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DOE STANDARD

INSTRUMENTATION AND CONTROL FUNCTIONAL AREA QUALIFICATION STANDARD

DOE Defense Nuclear Facilities Technical Personnel

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

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APPROVAL

The Federal Technical Capability Panel consists of senior U.S. Department of Energy (DOE) 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.

Karen L. Boardman, Chairperson
Federal Technical Capability Panel

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ACKNOWLEDGMENT

The Office of the Associate Administrator for Safety and Health (NA-SH) is the sponsor for the Instrumentation and Control (I&C) Functional Area Qualification Standard (FAQS). The sponsor is responsible for coordinating the development and/or review of the FAQS by subject matter experts to ensure the technical content of the standard is accurate and adequate for Department-wide application for those involved in the (I&C) program. The sponsor, in coordination with the Federal Technical Capability Panel, is also responsible for ensuring the FAQS is maintained current.

The following subject matter experts participated in the development and/or review of this qualification standard:

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U.S. DEPARTMENT OF ENERGY
FUNCTIONAL AREA QUALIFICATION STANDARD

Instrumentation and Control

PURPOSE

The primary purpose of the Technical Qualification Program (TQP) is to ensure employees have the requisite technical competency to support the mission of the Department. The TQP forms the basis for the development and assignment of DOE personnel responsible for ensuring the safe operation of defense nuclear facilities. The technical qualification standards are not intended to replace the U.S. Office of Personnel Management (OPM) qualifications standards or other departmental personnel standards, rules, plans, or processes. However, the technical qualification standards should form the primary basis for developing vacancy announcements, qualification requirements, crediting plans, interview questions, and other criteria associated with the recruitment, selection, and internal placement of technical personnel.

APPLICABILITY

The Instrumentation and Control (I&C) Functional Area Qualification Standard (FAQS) establishes common functional area competency requirements for all DOE I&C personnel who provide assistance, direction, guidance, oversight, or evaluation of contractor technical activities that could impact the safe operation of DOE's defense nuclear facilities. This technical FAQS has been developed as a tool to assist DOE program and field offices in the development and implementation of the TQP in their organization. For ease of transportability of qualifications between DOE elements, program and field offices are expected to use this FAQS without modification of competency statements or KSA's. Satisfactory and documented attainment of the competency requirements contained in this technical FAQS ensures personnel possess the minimum requisite competence to fulfill functional area duties and responsibilities common to the DOE complex. Additionally, needed office-/site-/facility-specific qualification standards, handled separately, supplement this FAQS and establish unique operational competency requirements at the headquarters, field element, site, or facility level.

It should be noted that the competencies of management and leadership, general technical knowledge, regulations, administrative capability, and assessment and oversight are embodied in the competencies in this standard. All these factors have a bearing on safety. Although the focus of this standard is technical competence, competencies such as good communication, recognized credibility, ability to listen and process information, and the ability to guide an effort to get it right the first time are recognized as important aspects of safety.

IMPLEMENTATION

This FAQS identifies the minimum technical competency requirements for DOE personnel. Although there are other competency requirements associated with these positions, this FAQS identifies the specific, common technical competencies required throughout all defense nuclear facilities for I&C personnel.

The term “must” denotes a mandatory requirement, “should” denotes a recommended practice that is not required, and “may” denotes an option in this standard.

The competencies identify various levels 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 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 knowledge required to monitor and assess operations/activities, to apply standards of acceptable performance, and to recognize the need to seek and obtain appropriate expert advice (e.g., technical, legal, safety) or consult appropriate reference materials required to ensure the safety of DOE activities.
>
> **Demonstrate the ability** is the actual performance of a task or activity in accordance with policy, procedures, guidelines, and/or accepted industry or DOE practices.

Headquarters and field elements must establish a program and process to ensure DOE personnel possess the competencies required by their position, including the competencies identified in this technical FAQS. Documentation of the completion of the requirements in this standard must be included in the employees’ training and qualification records. Satisfactory attainment of competency requirements contained in this technical FAQS may be documented using the example I&C FAQS qualification card from the Federal Technical Capability Program Directives and Standards page, http://www.hss.energy.gov/deprep/ftcp/directives/directives.asp.

