9-R is the primary DoD regulation covering the transport of radioactive material. Part II of DTR 4500.9-R, *Cargo Movement,* contains the following chapters (USTRANSCOM 2024b):

- Chapter 201 - *General*
- Chapter 202 - *Routing*
- Chapter 203 - *Shipper*
- Chapter 204 - *Hazardous Material*
- Chapter 205 - *Transportation Protective Service (TPS) Shipments*
- Chapter 206 - *Bills of Lading*
- Chapter 207 - *Carrier Performance*
- Chapter 208 - *Packaging and Handling*
- Chapter 209 - *Loss & Damage*
- Chapter 210 - *Transportation Discrepancy Report (TDR)*
- Chapter 211 - *Claims*
- Chapter 212 - *Payment System*
- Chapter 213 - *Defense Freight Transportation Services (DFTS)*

Chapter 204, *Hazardous Material*, states that for nonnational security movements, the labeling, placarding, marking, compatibility, emergency response guidance, and other hazardous materials regulations requirements of 49 CFR are applicable to DoD-regulated HAZMAT cargo transported by military or commercially operated conveyances (USTRANSCOM 2025).

9.3.2 DOT

The transportation of hazardous materials is subject to regulation by DOT regulations in 49 CFR. DOT regulations include specific requirements for the transport of hazardous material contained in the DOT Hazardous Materials Regulations (49 CFR Parts 171–185). DOT regulations contain transportation-mode-specific requirements. For example, shipments of irradiated fuel would likely require compliance with 49 CFR 172.820, colloquially known as the Rail Routing Rule. DOT also issues Special Permits for radioactive materials shipments.

DOT regulations apply to transport by interstate, intrastate, and by foreign carriers by rail car, aircraft, motor vehicle, and vessel; shipper's pre-transportation activities to present for shipment a hazardous material in a package, container, rail car, aircraft, motor vehicle, or vessel with accompanying marking, labeling, placarding, and shipping papers; and manufacture, fabrication, marking, maintenance, reconditioning, repairing, or testing of a package or container that is represented, marked, certified, or sold for use in the transportation of hazardous materials.

NRC regulations also include transportation requirements; the delineation of authority between the NRC and DOT is described in an MOU between the NRC and DOT that was published in the *Federal Register* on July 2, 1979 (DOT and NRC 1979).

The document "Radioactive Material Regulations Review" contains a useful summary of DOT and NRC transportation regulations (DOT 2008).

9.3.3 NRC

The primary role for the NRC would be in the area of transportation package approval. NRC transportation package regulations are contained in 10 CFR Part 71. In addition, there is substantial NRC transportation-related guidance contained in NRC Regulatory Guides (NRC 2024p) and SRPs (e.g., NUREG-2216) (NRC 2020d).

As mentioned previously, the specific regulatory pathway used for NRC transportation package approval has not been established, and several regulatory pathways could be feasible (e.g., see 10 CFR 71.41(c), 10 CFR 71.41(d), and 10 CFR 71.12).

The transportation of plutonium by air is subject to more stringent requirements than is the transport of other fissile materials by air. The plutonium air transport regulations are contained in 10 CFR 71.64 and 10 CFR 71.88. The specific requirements are discussed in PNNL (2023).

9.4 OCONUS Considerations

9.4.1 Through Country Transit

Transshipping radioactive material through a country requires approval by the country. This approval is done by the country's Transportation Competent Authority (DOT 2017). The DOT Pipeline and Hazardous Materials Safety Administration (PHMSA) is the U.S. Transportation Competent Authority. In general, transportation package approval by the NRC is advantageous in seeking foreign Transportation Competent Authority approval.

There have been cases where shipments of radioactive material have been denied access to specific ports. For this reason, early planning is key to shipping radioactive material OCONUS.

9.4.2 Certifications

NRC issues certificates of compliance (CoCs) or approval letters for transportation packages of nuclear materials. Organizations that intend to fill the role as the shipper must submit an application to NRC to demonstrate the safety and operational characteristics of the package design. An analysis of Army options for shipping a microreactor assumes that a design would be shipped as a Type AF or BF package. Therefore, a CoC or approval letter would require approval through NRC.

9.4.3 Restrictions and Exemptions

As a condition of transport, compensatory measures may be required. In addition, transportation package approval may be authorized through a 10 CFR 71.12 exemption.

