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DOE STANDARD

CONFINEMENT VENTILATION AND PROCESS GAS TREATMENT FUNCTIONAL AREA QUALIFICATION STANDARD

DOE Defense Nuclear Facilities Technical Personnel

U.S. Department of Energy **AREA TRNG**
Washington, D.C. 20585

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 10.11.13

KAREN L. BOARDMAN, CHAIRPERSON
FEDERAL TECHNICAL CAPABILITY PANEL

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ACKNOWLEDGMENT

The Hanford Site (DOE/WTP, DOE/ORP, DOE/RL) is the sponsor for the Confinement Ventilation and Process Gas Treatment Functional Area Qualification Standard. The sponsor is responsible for coordinating the development and/or review of the Functional Area Qualification Standard (FAQS) by Subject Matter Experts (SME) to ensure that the technical content of the standard is accurate and adequate for Department-wide application for those involved in the Confinement Ventilation and Process Gas Treatment Functional Area program. The sponsor, in coordination with the Federal Technical Capability Panel, is also responsible for ensuring that the FAQS is maintained current.

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DOE-STD-1168-2013

U.S. DEPARTMENT OF ENERGY
FUNCTIONAL AREA QUALIFICATION STANDARD

Confinement Ventilation and Process Gas Treatment

PURPOSE

DOE O 426.1, Chg.1, *Federal Technical Capability,* commits the Department to continuously strive for technical excellence. The Technical Qualification Program (TQP), 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, interview questions, and other criteria associated with the recruitment, selection, and internal placement of technical personnel.

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. The primary purpose of the TQP is to ensure that 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.

APPLICABILITY

The Confinement Ventilation and Process Gas Treatment (CV&PGT) FAQS establishes common functional area competency requirements for all DOE CV&PGT 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. The 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 technical FAQS without modification. Satisfactory and documented attainment of the competency requirements contained in this technical FAQS ensures that personnel possess the minimum requisite competence to fulfill their functional area duties and responsibilities common to the DOE complex. Additionally, needed office-/site-/facility-specific qualification standards, handled separately, supplement this technical FAQS and establish unique operational competency requirements at the headquarters or field element, site, or facility level.

This FAQS identifies the minimum technical competency requirements for DOE personnel who oversee CV&PGT systems. Although there are other competency requirements associated with the positions held by DOE personnel, this FAQS is limited to identifying the specific, common technical competencies required throughout all defense nuclear facilities.

This standard was developed for DOE engineers who specialize by discipline, and therefore are assigned as a SME or Safety Systems Oversight (SSO) engineers specifically for CV&PGT systems. This standard is narrowly focused, and may not be appropriate for sites at which

engineers are assigned by facility, responsible for oversight of many systems related to multiple engineering disciplines.

This Functional Area Qualification standard provides for two separate levels of qualification: Basic and Master Level. DOE personnel who oversee CV&PGT systems must qualify to all of the Basic (Section I) competencies within this standard. DOE personnel who play a significant role in oversight of site or complex-level standards and programs that govern safety related CV&PGT systems must qualify to all of the competencies in this standard, including the Master Level (Section II) competencies.

See the Federal Technical Capability Program [FTCP] Directives and Standards page at http://energy.gov/hss/information-center/department-energy-technical-standards-program, for an example of the CV&PGT FAQS qualification card.

Additionally, office-/site-/facility-specific qualification standards supplement this technical 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 listed in this standard. All of 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

The competency requirements define the expected knowledge and/or skill that an individual must meet. Each of the competency requirements is further described by a listing of supporting knowledge and/or skill statements. The supporting knowledge and/or skill statements for each competency requirement are provided to challenge the employee in the breadth and depth of his/her understanding of the subject matter. In selected competencies, expected knowledge and/or skills have been designated as “mandatory performance activities.” In these competencies, the actions are not optional.

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 a familiarity level, a working level, or a master level of knowledge. 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 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.
>
> **Master level** is defined as a comprehensive, intensive knowledge of the subject or process sufficient to provide advice regarding decisions impacting the integrity of nuclear

safety related Systems, Structures, and Components (SSC), especially where formal technical guidance such as codes and standards are not adequately prescriptive.

Headquarters and field elements must establish a program and process to ensure that applicable DOE personnel possess the competencies required by their position, including the competencies identified in this technical FAQS. Documentation of the completion of the requirements of this standard must be included in the employees' training and qualification records. Satisfactory attainment of the competency requirements contained in this technical FAQS may be documented using the example CV&PGT FAQS qualification card that can be obtained from the FTCP Directives and Standards webpage.

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, for whom this standard is applicable, who do not meet the 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 the ones listed for each of the competency requirements. Headquarters and field elements should use the supporting knowledge and/or skill statements and mandatory performance activities as a basis for evaluating the content of any training.