Equivalencies should be used sparingly and with the utmost rigor and scrutiny to maintain the spirit and intent of the TQP. Equivalencies may be granted for individual competencies based on objective evidence of previous education, training, certification, or experience. Objective evidence includes a combination of transcripts, certifications, and in some cases, a knowledge sampling obtained through written and/or oral examinations. Equivalencies must be granted in accordance with the TQP plan of the site/office/headquarters organization qualifying the individual. Supporting knowledge and/or skill statements should, and mandatory performance activities must, be considered before granting an equivalency for a competency.

Training must be provided to employees in the TQP who do not meet competencies contained in this technical FAQS. Training may include, but is not limited to, formal classroom and computer-based courses, self-study, mentoring, on-the-job training, and special assignments. Departmental training must be based on appropriate supporting knowledge and/or skill statements similar to those listed for each competency requirement. Headquarters and field elements should use the supporting knowledge and/or skill statements as a basis for evaluating the content of any training.

EVALUATION REQUIREMENTS

Attainment of competencies listed in this technical FAQS must be documented in accordance with the TQP plan or policy of the site/office/headquarters organization qualifying the individual and the requirements in DOE O 360.1C, *Federal Employee Training*, and DOE O 426.1, Chg 1, *Federal Technical Capability.*

The qualifying official or immediate supervisor should ensure the candidate meets the background and experience requirements of this FAQS. If the immediate supervisor is not qualified in this functional area, or the functional area of the competency being evaluated, the supervisor should

consult with a qualified individual prior to using one or a combination of the following individual competency evaluation methods:

- Satisfactory completion of a written examination
- Satisfactory completion of an oral examination
- Satisfactory accomplishment of an observed task or activity directly related to a competency
- Documented evaluation of equivalencies (such as applicable experience in the field) without a written examination

Field element managers/headquarters program managers must qualify candidates as possessing the basic technical knowledge, technical discipline competency, and position-specific knowledge, skills, and abilities required for their positions.

Final qualification of candidates must be performed using one or a combination of the following methods, in accordance with DOE O 426.1, Chg-1 (*Federal Technical Capability*)::

- Satisfactory completion of a comprehensive written examination with a minimum passing grade of 80 percent.
- Satisfactory completion of an oral examination by a qualified Senior Technical Safety Manager (STSM) or a qualification board of technically qualified personnel that includes at least one qualified STSM.
- Satisfactory completion of a walkthrough of a facility with a qualifying official for the purpose of verifying a candidate's knowledge and practical skills of selected key elements.

Guidance for oral interviews and written exams is contained in DOE-HDBK-1205-97, *Guide to Good Practices for the Design, Development, and Implementation of Examinations*, and DOE-HDBK-1080-97, *Guide to Good Practices for Oral Examinations.*

For oral examinations and walkthroughs, qualifying officials or board members should ask critical questions intended to integrate identified learning objectives during qualification. Field element managers/headquarters program managers or designees must develop formal guidance for oral examinations and walkthroughs that includes:

- Standards for qualification
- Use of technical advisors by a board
- Questioning procedures or protocol
- Pass/fail criteria
- Board deliberations and voting authorization procedures
- Documentation process

INITIAL QUALIFICATION AND TRAINING

Qualification of Instrumentation and Control (I&C) personnel must be conducted in accordance with the requirements of DOE O 426.1.

DOE personnel must participate in continuing education and training as necessary to improve performance and proficiency and ensure they stay up-to-date on changing technology and new requirements. This may include courses and/or training provided by:

- DOE
- Other government agencies
- Outside vendors
- Educational institutions

Beyond formal classroom or computer-based courses, continuing training may include:

- Self-study
- Attendance at symposia, seminars, exhibitions
- Special assignments
- On-the-job experience

A description of suggested learning activities and the requirements for the continuing education and training program for this FAQS are included in appendix A.