9.5 Additional Reports

Multiple Pacific Northwest National Laboratory (PNNL) reports have been produced, covering the transportation of nuclear materials. The following additional reports provide comprehensive guidance and context to date for the Army's transportation regulatory framework:

- ***Documentation of Applicable Regulations and Regulatory Authority for Microreactor Transportation* (PNNL 29718 Revision 1)** (Maheras et al. 2024). This report provides the Army OCE with information regarding the applicable regulations and regulatory authority for transportation that can be used to provide policy, direction, and oversight for transportable microreactor activities within the Army. The report also summarizes DOT and NRC regulations related to the transportation of Class 7 (radioactive) materials. These sections concentrate on the transport of fissile material packages and Type B packages, which would be most applicable to the transport of a microreactor before and after irradiation. It also emphasizes the DOE hazardous and radioactive material transportation regulations and the DoD hazardous materials regulations and provides requirements for DoD personnel involved in the shipment of radioactive material.
- ***Army Transportation Methodology Report: Planning the Movement of Microreactors* (PNNL-34110)** (PNNL 2023). PNNL and INL collaborated on a report for the Army to provide a transportation methodology and planning considerations for the movement of transportable microreactors. The report highlights the available shipment modes and unique challenges associated with transporting unirradiated and irradiated microreactors domestically. It also considers the transportation risks associated with the movement of SNM that can be used to inform decision-making for Army Senior Leaders. This report also discusses the various transportation modes available to the Army for transporting microreactors. It also highlights the importance of joint military planning operations that support the deploying unit's mission, which is generally defined as the movement of forces within operational areas. This framework is further outlined in joint guidance in the DTR and JPs.
- ***Development and Demonstration of a Risk Assessment Approach for Approval of a Transportation Package of a Transportable Nuclear Power Plant for Domestic Highway Shipment* (PNNL-36380, Revision 1)** (Coles et al. 2024). This report demonstrates how the plan for a hypothetical one-time shipment of a prototype microreactor with irradiated fuel might be implemented. This demonstration of how to implement the plan is intended to be used as a guide or template for the development of a hypothetical risk-informed exemption request to the NRC by the microreactor vendor for a ground surface shipment of a single unit by truck at a maximum frequency of once per year. This methodology was endorsed by NRC's Office of Nuclear Material Safety and Safeguards on October 7, 2024 (NRC 2024b)(NRC 2024).

10.0 Deployment and Redeployment to Support Expeditionary Energy (Mobile Nuclear Power Plants Only)

10.1 Overview

The requirements and guidance developed to support the Army's deployment and redeployment of MNPPs have been based upon processes already well established in JP 3-35 (JCS 2007), AR 525–93 *Army Deployment and Redeployment* (Army 2023a), and ATP 3-35, *Army Deployment and Redeployment* (Army ATP 2023). The additional requirements and guidance outlined in the draft revised AR 50–7 and its associated draft DA PAM focus largely on ensuring that specific roles, responsibilities, and actions specific to nuclear technology have been described due to its unique characteristics with an emphasis on safety. This includes the use of appropriate regulatory instruments (e.g., supporting programs, permits, oversight, and reporting) and regulatory interactions. These measures aim to ensure that all Army reactor program objectives are satisfied during deployment and redeployment activities.

Developing the deployment and redeployment chapters in the updated AR 50–7 and its supporting DA PAM required significant consideration, analysis, and careful selection of every element included. Each document was reviewed with attention to how it could be adapted to military application, and where it could support the novel needs of handling and transporting an operational nuclear reactor. Since MNPP use within the Army is a completely new mission space, the resulting framework had to be comprehensive enough to meet current safety expectations, but flexible enough to evolve with future technologies and mission profiles. This effort reflects the Army's commitment to designing a regulatory model that is both mission-driven and safe, while remaining adaptable to future developments in mobile nuclear energy.

10.2 Background for Deployment and Redeployment

In its inception, the Army Reactor Program evaluated and deployed several mobile reactor designs to provide expeditionary power (Corliss 1968). For example, the ML-1 reactor was an experimental truck-mounted nuclear reactor that was built and operated between 1961 and 1965. The PM-2A reactor, installed and operated at Camp Century in Greenland from 1960 to 1963, was delivered to Greenland in modules by airplane. The MH-1A reactor was barge-mounted on the Sturgis and provided power for the operation of the Panama Canal from 1968 to 1975 (USACE n.d.-a). However, until recently, the Army has not pursued the use of nuclear reactors for expeditionary power.