EVALUATION REQUIREMENTS

Attainment of the 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 must ensure that the candidate meets the background and experience requirements of this FAQS. Unless stated otherwise within the program or site TQP plan, attainment of the competencies listed in this CV&PGT FAQS should be evaluated and documented by either a qualifying official or immediate supervisor. If the immediate supervisor is not qualified in this functional area, the supervisor should consult with a qualified individual.

Qualification for individual competencies must be determined using one or a combination of the following 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; and/or

- Documented evaluation of equivalencies (such as applicable experience in the field or a Professional Engineering [PE] license) 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 must be performed using one or a combination of the following methods:

- Satisfactory completion of a comprehensive written examination. The minimum passing grade must be 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; and/or
- Satisfactory completion of a walk through of a facility with a qualifying official for the purpose of verifying a candidate's knowledge of CV&PGT systems.

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 CONTINUING TRAINING

Qualification of CV&PGT personnel must be conducted in accordance with the requirements of DOE O 426.1, Chg. 1.

DOE personnel must participate in continuing education and training as necessary to maintain their performance and proficiency and ensure that 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 programs for the CV&PGT FAQS are included in Appendix A of this document.

DUTIES AND RESPONSIBILITIES

The following are typical duties and responsibilities expected of personnel assigned to the CV&PGT Functional Area:

A. Serve as technical authorities for Heating, Ventilation, and Air Conditioning (HVAC) and Process Gas Treatment (PGT) systems. Responsible scope includes the nuclear air cleaning systems (a.k.a. Confinement Ventilation Systems [CVS]) and PGT systems (such as tank ventilation) in DOE nuclear facilities. CVS are often designated Safety Class or Safety Significant nuclear safety systems in DOE facilities, while the safety designations of PGT systems vary widely depending on application.

B. Review facility safety documentation for compliance with applicable nuclear and industrial safety requirements and functional performance needs.

C. Represent DOE and encourage development and refinement of requirements and sharing of information in the areas of CVS and PGT. Participate in the development and revision of implementing directives, DOE Orders, Standards and/or supplemental Contractor Requirement Documents. Serve as the interpretive authority for these requirements. Participate in meetings, professional conferences, and technical standards committees.

D. Provide oversight of the site CVS and PGT programs and their implementation. Participate in or lead assessments and surveillances of contractor related programs to determine adequacy of the implementation of CVS and PGT standards and requirements.

E. Evaluate the adequacy of facility design in accordance with applicable criteria.

F. Maintain proficiency in HVAC, CVS, and PGT engineering concepts and practices through practice, education, training, and a periodic review of air cleaning codes and standards, which apply to DOE and its contractors.

Position-specific duties and responsibilities for CV&PGT personnel are contained in their office-/site-/facility-specific qualification standard and/or position description.

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 education and experience for CV&PGT personnel are:

1. Education:

Bachelor of Science degree in Engineering or related physical science (Physics, for example) from an accredited institution or meet the alternative requirements for engineers or scientists specified in the Qualification Standards Handbook for the GS-0800, Professional Engineering Series/GS-1300, Physical Science series.

2. Experience:

Personnel qualifying to the Master level CV&PGT Functional Area Qualification must possess a minimum of four years of industrial, military, federal, state, or other directly-related background that has provided specialized experience in CV and/or PGT.

REQUIRED TECHNICAL COMPETENCIES

The competencies contained in this standard are distinct from those competencies contained in the General Technical Base (GTB) Qualification Standard. All CV&PGT 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 of the competency requirements defines the level of expected knowledge and/or skill that an individual must possess to meet the intent of this standard. Each of the competency requirements is further described by a listing of supporting knowledge and/or skill statements that describe the intent of the competency statements. 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 the FAQS, the most recent revision should be used. It is recognized that some CV&PGT personnel may oversee facilities or systems that utilize predecessor documents to those identified. In those cases, such documents should be included in local qualification standards via the TQP.

Confinement Ventilation competencies represent the minimum technical competencies that a qualified individual in the subject matter of the standard is required to perform. Competencies are defined as those an individual in the functional area must possess to ensure that DOE defense nuclear facilities and programs are operated in accordance with applicable safety, health, and environmental requirements. Competencies from the GTB Qualification Standard are not repeated unless the level of knowledge is being raised, e.g. from familiarity level to working level.

Technical Competencies:

I. CV&PGT ENGINEERING;

Confinement Ventilation: Technical Concepts

1. Cascading Ventilation:
CV&PGT personnel must demonstrate a working level knowledge of the engineering principles and practices for radioactive contamination control using the confinement ventilation system.