DUTIES AND RESPONSIBILITIES

The following are typical duties and responsibilities expected of personnel assigned to the Instrumentation and Control (I&C) functional area:

A. Review the management and technical oversight of the design, construction, and modification process for instrumentation and control systems.

B. Serve as a technical resource for instrumentation and control systems project management.

C. Inspect and evaluate instrumentation and control systems for safe and efficient operation, performance of maintenance, performance of testing, and conformance to design, installation and operational requirements, in accordance with DOE directives and applicable industry codes and standards.

D. Provide instrumentation and control expertise for participation in accident investigation and problem-solving activities as appropriate.

E. Review and participate (as appropriate) in the development, review, and coordination of DOE directives.

F. Evaluate contractor compliance with relevant DOE directives and applicable industry codes and standards.

G. Review safety basis documents and assess whether safety functions performed by instrumentation and control systems have been adequately identified, and implemented.

H. Evaluate compliance with DOE STD 1195, *Design of Safety Significant Safety Instrumented Systems used at DOE Nonreactor Nuclear Facilities*, April 2011, or other equivalent industry codes and standards (e.g. ANSI/ISA-84.00.01- 2004).

I. Evaluate compliance of instrumentation and control systems and components for consistency between physical configuration, facility documentation, design requirements, applicable DOE directives, and industry codes and standards.

Position-specific duties and responsibilities for I&C personnel are contained in office-/site-/facility-specific qualification standards and/or position descriptions.

BACKGROUND AND EXPERIENCE

The OPM *Qualification Standards Operating Manual* establishes minimum education, training, experience, or other relevant requirements applicable to a particular occupational series/grade level, as well as alternatives to meeting specified requirements.

The preferred education and experience for Instrumentation and Control personnel are:

1. Education

   Baccalaureate degree in engineering, science, or in an applicable discipline from an accredited institution, or meet the alternative requirements specified for engineers in the Qualification Standards Handbook for the GS-0800, Professional Engineering Series

2. Experience

   Industrial, military, Federal, state, or other directly related background that has provided specialized experience in Instrumentation and Control. Specialized experience can be demonstrated through possession of the competencies outlined in this standard.

REQUIRED TECHNICAL COMPETENCIES

The competencies contained in this standard are distinct from competencies contained in the General Technical Base (GTB) Qualification Standard. All Instrumentation and Control (I&C) personnel must satisfy the competency requirements of the GTB Qualification Standard prior to or in parallel with the competency requirements contained in this standard. Each competency requirement defines the level of expected knowledge and/or skill an individual must possess to meet the intent of this standard. Each competency requirement is further described by supporting knowledge and/or skill statements that describe the intent of the competency statement. In selected competencies, expected knowledge and/or skills have been designated as "mandatory performance activities." In these competencies, the actions are not optional.

Note: When regulations, DOE directives, or other industry standards are referenced in this FAQS, the most recent revision should be used. It is recognized that some I&C personnel may oversee facilities that utilize predecessor documents to those identified. In those cases, such documents should be included in local qualification standards.

1. Instrumentation and Control (I&C) personnel must demonstrate a familiarity level knowledge of basic electrical engineering fundamentals.

Supporting Knowledge and/or Skills:

a. Explain the relationships between voltage, current, resistance, reactance, and impedance. This includes understanding of electrical circuits and their application in I&C systems design and operation.

b. Explain alternating current (AC), direct current (DC), batteries, Uninterruptible Power Supplies (UPS), diesel generators, and other backup power supplies and their application in I&C systems.

c. Explain the use of various types of electrical equipment and components, such as, motors, generators, transformers (e.g., current vs. potential transformers), capacitors, inductors, resistors, circuit breakers, electrical switchgear, motor control centers, motor operated valves, electrical relays, time delay relays, fuses, etc) and their application in I&C systems design

d. Explain the use of electrical test instruments and measuring devices (e.g., voltmeter, ammeter, and ohmmeter). Also explain the importance of, and relationship between calibration, precision, and accuracy etc., to the design and maintenance of I&C systems.