In 2018, the Army Deputy Chief of Staff G-4 issued a study on the use of *Mobile Nuclear Power Plants for Ground Operations* (Vitali et al. 2018). The study, recognizing that energy will be a critical enabling component for all military operations, realized that nuclear fuel provides the densest form of energy and allows for constant generation of electrical power without the need for continuous resupply. The study also cited multiple studies documenting the significant number of casualties that occurred during Operation Iraqi Freedom (OIF) resulting from hostile attacks on resupply missions associated with the ground transport of liquid fuels to support both ground and air missions in theater.

In 2019, Central Command issued a white paper entitled, *Mobile Nuclear Power Supporting Multi-Domain Capable & Ready Forces* (CENTCOM 2019). In that paper, mobile nuclear energy was viewed as a potential disruptive, leap-ahead technology that could be used to power future energy-intensive weapons systems, produce clean water, possibly produce synthetic fuels for vehicles, and reduce dependencies on supply lines.

While there are many opportunities where nuclear power offers tremendous advantages in terms of large amounts of energy, energy security, and reduced reliance on supply lines, it must also be acknowledged that this technology—if used in a combat theater of operation—would pose a number of risks and challenges. As a result of concerns related to deployment in combat theaters, the requirements written in

AR 50–7 limit initial deployments to SSAs and OSAs, as defined in TRADOC Pamphlet 525-3-1, *The U.S. Army in Multi-Domain Operations* (Army 2018d). This limitation is recommended to be in place until the technology and its associated operational concepts are more fully matured and better understood by the Army.

10.2.1 Key Risks and Challenges

While the Army acknowledges the strategic potential of mobile nuclear power, it must also account for operational risks that arise from integrating nuclear technology into military operations. The development of the draft updates to AR 50–7 and associated DA PAM reflects a careful balance between leveraging MNPP advantages and mitigating their inherent risks.

Security and Safety Risks

- **Radioactive Release:** A direct attack, sabotage, or battlefield damage to an MNPP could compromise reactor containment, leading to potential radiation release. Even minor incidents could force evacuations, restrict operational mobility, and create long-term contamination risks.
- **Core Cooling and Fuel Damage:** Nuclear reactors require active cooling and shielding systems. If these systems are disabled in combat, they could lead to reactor overheating, core damage, and possible fuel degradation.
- **Enemy Targeting:** As a high-value military asset, an MNPP could be a primary target for adversaries using precision-guided munitions or asymmetric warfare tactics.

Operational Challenges

- **Logistics and Maintenance:** Nuclear power operations require specialized skills, tools, and procedures that may not be easily available in a combat theater. If a malfunction occurs, repair options may be severely limited.
- **Mobility Constraints:** While MNPPs are designed for deployment, they are not as easily relocatable as conventional power sources. The relocation and logistics effort could require additional equipment not available in theater. Shutdown and cooldown periods introduce time constraints that could limit operational flexibility.
- **Siting in Foreign Lands:** Deploying MNPPs overseas requires extensive coordination with host nations and regulatory agencies. Concerns over reactor safety, environmental impact, and long-term site decommissioning must be addressed before deployment.

Regulatory, Political, and Ethical Considerations

- **International Law Compliance:** Deploying nuclear reactors in foreign combat zones raises legal and diplomatic challenges, particularly under treaties such as the NPT and the standards of the IAEA.
- **Civilian Risk and Public Perception:** Even in noncombat scenarios, deploying nuclear power assets near civilian populations introduces risks and potential reputational damage if an accident occurs.

These risks underscore the necessity of a robust regulatory framework for MNPP deployment, guiding their safe, secure, and effective use in military operations.

10.3 Establishing a Framework for MNPP Deployment and Redeployment

Given the lack of historical precedent for MNPP deployment in modern military operations, the Army needed a structured framework to guide planning, execution, and oversight. This framework was built on existing military and nuclear industry regulations, including

- **AR 525–93, *Army Deployment and Redeployment* (Army 2023a)**, and **ATP 3-35, *Army Deployment and Redeployment* (Army ATP 2023)**, for general mobility procedures
- **FORSCOM Regulation 500-3-3, *FORSCOM Mobilization and Deployment Planning System (FORMDEPS)***, which outlines mobilization and deployment planning, providing a structured approach to the movement of Army assets (Army 1999)
- **JP 3-35, *Deployment and Redeployment Operations***, which offers doctrine on deployment and redeployment, ensuring MNPP integration into larger force projection strategies (JCS 2007)
- **Commercial nuclear reactor safety and siting regulations**, adapted to meet military operational needs
- **Lessons from past military nuclear power programs**, such as
    - the ANPP, which deployed small reactors in Greenland, Antarctica, and the Panama Canal Zone
    - the Naval Nuclear Propulsion Program, which demonstrated safe and mobile nuclear operations aboard ships and submarines.