Supporting Knowledge and/or Skills:

Suggested Reference Material: DOE-HDBK-1169, *Nuclear Air Cleaning Handbook*

a. Describe the function(s) of all major components of a typical CVS (e.g., High-Efficiency Particulate Air (HEPA) filters, dampers, ductwork, fans, flow instruments, pressure instruments).

b. Identify which functions are typically considered safety functions (e.g., which accidents credit system components as preventive or mitigative barriers).

c. Describe the general principles relating to the design and installation of radiation protection containment/confinement systems including the following radiological protection considerations: Engineered ventilation hood, Engineered containment, Hot cells/canyons, and glove boxes.

d. Describe the concept of cascading pressure zones for radiological controls. Including definitions and examples of; Primary Confinement, Secondary Confinement, Tertiary Confinement (include zone numbering scheme).

Mandatory Performance Activities:

a. Sketch a typical Confinement Ventilation system labeling all major components including all typical system boundary points. Identify all key system instruments for monitoring parameters (e.g., air flow, pressure), system control features (e.g., interlocks) and system testing. Identify all key interface connections with other systems and expected support functions from these systems (e.g., electric power and the instrument air system).

b. Perform a facility walkdown of a typical Confinement Ventilation system. Locate and identify all major components (e.g., High-Efficiency Particulate Air (HEPA) filters, dampers, ductwork, fans, flow instruments, pressure instruments etc.).

2. Capture Velocity:
CV&PGT personnel must demonstrate a working level knowledge of design guideline associated with selecting capture velocity for hoods, gloveboxes, airlocks, and change rooms for confinement.

Supporting Knowledge and/or Skills:

Suggested Reference Materials: DOE-HDBK-1169, *Nuclear Air Cleaning Handbook*; American Glovebox Society AGS-G001 *Guideline for Gloveboxes:* ASHRAE 90365, *HVAC Design Guide for DOE Nuclear Facilities*; ACGIH Industrial Ventilation, *A Manual of Recommended Practice*; ASHRAE Standard 110, *Method of Testing Performance of Laboratory Fume Hoods*

Describe capture velocity guidelines for hoods, gloveboxes, airlocks, and change rooms and how a confinement ventilation engineer would ensure these guidelines were being met in an operating nuclear facility.

3. Principles of Filtration:
CV&PGT personnel must demonstrate a working level knowledge of particle dynamics and air filtration theory.

Supporting Knowledge and/or Skills

Suggested Reference Materials: DOE-HDBK-1169, *Nuclear Air Cleaning Handbook*; ASHRAE Handbook Fundamentals; ASHRAE HVAC Applications (Chapter 28 Nuclear Facilities); ACGIH Industrial Ventilation, *Manual for Recommended Practice*

a. Discuss the capture mechanisms for particles.
   - Impaction / Impingement
   - Interception
   - Diffusion (a.k.a. Brownian Motion)
   - Electrical
   - Gravitational
   - Sieving / Straining
   - Thermophoresis/thermomigration

b. Discuss the relationship between the particle size and velocity with respect to the capture mechanisms.

c. Discuss particle sizes found in typical radiological facilities.

d. Discuss impact of particle size on filter efficiency and filter loading capacity.

4. Dust Collection and Filtration:
CV&PGT personnel must demonstrate a familiarity level knowledge of the theory and operation of Dust Collection and Filtration.

Supporting Knowledge and/or Skills:

Suggested Reference Material: DOE-HDBK-1169, *Nuclear Air Cleaning Handbook*); ASHRAE Handbook, Systems and Equipment, Perry's Chemical Engineers' Handbook, ASHRAE 52.2, *Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle*

Size.

a. Describe Minimum Efficiency Reporting Value filter rating system per ASHRAE 52.2.

b. Describe the following filtration technologies and discuss the pros and cons and typical applications of each:
   - Glass Fiber
   - HEPA
   - Ultra-low Penetration Air (ULPA)
   - Sintered Metal
   - Sand / Granular Bed
   - Electrostatic Filters and Precipitators
   - Roughing filter
   - Settling Chamber / Baffle Chamber / Louver Chamber
   - Cyclone separators
   - Baghouse filter / Cartridge (Shaker, Reverse-flow, Pulse jet)

5. Fire Protection Considerations in Design:
CV&PGT Personnel must demonstrate a working level knowledge of Fire Protection Considerations in Nuclear Facility Ventilation Design.

Supporting Knowledge and/or Skills:

Suggested Reference Material: DOE-STD-1066, *Fire Protection Design Criteria*; DOE-HDBK-1169, *Nuclear Air Cleaning Handbook*

a. Describe the following risks posed to ventilation equipment by facility fires:
   - Soot
   - Embers
   - Heated Air
   - Exposure to flames

b. Discuss methods of protecting ventilation equipment from facility fires:
   - Water Mist
   - Heat Detection
   - Smoke Detection
   - Fire Walls
   - Area Suppression
   - Ember Screens
   - Deluge systems
   - Demisters
   - Combustible loading controls
   - Flammable Gas Detection

c. Discuss ventilation systems operational considerations for preventing release during fire accident scenarios.

d. Describe considerations in the selection of off-gas treatment media with respect to combustibility including alternative media such as silver zeolite and other methods for preventing or achieving media extinguishment.

