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DOE-STD-1146-2001
October 2001

DOE STANDARD

GENERAL TECHNICAL BASE QUALIFICATION STANDARD

DOE Defense Nuclear Facilities Technical Personnel

U.S. Department of Energy
Washington, D.C. 20585

AREA TRNG

APPROVAL

The Federal Technical Capability Panel consists of senior Department of Energy managers responsible for overseeing the Federal Technical Capability Program. This Panel is responsible for reviewing and approving the Qualification Standard for Department-wide application. Approval of this Qualification Standard by the Federal Technical Capability Panel is indicated by signature below.

Chairman
Federal Technical Capability Panel

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ACKNOWLEDGMENT

The Office of Training and Human Resource Development is the Sponsor for the General Technical Base Qualification Standard. The Sponsor is responsible for coordinating the development and/or review of the General Technical Base Qualification Standard by subject matter experts (SMEs) to ensure that the technical content of the standard is accurate and adequate for Department-wide application for those involved in the management of technical personnel or programs. The Sponsor, in coordination with the Federal Technical Capability Panel, is also responsible for ensuring that the General Technical Base Qualification Standard is maintained current.

The following SMEs participated in the development and/or review of this qualification standard:

Howard Pope	National Environmental Training Office
Rich Waite	Idaho Operations Office
Mark Holzmer	Chicago Operations Office
Mark Brown	Office of River Protection
Erik Erichsen	Richland Operations Office
H.M Worrell	Idaho Operations Office

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U.S. DEPARTMENT OF ENERGY
FUNCTIONAL AREA QUALIFICATION STANDARD

FUNCTIONAL AREA:

General Technical Base

PURPOSE

The Department's Federal Technical Capability Program Policy, issued by the Secretary in December 1998, commits the Department to continuously strive for technical excellence. The Technical Qualification Program, along with the supporting Technical Qualification Standards, complements the personnel processes that support the Department's drive for technical excellence. In support of this goal, the competency requirements defined in the Technical Qualification Standards should be aligned with and integrated into the recruitment and staffing processes for technical positions. The Technical Qualification Standards should form the primary basis for developing vacancy announcements, qualification requirements, crediting plans, interviewing questions, and other criteria associated with the recruitment, selection, and internal placement of technical personnel. Office of Personnel Management (OPM) minimum qualifications standards will be greatly enhanced by application of appropriate materials from the Technical Qualification Standards.

The Technical Qualification Standards are not intended to replace the OPM Qualification Standards nor other Departmental personnel standards, rules, plans, or processes. The primary purpose of the Technical Qualification Program is to verify that employees have the requisite technical competency to support the mission of the Department. The Technical Qualification Program forms the basis for the development and assignment of personnel responsible for ensuring the safe operation of defense nuclear facilities.

The General Technical Base Qualification Standard is intended to ensure that all technical employees in the Technical Qualification Program have a common level of core technical knowledge. Functional Area Qualification Standards build on this base knowledge to provide greater knowledge and skills for each individual functional area. Facility/Site Specific Qualification Standards build upon the knowledge and skills of the functional areas and provide the unique knowledge and skills for a functional area at a specific facility or site.

APPLICABILITY

The General Technical Base Qualification Standard establishes common technical competency requirements for Department of Energy personnel who provide assistance, direction, guidance, oversight, or evaluation of contractor technical activities impacting the safe operation of defense nuclear facilities. The General Technical Base Qualification Standard has been developed as a tool to assist program and field offices in the development and implementation of the Technical Qualification Program in their organization. Program and field offices are expected to use the

General Technical Base Qualification Standard as-is, or they may add to it with their own unique office, site or facility specific Technical Qualification Standards. In either case, satisfactory and documented attainment of the competency requirements contained in this Qualification Standard, and supporting Functional Area Qualification Standards, ensures that personnel possess the requisite competence to fulfill their functional area duties and responsibilities.