The resulting updated policy, the draft revised AR 50–7, provides high-level guidance on MNPP deployment, while the draft DA PAM expands upon it with specific implementation procedures. A detailed list of all resources used to develop the framework for MNPP deployment and redeployment can be found in Section 2.20 of this regulatory basis document.

10.3.1 Balancing Regulatory Oversight and Operational Flexibility

Unlike civilian nuclear power, which falls under NRC jurisdiction, military reactors must be operationally flexible. The updated draft AR 50–7 and DA PAM balance safety with mobility by

- minimizing unnecessary regulatory barriers, focusing oversight on key phases (design, commissioning, transport, decommissioning)
- allowing streamlined site permit modifications, enabling rapid adaptation to battlefield conditions
- ensuring predeployment certification rigor, so reactors meet safety standards before they enter an operational theater.

This ensures MNPPs remain mission-ready without unwieldy regulatory constraints.

10.3.2 Deployment Planning

Nuclear reactors come with new hazards and conflicts for the deployment process. Understanding these hazards or restrictions will define where an MNPP can be deployed or sited as part of a standardized deployment process. Current Army deployment planning techniques can be leveraged to incorporate the siting process into base design. This relies on

- **ATP 3.37-10, *Base Camps***, to identify how a deployed reactor, with its hazards and placement restrictions, will integrate into the base layout (Army 2017c)
- **ATP 3-34.5, *Environmental Considerations***, to perform standardized Environmental Baseline Surveys with regards to the pre- and post-impacts of nuclear power operations (Army 2015b)
- **ATP 3-34.45, *Electrical Power Generation and Distribution***, to integrate the power production and distribution requirements into the deployment process to ensure that the energy system can seamlessly integrate at a deployed location (Army and USMC 2024)
- **ATP 4-0.1, *Theater Distribution***, which synchronizes all elements of the transportation logistics process to ensure materiel is distributed to critical deployment locations in theater (Army 2014)
- **ATP 4-10.1, *Logistics Civil Augmentation Program Support to Operations***, which includes regulatory preplanned logistics and general engineering/minor construction support for base sustainment operations (Army 2023f)

- **ATP 4-16, *Movement Control***, which defines movement control process and identifies roles and responsibilities for Army organizations to allocate transportation assets for regulating movements (Army 2024c).

10.3.3 Presidential Approval for Initial Deployments

Given the strategic and political implications of deploying nuclear technology overseas, presidential approval will likely be required for initial MNPP deployments. This is due to

- **Historical precedent:** Every previous military nuclear deployment, including Naval Nuclear Propulsion and Cold War-era Army reactors, required high-level executive authorization.
- **International sensitivities:** Deploying MNPPs abroad involves diplomatic negotiations, host-nation approvals, and compliance with international nuclear treaties.
- **Global policy impact:** Introducing military nuclear reactors into expeditionary operations could set a precedent for other nations, affecting nonproliferation policies and strategic stability.

Initial MNPP operations will require executive authorization to align with national security priorities.

10.4 MNPP Deployments Not Considered

While the revised draft AR 50–7 and its associated DA PAM integrate guidance from multiple nuclear policy documents, some topics were deliberately omitted due to their lack of direct applicability to the MNPP Program. This was done to ensure that policies remain focused on military-specific deployment and operational requirements rather than extraneous regulatory or logistical concerns that would not impact the core mission of expeditionary nuclear power support.

10.4.1 Defense Support of Civil Authorities (DSCA)

DSCA refers to the use of military resources to support federal, State, and local authorities during emergencies, such as natural disasters, terrorist attacks, and other domestic crises. While DSCA is an essential component of military planning for disaster response, MNPPs were not designed for civilian emergency power generation. Unlike commercial backup power sources, MNPPs are engineered specifically to support expeditionary military operations in remote or contested environments, meaning that they lack the logistical framework and operational flexibility required for domestic emergency deployment.