Confinement Ventilation: Common Equipment

6. HEPA Filters and Housings:
CV&PGT personnel must demonstrate a working level knowledge of HEPA filter and housings.

Supporting knowledge and/or skills

Suggested Reference Material: American Society of Mechanical Engineers (ASME) AG-1, *Code on Nuclear Air and Gas Treatment*, Sections FC, FK; DOE-STD-3020, *Specification for HEPA Filters used by DOE Contractors*; DOE-HDBK-1169, *Nuclear Air Cleaning Handbook*

a. Describe the following HEPA filter sub-components and discuss the critical characteristics of each. Include application considerations for each:
   - Filter media
   - Filter pack
   - Filter case
   - Filter media separators
   - Filter media-to-pack sealant
   - Seals or gaskets
   - Faceguard

b. Discuss HEPA filter performance requirements and relationship to the ventilation system:
   - Penetration
   - Resistance to air flow
   - Maximum media velocity
   - Maximum differential pressure
   - Maximum design temperature
   - Dust holding capacity
   - High humidity air degradation
   - Acid gas degradation

c. Discuss HEPA filter recommended shelf and service life
   - Maximum recommended service life in wet and dry environments
   - Degradation factors
   - Maximum shelf life

d. Discuss HEPA filter housing configurations and requirements:
   - Single filter housings
   - Multiple filter housings
   - Aerosol test manifolds
   - Mixing uniformity
   - Airflow distribution
   - Filter trains
   - Prefilters

Mandatory Performance Activity:

Given pictures/drawings of HEPAs and housings, identify/describe components and subcomponents.

7. HEPA Filter Qualification:
CV&PGT personnel must demonstrate a working level knowledge of HEPA filter qualification (Proof-of-Design) requirements and qualification process.

Supporting Knowledge and/or Skills

Suggested Reference Material: ASME AG-1, *Code on Nuclear Air and Gas Treatment*, Sections FC, FK; DOE-HDBK-1169, *Nuclear Air Cleaning Handbook*

a. Describe the following qualification tests:
   - Resistance to airflow
   - Penetration
   - Rough handling
   - Heated air
   - Spot flame
   - Resistance to pressure

b. Describe the acceptance criteria for each of the qualification tests.

c. Describe the Qualified Product List published by Edgewood Chemical Biological Center (available in the HSS HEPA Filter website).

8. HEPA Filter testing:
CV&PGT personnel must demonstrate a working level knowledge of HEPA filter in-place testing and inspection requirements and process including testing equipment theory and operation.

Supporting knowledge and/or skills

Suggested Reference Material: ASME AG-1, *Code on Nuclear Air and Gas Treatment*, Sections FC, FK; TA; ASME N511, *Standard for In-Service Testing of Nuclear Air Treatment, Heating, Ventilating, and Air Conditioning Systems*; DOE-HDBK-1169 *Nuclear Air Cleaning Handbook*

a. Discuss pre-installation filter inspection.

b. Describe the purpose for the in-place HEPA filter test.

c. Discuss the requirements for the in-place HEPA filter test (ASME AG-1, N511) and acceptance criteria.

d. Identify required test frequency for the in-place HEPA filter leak test.

e. Describe the basic procedural steps taken during the test.

f. Discuss the type of aerosol generators and the principles of operation.

9. HEPA filter independent quality assurance (Filter Test Facility):
CV&PGT personnel must demonstrate a working level knowledge of HEPA filter independent quality assurance (Filter Test Facility) requirements and process.

Supporting knowledge and/or skills

Suggested Reference Material: DOE-STD-3025, *Quality Assurance Inspection and Testing of HEPA Filters*; DOE-STD-3020, *Specification for HEPA Filters Used by DOE Contractors,* DOE-HDBK-1169, *Nuclear Air Cleaning Handbook*

a. Discuss the purpose of the DOE Filter Test Facility and quality assurance testing.

b. Discuss when testing at the Filter Test Facility is required.

c. Describe the tests and inspections conducted at the DOE Filter Test Facility.

d. Identify HEPA filter quality defects commonly identified by the Filter Test Facility.

e. Discuss the contents of DOE-STD-3025 and the QA requirements for operations at the DOE Filter Test Facility

10. Hoods and Gloveboxes:
CV&PGT personnel must demonstrate a working level knowledge of the basic design, construction, and operation of gloveboxes and fume hoods.