IMPLEMENTATION

This Technical Qualification Standard identifies the common technical competency requirements for all personnel in the Technical Qualification Program. Although there are other competency requirements associated with the positions held by these personnel, this Technical Qualification Standard is limited to identifying the specific technical competencies. The competency statements define the expected knowledge and/or skill that an individual must possess. Each of the competency statements is further explained by a listing of supporting knowledge and/or skill statements. **The supporting knowledge and/or skill statements are not requirements and do not necessarily have to be fulfilled to meet the intent of the competency.**

The competencies identify a familiarity level, a working level, or an expert level of knowledge; or they require the individual to demonstrate the ability to perform a task or activity. These levels are defined as follows:

Familiarity level is defined as basic knowledge of, or exposure to, the subject or process adequate to discuss the subject or process with individuals of greater knowledge.

Working level is defined as the knowledge required to monitor and assess operations/activities, to apply standards of acceptable performance, and to reference appropriate materials and/or expert advice as required to ensure the safety of Departmental activities.

Expert level is defined as a comprehensive, intensive knowledge of the subject or process sufficient to provide advice in the absence of procedural guidance.

Demonstrate the ability is defined as the actual performance of a task or activity in accordance with policy, procedures, guidelines, and/or accepted industry or Department practices.

Headquarters and Field elements shall establish a program and process to ensure that personnel possess the basic technical competencies required of their position. That includes the competencies identified in this Technical Qualification Standard. Documentation of the completion of the requirements of Technical Qualification Standards shall be included in the employee's training and qualification record.

Equivalencies may be granted for individual competencies based upon an objective evaluation of the employee's prior education, experience, and/or training. Equivalencies shall be granted in accordance with the policies and procedures of the program or field office. The supporting knowledge and/or skill statements, while not requirements, should be considered before granting an equivalency for a competency.

Training shall be provided to employees in the Technical Qualification Program who do not meet the competencies contained in the Technical Qualification Standard. Departmental training will be based upon appropriate supporting knowledge and/or skill statements similar to the ones listed for each of the competency statements. Headquarters and Field elements should use the supporting knowledge and/or skill statements as a basis for evaluating the content of any training courses used to provide individuals with the requisite knowledge and/or skill required to meet the Technical Qualification Standard competency statements.

EVALUATION REQUIREMENTS

Attainment of the competencies listed in this Technical Qualification Standard should be documented by an authorized qualifying official or the individual's immediate supervisor using any of the following methods:

- Documented evaluation of equivalencies
- Written examination
- Documented oral evaluation
- Documented observation of performance

CONTINUING TRAINING

There is no Continuing Training associated with the General Technical Base Qualification Standard.

DUTIES AND RESPONSIBILITIES

There are no Duties and Responsibilities associated with the General Technical Base Qualification Standard.

BACKGROUND AND EXPERIENCE

There are no Background and Experience recommendations associated with the General Technical Base Qualification Standard.

TECHNICAL COMPETENCIES

Each of the competency statements defines the level of expected knowledge and/or skill that an individual must possess to meet the intent of this Technical Qualification Standard. The supporting knowledge and/or skill statements further describe the intent of the competency statements but are not requirements.

Note: ***When regulations, Department of Energy directives or other industry standards are referenced in the Qualification Standard, the most recent revision should be used.***

NUCLEAR FUNDAMENTALS

1. Personnel shall demonstrate a familiarity level knowledge of basic nuclear theory and principles.

Supporting Knowledge and/or Skills

. a. Describe the three forces that are found within a nucleus.

b. Define mass defect and binding energy and discuss their relationship.

c. Describe the following processes, and trace the decay chain for a specified nuclide on the chart of the nuclides.
- Alpha decay
- Beta-minus decay
- Beta-plus decay
- Electron capture

d. Define the following terms:
- Radioactivity
- Radioactive decay constant
- Curie
- Radioactive half-life
- Radioactive equilibrium

e. Describe the following neutron/nucleus interactions:
- Elastic scattering
- Inelastic scattering

f. Compare and contrast capture (absorption), fission, and particle ejection nuclear reactions.