e. Explain the requirements of electrical safety class and safety significant systems (e.g. application of DOE O 420.1C, *Facility Safety*, DOE G 420.1-1A, IEEE Std 379, *Application of the Single-Failure Criterion to Nuclear Power Generating Station Safety Systems*, IEEE Std-384, *Criteria for Independence of Class 1E Equipment and Circuits*, etc) and their application in I&C systems design.

f. Explain the use of electrical components (e.g., using analog relays, relay logic, motors, and motor operated valves, etc) as they relate to I&C systems design, and

explain how they are reviewed and analyzed to ensure that they demonstrate that the design meets the requirements of the Documented Safety Analysis (DSA), DOE O 420.1C, and other industry standards.

g. Explain the importance of considering normal and anticipated abnormal environmental conditions (e.g. temperature, humidity, radiation, etc) when selecting electrical components for use in I&C systems design (e.g. guidance of IEEE Std 323, *IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations*, and DOE O 420.1C, etc.).

2. I&C personnel must demonstrate a familiarity level knowledge of basic mechanical engineering fundamentals, including thermodynamics and hydraulics.

Supporting Knowledge and/or Skills:

a. Explain basic theory of thermodynamics and hydraulics as related to process systems control and operations (e.g. relationship between fluid system pressure, temperature, density, flow, etc.).

b. Explain how the following components may be applied to I&C systems design, and the importance of their characteristics to I&C systems design and operations.

- Gate valve
- Globe valve
- Butterfly valve
- Diaphragm valve
- Check valve
- Relief valve
- Pressure regulating valve
- Solenoid valve actuator
- Pneumatic valve actuator
- Orifice plate
- Centrifugal pump
- Positive displacement pump
- Compressor
- Instrument air system
- Dampers
- HEPA filters

c. Explain the thermodynamic concepts and operational considerations for fluid systems (e.g. HVAC system, liquid process systems, etc) related to I&C systems design.

3. I&C personnel must demonstrate a familiarity level knowledge of basic civil/structural engineering fundamentals.

Supporting Knowledge and/or Skills:

a. Explain seismic design constraints imposed on I&C systems.

b. Explain the effect of vibration on I&C systems and methods to mitigate that effect.

c. Explain the requirements of seismic qualification of I&C structures, systems and components (e.g. IEEE Std 344 requirements).

d. Explain the function and operation of seismic instrumentation systems.

4. I&C personnel must demonstrate a familiarity level knowledge of basic chemical engineering fundamentals.

Supporting Knowledge and/or Skills:

a. Explain the additional design requirements that must be considered when applying I&C systems for use in chemical processes.

b. Explain special design requirements for the use of instrumentation in chemically harsh environments (e.g. corrosive, toxic, etc.).

5. I&C personnel must demonstrate a working level knowledge of basic I&C systems fundamentals and their applications in process systems operations.

Supporting Knowledge and/or Skills:

a. Explain the construction, operation, characteristics, limitations, and application of commonly used sensing instruments in process systems, monitoring parameters such as:

- pressure
- temperature
- flow
- level
- vibration

b. Explain the function and use of final control elements (e.g. motor operated valves, solenoid actuated valves, dampers, and pumps, etc). Explain the importance of final control elements and considerations used during the selection process (e.g., reliability, response time, and other essential features).

c. Explain the application of process and instrumentation diagrams (P&IDs) and their importance in I&C systems design and operation.

d. Explain the use of logic and loop diagrams, and explain how I&C systems design can be expressed using logic diagrams (e.g., application of Boolean logic).

e. Explain the application, advantages, and disadvantages of pneumatic control systems applications (e.g., pneumatic control of solenoid valves, air compressors, air start of diesel generator, etc).

f. Explain the application, advantages, and disadvantages of hydraulic control systems applications (e.g., hydraulic lift, turbine controls).