Supporting knowledge and/or skills

Suggested Reference Material: American Glovebox Society, AGS-G001-2007, *Guideline for Gloveboxes*; AGS-G006-2005, *Design and Fabrication of Nuclear Application Gloveboxes*; ASHRAE 110, *Method of Testing Performance of Laboratory Fume Hoods*; DOE-HDBK-1169, *Nuclear Air Cleaning Handbook*

a. Explain the general functions of a glovebox and fume hood.

b. Describe the design considerations of a glovebox, including shielding, criticality safety, seismic requirements, decontamination and decommissioning, materials, reinforcement, gloves and glove ports, filters, atmosphere, fire protection provisions, instrumentation, and testing.

c. Describe the design considerations of a fume hood, such as hood velocity, face opening, sash.

d. Describe the operation of gloveboxes and fume hoods.

e. Describe the maintenance, including routine surveillances that may be applicable to gloveboxes and fume hoods.

11. Fans and Blowers:
CV&PGT Personnel must demonstrate working level knowledge of fan and blower operation and uses.

Supporting knowledge and/or skills

Suggested Reference Material: ASME AG-1 Section BA, Air Movement and Control Association (AMCA) 99; AMCA 201; AMCA 204; AMCA 210 / ASHRAE 51, AMCA 211; DOE-HDBK-1169, *Nuclear Air Cleaning Handbook*

a. Explain the fan laws.

b. Discuss the different types of impeller designs for single stage fans.

c. Discuss ASME AG-1 code requirement tests and inspections.

d. Discuss AMCA fan arrangements (not necessary to memorize numbers but describe the purpose of this numbering system).

e. Discuss AMCA rotation and discharge designations for centrifugal fans.

f. Discuss methods of fan control (variable inlet vanes, inlet or outlet volume control dampers, variable frequency drives) and some benefits and drawbacks of each.

g. Discuss impact to a fan curve from operating fans in series and in parallel.

h. Discuss methods for measuring and monitoring fan performance.

i. Discuss fan control schemes (pressure and flow control).

j. Discuss common fan maintenance and wear parts.

k. Discuss fan acceptance test requirements from ASME AG-1 Section BA.

l. Discuss the difference between a catalog fan performance curve and an AMCA 210 test established performance curve.

m. Discuss fan balance quality and vibration testing and monitoring guidelines.

n. Discuss applications where single stage fans are not sufficient and thus multistage blowers (compressors) would be called for.

Mandatory Performance Activity:

Given system resistance curve and a fan performance curve, identify the operating point, find the pressure, flow, and horsepower at the operating point, determine fan dead-head pressure, describe what a multi-speed curve would look like given a variable frequency drive control, discuss how dirty filters might impact fan performance, discuss how failure to account for system effect would change the system curve and the performance point, and identify the unstable portion of the curve.

12. Dampers and Valves:
CV&PGT Personnel must demonstrate working level knowledge of valve and damper operation and uses.

Supporting knowledge and/or skills

Suggested Reference Material: ASME AG-1 Section BA; AMCA 99; AMCA 201; AMCA 204; AMCA 210 / ASHRAE 51, AMCA 211; ASME AG-1 Section DA; ANSI/FCI 70-2; DOE-HDBK-1169, *Nuclear Air Cleaning Handbook*

a. Describe the different types of dampers.

b. Describe some different types of valves.

c. Discuss typical uses for types of dampers and valves found commonly in a confinement ventilation system or PGT system.

d. Discuss valve and damper maintenance considerations and leak points.

e. Describe ASME AG-1 Section DA damper leakage classes (0, I, II, III) and control valve leakage classifications per ANSI/FCI 70-2 (Class I, II, III, IV, V, VI).

f. Discuss some gasket / valve seat material considerations (resistance to high temperature, radiation, chemical, etc.).

13. Control Systems:
CV&PGT Personnel must demonstrate working level knowledge of control system principles of operation and uses.

Supporting knowledge and/or skills

Suggested Reference Material: DOE-HDBK-1169, *Nuclear Air Cleaning Handbook*
DOE-HDBK-1013, *DOE Fundamentals Handbook, Instrumentation and Control*
Note: Useful tools can also be found on the websites of instrument code committees, industry organizations, and suppliers, such as ISA, Fieldbus, Hartcomm, and Profibus.

a. Discuss ventilation control schemes.

b. Discuss types of instruments used to measure flow and pressure for ventilation control.

c. Discuss types of instruments / indications used to measure fan performance.

d. Discuss methods to transmit signals to control computers.

e. Discuss Proportional Integral and Derivative control settings.

f. Discuss equipment used to control fans.

g. Discuss means of actuating dampers and valves.

HVAC: Technical Concepts

14. Indoor Air Quality, Concentration of Toxic Chemicals, and Dilution Ventilation: CV&PGT personnel must demonstrate a familiarity level knowledge of Indoor Air Quality (IAQ), Concentration of Toxic Chemicals, and Dilution Ventilation.