2. Personnel shall demonstrate a familiarity level knowledge of the basic fission process and results obtained from fission.

Supporting Knowledge and/or Skills

a. Explain the fission process utilizing the liquid drop model.

b. Compare and contrast the characteristics of fissile material, fissionable material, and fertile material.

c. Discuss the various energy releases that result from the fission process.

d. Define criticality and explain how it is detected.

e. List five factors that affect criticality.

f. Identify the hazards that result from an unwanted criticality.

g. Explain the double contingency principle as it relates to criticality control.

h. Discuss the potential hazards associated with accidental/unwanted criticality.

3. Personnel shall demonstrate a familiarity level knowledge of radiological controls and theory.

Supporting Knowledge and/or Skills

a. Define ionizing radiation.

b. Describe how nuclear radiation is generated.

c. Describe each of the following forms of radiation in terms of structure, electrostatic charge, interactions with matter, and penetration potential:

- alpha
- gamma
- beta
- neutron (slow and fast)

d. Discuss the types of materials that are best suited for shielding the above radiation types.

e. Describe the biological effects and the primary hazard(s) of each radiation type.

f. Discuss radiation dose and how it is measured including the terms RAD, REM, Roentgen, and international standard units (SI).

g. Define Quality Factor and describe how it is used.

h. Define the term ALARA and describe the basic methods for achieving ALARA.

4. Personnel shall demonstrate a familiarity level knowledge of contamination control and theory.

Supporting Knowledge and/or Skills

a. Define contamination and describe three types of contamination.

b. Describe three ways to control contamination.

c. Describe how contamination is detected.

d. Describe three ways contamination could enter the body and the methods used to prevent internal contamination.

e. Describe the methods used for internal dose determination.

f. Describe the types of personnel protective equipment.

g. Describe the potential effects of radioactive contamination outside of radiation areas.

5. Personnel shall demonstrate a familiarity level knowledge of basic radiation detection methods and principles.

Supporting Knowledge and/or Skills

a. Describe the proper use, function, and radiation detected by different types of Thermoluminescent Dosimeters and Pocket Ion Chambers.

b. State the purpose and function of the following radiation monitoring systems:

- Criticality
- Area
- Process
- Airborne

6. Personnel shall demonstrate a familiarity level knowledge of the requirements documents for radiological control practices, procedures, and limits.

Supporting Knowledge and/or Skills

a. Discuss the purpose and general requirements of 10 CFR 835.

b. Discuss the purpose and general requirements of DOE Order 5400.5, *Radiation Protection of the Public and Environment*.

c. Referring to the DOE-STD-1098-99, *Radiological Control*, locate and discuss the following requirements:

- Access training
- Dose limits
- Posting types and use
- Access requirements

ENVIRONMENTAL MANAGEMENT

7. Personnel shall demonstrate a familiarity level knowledge of the sources and types of radioactive and hazardous waste associated with DOE facilities.

Supporting Knowledge and/or Skills

a. Compare and contrast the material classification criteria for the following:

- Low Level Radioactive Waste
- Hazardous Waste
- Transuranic Waste
- High Level Radioactive Waste
- Mixed Hazardous Waste

b. Describe potential sources for the following types of waste in a DOE facility:

- Low Level Radioactive Waste
- Hazardous Waste
- Transuranic Waste
- High Level Radioactive Waste
- Mixed Hazardous Waste

c. Discuss the various types of storage, treatment and disposal used to manage the following types of waste:

- Low Level Radioactive Waste

- Hazardous Waste
- Transuranic Waste
- High Level Radioactive Waste
- Mixed Hazardous Waste

8. Personnel shall demonstrate a familiarity level knowledge of orders, standards, and regulations related to environmental protection, restoration, and waste management issues.