g. Explain the consideration of process systems parameters (e.g. pressure, temperature, flow, etc.), instrument compatibility (e.g., range, accuracy, response time, sensitivity, reliability), role of safety functions stated in the documented safety analysis (DSA), set points, process safety limits, control room displays, etc., while selecting instruments for I&C systems design.

h. Explain basic I&C systems installation requirements, such as design consideration for the installation of sensing lines, use of valve manifolds, accessibility for maintenance and calibration, etc.

i. Explain how process chemistry parameters can apply to I&C system design (e.g., pH, conductivity, turbidity, moisture, humidity, hydrogen, oxygen, chlorine, etc.).

6. I&C personnel must demonstrate a familiarity level knowledge of specialty instrumentation and its applications.

Supporting Knowledge and/or Skills:

a. Explain the functional and safety requirements (e.g. as stated in DSA, System Design Specification etc) and applicability of the following specialty instruments:

- Radiation monitors (e.g. CAMs, portal monitors, etc.)
- Gas analyzers
- Effluent monitors
- Refractometer

7. I&C personnel must demonstrate a working level knowledge of application of digital systems in I&C systems design.

Supporting Knowledge and/or Skills:

a. Explain the application of electronics and programmable electronics in I&C systems. (e.g., smart transmitters, programmable logic controllers, processors, communication modules, input/output modules, interface modules, power supplies, fieldbus, etc).

b. Explain the application of software development concepts, including software quality assurance activities and their importance to ensuring DI&C systems perform their functions correctly. (e.g., requirements of DOE O 414.1D and additional guidance of DOE G 414.1-4)

c. Explain the advantages, disadvantages, and issues involved in the application of wireless technology for field instruments.

d. Explain the advantages, disadvantages, and limitations for the use of digital and/or wireless systems in I&C applications (e.g., signal interference, security, software quality, etc)

e. Explain various failure modes and design considerations that are specific to digital I&C systems

NOTE: New facilities are mostly using digital technologies for I&C systems design. Many of the existing nuclear facilities' I&C systems (mostly analog at present) are being replaced with digital systems. The digital systems certainly bring added benefit due to

their flexibility, accuracy and cost effectiveness. The complexity of digital I&C systems, however, requires a comprehensive implementation plan to ensure that facility safety is maintained. This implies that all phases of the digital systems project should include extensive verification and validation (V&V) to ensure that systems functions and interactions between subsystems have been adequately considered. The introduction of new software can result in new sets of potential failure modes, which must be accounted for. The dominating failure mode of software based systems is systemic in nature, which means that redundancy alone does not necessarily provide the same level of protection as in analog systems. Consequently, issues such as protection against common cause failures must be evaluated and addressed at a greater level of detail than would have been sufficient for analog based systems.

I&C personnel should have a good understanding of digital systems design and specification, application of software quality assurance, failure modes, etc.

8. I&C personnel must demonstrate a working level knowledge of I&C Systems Design and Analysis.

Supporting Knowledge and/or Skills:

a. Explain the role of DSAs, System Design Descriptions, and process P&IDs for I&C systems design.

b. Explain the importance of instrument response time, accuracy, precision, set points, and process safety limits for I&C systems design.

c. Explain the use of reset/rate/proportional controls used in process controls, feedback controls, control of system stability, etc.

d. Explain the application of DOE-STD-1195-2011, *Design of Safety Significant Safety Instrumented Systems Used at DOE Nonreactor Nuclear Facilities.* This includes understanding of reliability analysis of safety instrumented systems, common mode/common cause failures, and life cycle management of I&C systems.

e. Explain the design considerations for sensors, logic solvers, and final control elements (e.g. structures, systems, and components diversity and redundancy, one-out-of- two/ two-out-of-three logic, etc) that are essential for reliable I&C systems design.

f. Explain how human factors engineering criteria and requirements are used for safe and efficient operations (e.g., use of DOE-STD-1186-2004, *Specific Administrative Controls*, NUREG-0700, *Human-System Interface Design Review Guidelines, etc.).*

g. Explain the basic requirements for control room design, displays, annunciators, and operators' interface.

h. Explain the design requirements for safety class and safety significant I&C systems design.

i. Explain the consideration of failure modes in I&C systems design, and how different failure modes influence the selection of motive power for I&C systems.

j. Explain alarm management.