Supporting Knowledge and/or Skills:

Suggested Reference Material: 29 CFR 1910, Subpart G 1910.94, Ventilation, ASHRAE 62, *Ventilation for Acceptable Indoor Air Quality*; ACGIH Industrial Ventilation, *A Manual of Recommended Practice*; NFPA 101, Life Safety Code (7.2.1.4.5, egress door pressure); ASME AG-1, Section SA; DOE-HDBK-1100, Chemical Process Hazards Analysis, DOE-HDBK-1101, Process Safety Management for Highly Hazardous Chemicals, DOE Protective Action Criteria (PAC) Database, 29 CFR 1910, "Occupational Safety and Health Standards;" 10 CFR 851, Worker Safety and Health Program (hierarchies of control), National Institute for Occupational Safety and Health (NIOSH) Documentation for Immediately Dangerous to Life or Health Concentrations (IDLH); ANSI/ AIHA Z9.2-2012, Fundamentals Governing the Design and Operation of Local Exhaust Ventilation Systems,

a. Discuss potential contaminants that can affect IAQ.

b. Describe control technologies to provide acceptable IAQ.

c. Discuss DOE, NIOSH, and ACGIH toxic chemical control levels.

d. Duct leakage requirements for vacuum and pressurized sections of duct.

15. Psychrometric Charts and Relative Humidity control:
CV&PGT personnel must demonstrate a familiarity level knowledge of Psychrometric Charts and Relative Humidity control

Supporting Knowledge and/or Skills:

a. Suggested Reference Material: ASHRAE Handbook, Fundamentals

b. Discuss methods of controlling relative humidity in ventilation systems.

Mandatory Performance Activities:

a. Given a point on a psychrometric chart, identify:
   - Dry-bulb temperature
   - Wet-bulb temperature
   - Relative humidity
   - Dew point
   - Humidity ratio
   - Specific enthalpy
   - Specific volume
   - Pressure
   - Direction depicting evaporative cooling
   - Direction depicting sensible heating

16. Drawings:
CV&PGT personnel must demonstrate a working level knowledge of Engineering Drawings.

Suggested Reference Material: DOE-HDBK-1016, *DOE Fundamentals Handbook, Engineering Symbology, Prints, and Drawings (Volume 1 & 2)*; IEEE 315A / ANSI 315, *Graphic Symbols for Electrical and Electronics Diagrams*; IEEE 991, *Standard for Logic Circuit Diagrams*; ANSI/ASHRAE 134, *Graphic Symbols for Heating, Ventilation, Air-Conditioning, and Refrigerating Systems*

Mandatory Performance Activities:

a. Given a flow diagram, describe the system at a basic level.

b. Given a Ventilation and Instrumentation Diagram (V&ID) or Piping and Instrumentation Diagram (P&ID) , identify components and instruments.

c. Given a duct or pipe orthographic/isometric drawing, locate and identify certain components called out on the corresponding V&ID.

17. Stack monitoring systems:
CV&PGT personnel must demonstrate a familiarity level knowledge of Stack monitoring systems

Supporting Knowledge and/or Skills:

Suggested Reference Material: ANSI N13.1, *Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities*; 40 CFR 61, Subpart H, *National Emissions Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities*

Discuss considerations for installation of stack monitoring equipment in terms of accessibility, testability, reliability, rule-of-thumb duct diameters for adequate mixing, and where to find stack monitoring system qualification guidelines.

18. High Performance Building:
CV&PGT personnel must demonstrate a familiarity level knowledge of High Performance Building

Supporting Knowledge and/or Skills:

Suggested Reference Material: DOE O 413.3B, Program and Project Management for the Acquisition of Capital Assets; DOE G 413.3-6A, High Performance Sustainable Building; Energy Policy Act of 2005 (EPACT 2005); Energy Independence and Security Act of 2007 (EISA 2007); Executive Order 13423; Executive Order 13514.

a. Describe the basic goals of the DOE Energy Efficiency and Renewable Energy initiative.

b. Demonstrate a basic awareness of the mandatory requirements established by EPACT 2005 and EISA 2007.

HVAC: Common Equipment

19. Air Handling Units:
CV&PGT personnel must demonstrate a familiarity level knowledge of Air Handling Units

Supporting Knowledge and/or Skills:

Suggested Reference Material: ASHRAE Handbook, Systems and Equipment

a. Discuss components of air handling units and basic functions of each.

b. Discuss common mode failures of air handling units.

c. Discuss hazards associated with air handling units.

20. Heat Exchangers:
CV&PGT personnel must demonstrate a familiarity level knowledge of the construction and operation of heat exchangers.