Supporting Knowledge and/or Skills

a. Discuss the purpose of the following environmental regulations as they apply to the Department and the contractors that operate its facilities:

- National Environmental Policy Act (NEPA)
- National Pollution Discharge Elimination System (NPDES)
- Resource Conservation and Recovery Act (RCRA)
- Comprehensive Environmental Response, Compensation, and Liability Act-SuperfundAct (CERCLA)

b. Using references, discuss the purpose of the following environmental regulations as they apply to the Department and the contractors that operate its facilities:

- Clean Water Act (CWA)
- Clean Air Act (CAA)
- Emergency Planning and Community Right-To-Know Act (EPCRA)
- Federal Facilities Compliance Act (FFCA)
- Pollution Prevention Act of 1990 (PPA)
- Safe Drinking Water Act (SDWA)
- Superfund Amendment Reauthorization Act (SARA)
- Toxic Substance Control Act (TSCA)

c. Using references, discuss the purpose and general requirements of the following DOE Orders:

- DOE Order 5400.1, *General Environmental Protection Program*
- DOE Order 451.1 B (formerly DOE Order 5440.1), *National Environmental Policy Act Compliance Program*
- DOE Order 435.1, *Radioactive Waste Management*

d. Using references, discuss the purpose and applicability of International Standard ISO 14001, *Environmental Management Systems*.

9. Personnel shall demonstrate a familiarity level knowledge of the purpose and content of 29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response*.

Supporting Knowledge and/or Skills

a. Using 29 CFR 1910.120 as a reference, discuss its purpose as it applies to the Department and the contractors that operate its facilities with respect to:

- Cleanup Operations
- Corrective Actions
- Voluntary Clean-up Operations
- Operations Involving Hazardous Wastes
- Emergency Response Operations

b. Using 29CFR1910.120 as a reference, discuss the role of the Department in the identification, assessment, and reaction to potential risks posed by hazardous wastes that exist at Department sites.

10. Personnel shall demonstrate a familiarity level knowledge of potential personal and organizational liability associated with the Federal Facilities Compliance Act (FFCA).

Supporting Knowledge and/or Skills

a. Using the Federal Facilities Compliance Act as a reference, discuss the Departments liabilities associated with the Federal Facilities Compliance Act including the following:

- Federal Agency Liability
- Federal Employee Liability
- Civil Penalties
- Criminal Penalties
- Resource Conservation and Recovery Act (RCRA)

b. Discuss the purpose and application of Site Treatment Plans.

SAFETY MANAGEMENT

11. Personnel shall demonstrate a familiarity level knowledge of the Department's philosophy and approach to implementing Integrated Safety Management.

Supporting Knowledge and/or Skills

a. Explain the objective of Integrated Safety Management.

b. Describe how the seven Guiding Principles in the Integrated Safety Management Policy are used to implement an integrated safety management philosophy.

c. Describe the five core safety management functions in the Integrated Safety Management Policy and discuss how they provide the necessary structure for work activities.

d. Identify and discuss existing Department programs and initiatives that lead to successful implementation of Integrated Safety Management including:

- Standards/Requirements Identification Documents (S/RIDs) and Work Smart Standards
- Contract reform and performance-based contracting

e. Discuss the purpose, content, and application of DOE Policy 450.4, *Safety Management System Policy*.

f. Discuss the relationship of DEAR Clause 970.5223-1, “Integration of Environment, Safety and Health into Work Planing and Execution” to the Integrated Safety Management process.

12. Personnel shall demonstrate a familiarity level knowledge of the Occupational Safety and Health Act (OSHA) necessary to identify safe/unsafe work practices.

Supporting Knowledge and/or Skills

a. Describe DOE's responsibilities with respect to OSHA including the following:

- Hazard recognition and evaluation
- Accident investigation
- Hazard reduction/elimination
- Job safety analysis
- Accident/injury/illness prevention
- Blood-borne pathogens

b. Using references, discuss the purpose of 29 CFR 1910, *Occupational Safety and Health Standards* and 29 CFR 1960, *Basic Program Elements for Federal Employee Occupational Safety and Health and Related Matters*.

c. Discuss the regulatory interfaces between OSHA and other regulatory agencies.

d. Discuss workplace inspection techniques.

e. Discuss the major components of the OSHA Hazard Communication Protocol.