9. I&C personnel must demonstrate a working level knowledge of procurement, installation, and testing.

Supporting Knowledge and/or Skills:

a. Explain the key elements of the procurement process for I&C structures, systems and components as defined in DOE O 414.1D, Quality Assurance. This includes quality assurance requirements for both hardware and software.

b. Explain the importance of quality assurance requirements for safety software used in design, analysis, and controls (e.g., requirements of DOE O 414.1D, *Quality Assurance,* and additional guidance of DOE G 414.1-4, *Safety Software Guide for use with 10 C.F.R 830 Subpart A, Quality Assurance Requirements, and DOE O 414.1D).*

c. Explain the importance of adequately identifying I&C requirement specifications to ensure that system functional and performance requirements used for design, procurement, installation and operation are appropriate for the selected equipment, and identify potential consequences of improperly classifying equipment.

d. Explain the methods for establishing I&C structures, systems, and components storage, installation, and acceptance criteria for testing and calibration.

10. I&C personnel must demonstrate a familiarity level knowledge of operations and maintenance of I&C systems.

Supporting Knowledge and/or Skills:

a. Explain the maintenance management requirements as defined in DOE O 433.1B Admin Chg 1, *Maintenance Management Program for DOE Nuclear Facilities*, and DOE G 433.1-1A, *Nuclear Facility Maintenance Management Program Guide for use with DOE O 433.1B*.

b. Explain safety-related maintenance requirements.

c. Explain the relationship between maintenance and conduct of operations, quality assurance, and configuration management.

11. I&C personnel must demonstrate a working level knowledge of the configuration management process applied to I&C systems documentation.

Supporting Knowledge and/or Skills:

a. Explain the importance of the configuration management process as it applies to I&C systems (e.g., documenting, controlling, revising, and issuing I&C drawings, as-built configuration, software, calculations, and analyses).

b. Explain the change control process described in DOE-STD-1073-2003, *Configuration Management Program* and DOE O 414.1D, *Quality Assurance*.

c. Explain the purpose and objectives of the operational configuration management program, and explain how it relates to I&C systems.

12. I&C personnel must demonstrate a working level knowledge of life cycle management.

Supporting Knowledge and/or Skills:

a. Explain the importance of life cycle management to I&C systems.

b. Explain the mechanisms for feedback of relevant information, such as trend analysis and instrumentation performance reliability data, to identify necessary program modifications.

c. Explain the purpose and importance of maintenance history.

13. I&C personnel must demonstrate a working level knowledge of surveillance and assessment techniques, reporting, and follow up actions for I&C systems and programmatic elements.

Supporting Knowledge and/or Skills:

a. Describe the role of I&C personnel in performance oversight of government-owned, contractor-operated (GO-CO), and government-owned, government-operated (GO-GO)facilities.

b. Describe the assessment requirements and limitations associated with the interface of I&C personnel and contractor employees.

c. Describe how planning, observations, interviews, and document research are used during an assessment.

d. Explain the essential elements of a performance-based assessment including investigation, fact-finding, and reporting.

e. Describe the methods by which noncompliance is determined and communicated to the contractor and Departmental management.

Mandatory Performance Activities:

a. Develop an assessment report.

b. Demonstrate the ability to communicate technical issues (both orally and by written report) when working or interacting with contractors, stakeholders, and other internal and external organizations.

c. Evaluate an I&C system to support review and approval of a new or revised facility Documented Safety Analysis and/or TSR. The scope of the review will be dictated by the changes associated with the I&C system (e.g., new I&C system design, modification of an existing design, addition of instrument loops to a PLC or DCS, setpoint modification, etc.).

d. Evaluate a Safety Function specified in a new or revised facility Documented Safety Analysis and/or TSR for satisfactory identification and classification of I&C needed to fulfill and/or support that Safety Function. The scope of the review will be dictated by the change in the Safety Function (e.g. new facility, newly identified Safety Function, modification of a previously identified Safety Function, added Performance Criteria, etc.)