Supporting knowledge and/or skills

Suggested Reference Material: DOE-HDBK-1012/2-92, *Thermodynamics, Heat Transfer, and Fluid Flow (Volume 2 of 3)*; DOE-HDBK-1018/2-93, *Mechanical Science (Volume 2 of 2)*.

a. Describe the principle of operation for the following types of heat exchangers:
   - Shell and tube
   - Fin and tube
   - Cooling tower

b. Define the following terms as they apply to heat exchangers:
   - Tube sheet
   - Telltale drain
   - Parallel flow
   - Counter-flow
   - Cross-flow

c. Explain the principle of operation of a forced-draft cooling tower.

d. Explain the principle of operation of a natural convection (parabolic) cooling tower.

21. Chillers:
CV&PGT personnel must demonstrate a familiarity level knowledge of the theory and operation of HVAC Chillers.

Supporting Knowledge and/or Skills:

Suggested Reference Material: DOE-HDBK-1018/2-93, *Mechanical Science (Volume 2 of 2)*

a. Define the following terms as they apply to HVAC systems:
   - Latent heat of vaporization
   - Latent heat of fusion
   - Refrigerant
   - Vaporization point
   - Air and non-condensable gases

b. Discuss the function of the following components of a typical HVAC system:
   - Chiller
   - Pressure sensor
   - Differential pressure indicator
   - Compressor
   - Condenser
   - Thermal expansion valve
   - Evaporator coils
   - Receiver

c. Discuss refrigerant leak detection.

d. Discuss the general hazards involved in handling refrigerants.

e. Given a diagram of a basic Chiller system, discuss the theory of operation of Chiller systems and identify the system's components and their functions.

Process Gas Treatment

22. Flammable gas generation and venting:
CV&PGT personnel must demonstrate a familiarity level knowledge of flammable gas generation and venting to prevent exceeding Lower Flammable Limit (LFL) concentration.

Supporting Knowledge and/or Skills:

Suggested Reference Material: NFPA 69 2008 Edition, "Explosion Prevention Systems," Annex D, "Ventilation Calculations," DOE-STD-1066 *Fire Protection Design Criteria*

a. Discuss sources of flammable gases associated with liquid radioactive waste.

b. Discuss methods of controlling environment below LFL.

23. Process Gas Treatment:
CV&PGT personnel must demonstrate a familiarity level knowledge of PGT.

Supporting Knowledge and/or Skills:

Suggested Reference Material: ASHRAE *Handbook Systems and Equipment, Section on Industrial Gas Cleaning and Air Pollution Control*; DOE-HDBK-1169, *Nuclear Air Cleaning Handbook*; ASME AG-1, *Code on Nuclear Air and Gas Treatment;* Perry's Chemical Engineers' Handbook.

a. Discuss equipment used for treating waste streams for removal or reduction of gaseous chemical contaminants:
   - Adsorption beds
   - Scrubbers
   - Thermal oxidizers
   - Catalytic reducers

b. Discuss various types of scrubbers and electrostatic precipitators used to remove solid chemical contaminants from process gas treatment airstreams.
   - Condensers
   - Electrostatic Filters and Precipitators
   - Wet Scrubbers

Regulatory: Management, Assessment, and Oversight

24. DOE O 420.1C, Facility Safety:
CV&PGT personnel must demonstrate a working level knowledge of DOE O 420.1C, Facility Safety and of the associated guidance of DOE G 420.1-1A, *Nonreactor Nuclear Safety Design Guide for Use with DOE O 420.1C, Facility Safety* as they relate to confinement ventilation and process gas treatment systems.

Suggested Reference Material: DOE O 420.1C, *Facility Safety*; DOE-STD-1020, *Natural Phenomena Hazards Analysis and Design Criteria for DOE Facilities*; DOE G 420.1-1A, *Nonreactor Nuclear Safety Design Guide for use with DOE O 420.1C, Facility Safety*, Section 5.4.12, and APPENDIX A: Confinement Ventilation Systems Design and Performance Criteria.

Supporting Knowledge and/or Skills:

a. Discuss the purpose and applicability of DOE O 420.1C, Facility Safety.

b. Discuss the requirements imposed by DOE O 420.1C on the contractors that operate DOE nuclear facilities.

c. Discuss the focus and the content of the sections of DOE O 420.1C:
   - Nuclear Safety Design Criteria
   - Fire protection
   - Nuclear criticality safety
   - Natural phenomena hazards mitigation
   - Cognizant System engineer program

d. Discuss the content of Design Criteria for Safety Structures, Systems, and Components (Attachment 3 of DOE O 420.1C).

e. Discuss the scope and general content of DOE G 420.1-1A.

f. Discuss the scope and general content of the Confinement Ventilation Systems Design and Performance Criteria listed in DOE G 420.1-1A, Appendix A.

g. Discuss the differences and design considerations of Safety Class, Safety Significant, and Defense-in-Depth CV&PGT systems.