The key reasons for excluding DSCA from MNPP guidance include:

- **DSCA focuses on civilian support, not combat operations.** FORSCOM Regulation 500-3-3 outlines detailed procedures for integrating military assets into civilian emergency response efforts, emphasizing coordination with FEMA and local governments. However, MNPPs are not intended to function as emergency relief power sources—their deployment is tied to military force projection and not domestic crisis response (Army 1999).
- **Regulatory and jurisdictional conflicts.** DSCA operations are typically coordinated with civilian energy authorities and federal emergency agencies, but MNPPs fall under military control, making their integration into DSCA efforts impractical.
- **Operational complexity and security risks.** Deploying nuclear power assets into domestic disaster zones would introduce significant security risks, including potential sabotage, radiological safety concerns, and public opposition. JP 3-35 emphasizes the importance of security and rapid mobility in military redeployment, which would be significantly hindered if MNPPs were subject to the lengthy regulatory approvals associated with DSCA coordination (JCS 2007).

Given these factors, DSCA provisions were excluded from MNPP policy to avoid unnecessary constraints and ensure MNPPs remain dedicated to warfighter support and expeditionary military operations.

10.4.2 Extended Siting Timelines for Fixed Nuclear Plants

Unlike commercial nuclear plants, which undergo multiyear environmental impact assessments and regulatory reviews, MNPPs must be rapidly deployable to support military operations.

The key reasons for streamlining the MNPP siting process include:

- **Expeditionary deployment requirements.** JP 3-35 emphasizes rapid force projection and mobility, meaning MNPPs must be sited quickly and efficiently in austere locations (JCS 2007). Requiring the same environmental reviews, public hearings, and zoning approvals as commercial nuclear plants would delay military operations and reduce strategic flexibility.
- **Minimization of civilian oversight.** Unlike fixed nuclear plants, which are subject to extensive regulatory oversight, MNPPs are self-contained and operated entirely by military personnel. FORSCOM Regulation 500-3-3 outlines streamlined military siting processes that prioritize mission objectives over civilian regulatory concerns (Army 1999).
- **Flexible siting criteria.** Traditional nuclear siting regulations account for long-term environmental impacts, but MNPPs are intended for short-term, mission-specific deployments. This allows the Army to focus on operational security, force protection, and logistical feasibility rather than prolonged regulatory compliance.

By excluding extended siting requirements, MNPP policies maintain the flexibility needed to support rapid, scalable deployments, ensuring nuclear power remains a viable expeditionary energy solution.

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10 CFR Part 20. Code of Federal Regulations, Title 10, Energy, Part 20, "Standards for Protection against Radiation. https://www.ecfr.gov/current/title-10/chapter-I/part-20?toc=1.

10 CFR Part 20 Subpart E. Code of Federal Regulations, Title 10, Energy, Part 20, "Standards for Protection against Radiation," Subpart E, "Radiological Criteria for License Termination. https://www.ecfr.gov/current/title-10/part-20/subpart-E.

10 CFR Part 26. Code of Federal Regulations, Title 10, Energy, Part 26, "Fitness for Duty Programs. https://www.ecfr.gov/current/title-10/chapter-I/part-26.

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Appendix A Terms

Credited Performance – An action or system, structure, and component (SSC) designed to prevent or lessen harmful conditions, the loss of essential safety functions, or accidents, and which was used to demonstrate the safety basis of the facility.

Specified Acceptable Design Limits – Specified acceptable radionuclide release design limits are measures of fuel coating performance. They are used to establish the minimum requirements for fuel coating performance in different reactor designs. Specified acceptable fuel design limits are requirements that ensure certain fuel parameters are not exceeded during normal operation, including the effects of anticipated operation.

Beyond Design-Basis Events – The accident sequences that are possible but were not fully considered in the design process because they were judged to be too unlikely. (In that sense, they are considered beyond the scope of design-basis accidents that a nuclear facility must be designed and built to withstand.) As the regulatory process strives to be as thorough as possible, “beyond design-basis” accident sequences are analyzed to fully understand the capability of a design.

Design Extension Conditions – The postulated accident conditions are not considered for design-basis accidents but **are considered in the design process** for the facility in accordance with best estimate methodology and for which releases of radioactive material are kept within acceptable limits.

Severe Accidents – A type of accident that may challenge safety systems at a level much higher than expected.

Graded Approach – The process of ensuring that the level of analysis, documentation, and actions used to comply with a requirement in this part are commensurate with

- the relative importance to safety, safeguards, and security
- the magnitude of any hazard involved
- the life-cycle stage of a facility
- the programmatic mission of a facility
- the particular characteristics of a facility
- the relative importance of radiological and nonradiological hazards
- any other relevant factor.

Pacific Northwest National Laboratory

902 Battelle Boulevard
P.O. Box 999
Richland, WA 99354

1-888-375-PNNL (7665)

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