14. I&C personnel must demonstrate a working level knowledge of problem analysis principles and the ability to apply techniques as necessary to identify problems, determine potential causes of problems, and identify potential corrective actions.

Mandatory Performance Activities:

a. Demonstrate the application of problem analysis techniques including the following:
   - Failure Modes and Effects Analysis (FMEA)
   - Fault Tree Analysis (FTA)
   - Root Cause Analysis

b. Using event and/or occurrence data, apply problem analysis techniques and demonstrate the ability to identify problems and how they could be resolved.

15. I&C personnel must demonstrate a working level knowledge of process and instrumentation diagrams (P&IDs), logic diagrams, electrical schematics, loop diagrams for I&C systems, construction drawings, as-built drawings, and wiring diagrams.

Supporting Knowledge and/or Skills:

a. Discuss the origin and purpose of “as-built” drawings.

Mandatory Performance Activities:

a. Using P&IDs, identify I&C devices by symbology and explain their functions.

b. Using logic diagrams, loop diagrams, and electrical schematics describe the effect of an action taken.

c. Using construction drawings, identify instrument sensing lines, instrument valve manifold and instrument mounting details, and verify compliance with instrument installation requirements.

d. Walk down a facility to demonstrate the ability to verify that installation conforms to P&IDs and other relevant documentation.

16. I&C personnel must demonstrate a working level knowledge of DOE and industry codes and standards and their applicability as they relate to I&C systems design, procurement, installation, testing, operations and maintenance. I&C personnel must also demonstrate the ability to evaluate compliance with applicable DOE and industry codes and standards. If listed documents have been superseded or replaced, the latest version should be used

Supporting Knowledge and/or Skills:

a. Discuss the purpose and content of the Documented Safety Analysis (DSA).

b. Discuss the purpose and content of Technical Safety Requirements (TSR) (ref: *DOE G 423.1-1A, Implementation Guide for Use In Developing Technical Safety Requirements).*

c. Discuss the purpose and content of 10 CFR Part 830, *Nuclear Safety Management.*

d. Discuss the purpose and content of DOE O 414.1D, *Quality Assurance,* 05-18-13.

e. Discuss the purpose and content of DOE G 414.1-4, Safety Software Guide for use with 10 C.F.R 830 Subpart A, Quality Assurance Requirements, and DOE O 414.1D Admin Chg 1, Quality Assurance, 05-08-13.

f. Discuss the purpose and content of DOE O 420.1C, *Facility Safety*, 12-04-2012.

g. Discuss the purpose and content of DOE G 420.1-1A, *Nonreactor Nuclear Safety Design Criteria for Use with DOE O 420.1C, Facility Safety,* 12-04-2012.

h. Discuss the purpose and content of DOE O 433.1B Admin Chg 1, *Maintenance Management Program for DOE Nuclear Facilities*, 4-21-2010.

i. Discuss the purpose and content of DOE G 433.1-1A, *Nuclear Facility Maintenance Management Program Guide for use with DOE O 433.1B*, 9-12-11.

j. Discuss the purpose and content of DOE-STD-1073-2003, *Configuration Management Program.*

k. Discuss the purpose and content of DOE-STD-1189-2008, *Integration of Safety into the Design Process.*

l. Discuss the purpose and content of DOE-STD-1195-2011, *Design of Safety Significant Safety Instrumented Systems Used at DOE Nonreactor Nuclear Facilities.*

m. Discuss the purpose and content of DOE-STD-3024-2011, *Content of System Design Descriptions.*

n. Discuss the purpose and content of ISA-18.1-1979 (R2004), *Annunciator Sequences and Specifications.*