13. Personnel shall demonstrate a familiarity level knowledge of Fire Safety for Department facilities necessary to identify safe/unsafe work practices.

Supporting Knowledge and/or Skills

a. Discuss the critical aspects of fire prevention, emergency planning and control of fires.

b. Describe fire hazards that could affect the safety of facility personnel.

c. Discuss the key elements of the National Fire Protection Association Life Safety Code.

d. Discuss the purpose of Fire Hazard Analysis.

e. Describe the characteristics and methods/agents used to extinguish the following classes of fires:

- Class A
- Class B
- Class C
- Class D

f. Discuss the key components and use of building fire protection equipment including: detection, alarm, and communication systems, and extinguishing systems (automatic and manual).

14. Personnel shall demonstrate a familiarity level knowledge of industrial hygiene principles.

Supporting Knowledge and/or Skills

a. Discuss the key elements of a Hazards Communication Program and the use of Material Safety Data Sheets (MSDS).

b. Define a carcinogen and provide examples of carcinogens.

c. Discuss the key elements of a Carcinogen Control Program including specifically carcinogenic chemicals and asbestos control.

d. Discuss the importance of facility sanitation and housekeeping programs.

e. Discuss the importance and types of equipment used for personnel protection and safety including:

- Eye protection
- Foot protection
- Ear protection
- Protective clothing
- Head protection
- Respiratory protection

CONDUCT OF OPERATIONS

15. Personnel shall demonstrate a working level knowledge of the principles of Conduct of Operations and relate these principles to an operational environment.

Supporting Knowledge and/or Skills

a. Referring to a copy of DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities* (including Attachment 1), locate applicable guidelines and requirements for specific activities.

b. For each of the eighteen chapters in Attachment 1 to the DOE Order 5480.19, explain how each chapter contributes to an effective and safe operational environment.

c. Referring to a copy of each: DOE Order 232.1A, *Occurrence Reporting and Processing of Operations Information* (formerly DOE Order 5000.3B, *Occurrence Reporting*), DOE Order 433.1, *Maintenance Management Program for DOE Nuclear Facilities* (formerly DOE Order 4330.4B, *Maintenance Management Program*), and 414.1A, *Quality Assurance*, explain how each contributes to a proper conduct of operations environment.

d. Describe the purpose of Safeguards and Security, and the role that it plays with regards to conduct of operations.

e. Discuss proper critique principles and describe a proper critique process, including key elements.

f. Define root cause, and explain its importance to operational safety.

g. Define and describe what Lessons Learned are, and explain their importance to operational safety.

h. Describe Stop Work Authority, and your role in its application.

i. Describe the key elements that determine the safety significance of a condition.

j. Describe the key elements of a lockout and tagout system.

16. Personnel shall demonstrate a familiarity level knowledge of DOE Order 232.1, Occurrence Reporting and Processing of Operations Information.

Supporting Knowledge and/or Skills

a. State the purpose of the Order.

b. Define the following terms:

- Event
- Condition
- Facility
- Notification report
- Occurrence report
- Reportable occurrence

c. Discuss the Department's policy regarding the reporting of occurrences as outlined in the Order.

d. State the different categories of reportable occurrences and discuss each.

17. Personnel shall demonstrate a familiarity level knowledge of DOE Order 414.1A, *Quality Assurance*.

Supporting Knowledge and/or Skills

a. Discuss the objectives and applicability of the DOE Order 414.1A, including its relationship to 10CFR830.120.

b. Discuss the General Requirements section of the Order, including the applicability to DOE and the contractors that operate DOE facilities.

c. Describe in general terms, the following requirements contained in the following sections of the Quality Assurance Criteria:

– Management
– Performance
– Assessment

d. Discuss the Safety Issue Corrective Action Process as described in the Order.

AUTHORIZATION BASIS REQUIREMENTS AND DOCUMENTATION

18. Personnel shall demonstrate a familiarity level knowledge of DOE Order 5480.21, *Unreviewed Safety Questions*.

Supporting Knowledge and/or Skills

a. Describe the purpose of the Unreviewed Safety Question (USQ) Order 5480.21 and the concept of the USQ process and its relationship to 10 CFR 830 Subpart B.

b. Discuss the reasons for performing an unreviewed safety question determination.

c. Define and discuss the following terms as they relate to USQ:

- Accident analyses
- Safety evaluation
- Technical safety requirements

d. Describe the situations which require a safety evaluation to be performed.

e. Define the conditions for an unreviewed safety question.

f. Describe the responsibilities of contractors authorized to operate defense nuclear facilities for the performance of safety evaluations.

g. Describe the action(s) to be taken by a contractor upon identifying information that indicates a potential inadequacy of previous safety analyses or a possible reduction in the margin of safety as defined in the technical safety requirements.

h. Discuss the action(s) to be taken if it is determined that an unreviewed safety question is involved.

i. Discuss the qualification and training requirements for personnel who perform safety evaluations.

19. Personnel shall demonstrate a familiarity level knowledge of the Technical Safety Requirements as described in Department of Energy (DOE) Order 5480.22, *Technical Safety Requirements*, and Department of Energy (DOE) Order 5480.23, *Nuclear Safety Analysis Reports*, and Code of Federal Regulations (CFR) 10 CFR 830 Subpart B, *Nuclear Safety Management Design*.

Supporting Knowledge and/or Skills

a. Define and compare the terms "risk" and "hazard" and discuss the factors that can affect risk.

b. Explain and compare the terms Design Basis and Authorization Basis.

c. Discuss the purpose of Technical Safety Requirements and Safety Analysis Reports and the relationship between the two documents.

d. Describe the responsibilities of contractors authorized to operate defense nuclear facilities for Technical Safety Requirements and Safety Analysis Reports.

e. Define the following terms and discuss the purpose of each:

- Safety limit
- Limiting control settings
- Limiting conditions for operation
- Surveillance requirements

f. Discuss the possible source documents that may be used in developing Technical Safety Requirements.

g. Discuss the conditions that constitute a violation of the Technical Safety Requirements and state the reporting requirements should a violation occur.

20. Personnel shall demonstrate a familiarity level knowledge of DOE Order 420.1, *Facility Safety*.

Supporting Knowledge and/or Skills

a. Discuss the purpose and applicability of the Order.

b. Discuss the requirements imposed by the Order on the contractors that operate DOE nuclear facilities.

c. Discuss in general terms, the focus and content of the following sections of the Order:

- Nuclear Safety
- Fire Protection

- Nuclear Criticality Safety
- Natural Phenomena Hazards Mitigation

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CONTINUING EDUCATION, TRAINING AND PROFICIENCY PROGRAM

There is no specific continuing training associated with the General Technical Base Qualification Standard. However, personnel are encouraged to stay up-to-date on technical fundamentals. In particular, personnel should maintain a current level of knowledge of the Orders, Guides and regulations contained in this standard.

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CONCLUDING MATERIAL

Review Activity:

DOE

DP-NNSA
EH
EM
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NN-NNSA
RW
SC

Field Offices

AL
CH
ID
NV
OAK
OH
OR
RF
RL
SF
SR
Fernald
Carlsbad Field Office (CBFO)
Office of River Protection

National Laboratories

ANL
BNL
INEEL
LANL
LLNL
ORNL
SNL

Area Offices

Amarillo Area Office
Argonne Area Office
Brookhaven Area Office
Fermi Area Office
Kirtland Area Office
Los Alamos Area Office
Princeton Area Office
Rocky Flats Area Office
Y-12 Area Office

Preparing Activity:

DOE-MA-31

Project Number:

TRNG-0013