o. Discuss the purpose and content of ANSI/ISA-18.2-2009 (R2004), *Management of Alarm Systems for the Process Industries.*

p. Discuss the purpose and content of ISA-67.01.01-2002 (R2007), *Transducer and Transmitter Installation for Nuclear Safety Applications.*

q. Discuss the purpose and content of ISA-67.02.01-1999, *Nuclear-Safety-Related Instrument Sensing Line Piping and Tubing Standard for Use in Nuclear Power Plants.*

r. Discuss the purpose and content of ANSI/ISA-67.04.01-2006 (R2011), *Setpoints for Nuclear Safety-Related Instrumentation.*

s. Discuss the purpose and content of ANSI/ISA-84.00.01-2004 (IEC 61511 Mod), *Functional Safety: Safety Instrumented Systems for the Process Industry Sector – Part 1: Framework, Definitions, System, Hardware and Software Requirements*.

t. Discuss the purpose and content of ISA-TR84.00.06, *Safety Fieldbus Design Considerations for Process Industry Sector Applications*.

u. Discuss the purpose and content of IEEE Std 7-4.3.2-2003, IEEE Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations.

v. Discuss the purpose and content of IEEE Std 323-2003, *IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations,* 2004.

w. Discuss the purpose and content of IEEE Std 344-2004, *IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations*.

x. Discuss the purpose and content of IEEE Std 379-2000, *IEEE Standard Application of the Single-Failure Criterion to Nuclear Power Generating Station Safety Systems,* 2001.

y. Discuss the purpose and content of IEEE Std 384-2008, *IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits.*

z. Discuss the purpose and content of IEEE Std 1023-2004, *IEEE Recommended Practice for the Application of Human Factors Engineering to Systems, Equipment, and Facilities of Nuclear Power Generating Stations and Other Nuclear Facilities*.

aa. Discuss the purpose and content of NUREG-0700, *Human-System Interface Design Review Guidelines,* Revision 2, Nuclear Regulatory Commission, 2002.

APPENDIX A
CONTINUING EDUCATION, TRAINING, AND PROFICIENCY PROGRAM

This standard does not require requalification.

Headquarters or field element managers must ensure the following:

1. Establish expectations related to the performance of duties and responsibilities in this FAQS, considering regulatory and/or contractual requirements as appropriate.
2. Identify specific continuing training requirements in the site/office/position specific qualification standard(s) or procedures.
3. Approve all established continuing training requirements related to defense nuclear facility safety oversight as determined for their office or site.

Instrumentation and Control (I&C) personnel must complete continuing technical education and/or training covering topics directly related to the I&C FAQS as determined by the appropriate headquarters or field element managers as follows:

1. Address changes to DOE directives, guides, standards, policies, and rules since the last qualification was completed.
2. Perform practical factor exercises as appropriate, especially those that are mandatory and others as required by the associated FAQS.
3. Attend seminars, symposia, or technical meetings related to I&C as resources are available.

   Note: Continuing technical education and/or training may include courses/training provided by the DOE, other government agencies, outside vendors, or local educational institutions. Continuing training topics should also address identified weaknesses in the knowledge or skills of the individual personnel, and current technical issues related to the associated FAQS. Where continuing education is mandatory for maintaining professional registration (e.g., Professional Engineer) or professional certification (e.g., Certified Health Physicist), this will normally be sufficient, and only needs to be augmented by DOE directives reviews and any site-specific requirements (e.g., new/revised DSAs).

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CONCLUDING MATERIAL

Review Activity:
EM
NNSA
NE
SC

Preparing Activity:
NA-SH

Project Number:
P1162-2003REV

Field and Operations Offices:
CBFO
CH
ID
OH
OR
ORP
RL
SR

Site Offices:
Argonne Site Office
Brookhaven Site Office
Fermi Site Office
Kansas City Field Office
Livermore Field Office
Los Alamos Field Office
Nevada Field Office
Nuclear Production Office
Princeton Area Office
Savannah River Field Office
Sandia Field Office