25. Code Requirements:
CV&PGT Personnel must demonstrate a familiarity level knowledge of applicable codes and standards and DOE handbooks.

Supporting Knowledge and/or Skills:

Suggested Reference Material: Applicable standards are listed as reference materials in previous competencies within this standard.

Discuss the general scope and subject matter for various standards and DOE handbooks that are relevant to activities conducted at DOE defense nuclear facilities:

- DOE-HDBK-1169
- DOE-STD-3020
- DOE-STD-3025
- ASHRAE handbooks, design guides, standards
- ASME AG-1
- AMCA
- American Glovebox Society
- ACGIH
- NFPA

26. Configuration Management (CM), Maintenance, and Startup:
CV&PGT personnel must demonstrate a working level knowledge of CM.

Supporting Knowledge and/or Skills:

Suggested Reference Material: DOE-STD-1073-2003, *Configuration Management Program*.

a. Describe the purpose and objectives of CM, emphasizing the following elements:
   - Design control
   - Work control
   - Change control
   - Document control
   - Assessment

b. Discuss the site-specific process for dispositioning work and change packages.

27. System Design Descriptions:
CV&PGT personnel must demonstrate a familiarity level knowledge of System Design

Descriptions

Supporting Knowledge and/or Skills:

Suggested Reference Material: DOE-STD-3024, *Content of System Design Descriptions*

a. Discuss the purpose scope and application of DOE-STD-3024. Included in the discussion the key terms, essential elements, and personnel responsibilities.

b. Discuss the system functional requirements.

c. Discuss the key elements
   - Configuration
   - Operation
   - Testing and Maintenance

28. Maintenance Management Practices:
CV&PGT personnel must demonstrate a working level knowledge of maintenance management practices.

Supporting Knowledge and/or Skills:

Suggested Reference Material: DOE O 433.1B, *Maintenance Management Program for DOE Nuclear Facilities;* DOE G 433.1-1A, *Nuclear Facility Maintenance Management Program Guide for Use with DOE O 433.1B;* and DOE O 426.2 *Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities*

a. Define each of the following maintenance-related terms and explain its relationship to the others:
   - Corrective
   - Planned
   - Preventive
   - Reliability centered
   - Predictive

b. Describe the elements of an effective work control program and the documentation used to control maintenance.

c. Discuss the importance of maintaining a proper balance of preventive and corrective maintenance.

d. Define the term “life-limiting component” and discuss its impact on facility operation.

e. Identify typical maintenance performance indicators and discuss their importance.

f. Discuss how maintenance is related to conduct of operations, quality assurance, and configuration management.

g. Discuss the purpose of Reliability, Availability, Maintainability, and Inspectability analyses in the establishment of maintenance requirements.

h. Discuss the training and qualification requirements for personnel who may perform maintenance on nuclear facility engineered safety features.

29. Assessment Techniques:
CV&PGT personnel must demonstrate a working level knowledge of assessment techniques to assess facility performance and contractor design and construction activities, report results, and follow-up on actions taken as the result of assessments.

Supporting Knowledge and/or Skills:

Suggested Reference Material: DOE G 414.1-1B, *Management and Independent Assessments Guide*

Discuss the following elements of the assessment/surveillance process:

- Facility Notification
- Surveillance / Assessment Plan
- Entrance meetings
- Assessment and Surveillance conduct methods (interviews, document reviews, observation)
- Factual Accuracy review
- Exit meetings
- Closure process
- Tracking to closure
- Follow-up
- Contractor corrective action implementation

30. Corrective Action Management & Causal Analysis:
CV&PGT personnel must demonstrate a familiarity level knowledge of problem analysis principles and the ability to apply the techniques necessary to identify problems, determine potential causes of problems, and identify corrective action(s).

Supporting Knowledge and/or Skills:

Suggested Reference Material: Archived DOE O 232.2, *Occurrence Reporting Causal Analysis Guide*

a. Describe and explain the application of problem analysis techniques including the following:
   - Root Cause Analysis (RCA)
   - Causal factor analysis
   - Change analysis
   - Barrier analysis
   - Management Oversight Risk Tree analysis

b. Describe and explain the application of the following RCA processes in the performance of occurrence investigations:
   - Event and causal factors charting
   - Root cause coding
   - Recommendation generation

Mandatory Performance Activity:

Witness at least one contractor or Department problem analysis.

31. Safety-in-Design:
CV&PGT personnel must demonstrate a familiarity level knowledge of safety in design as described and required in DOE O 413.3B, Program and Project Management for the Acquisition of Capital Assets.

Supporting Knowledge and/or Skills:

Suggested Reference Material: *DOE STD 1189, Integration of Safety into the Design Process;* DOE O 413.3B, *Program and Project Management for the Acquisition of Capital Assets*; DOE M 413.3-1, *Project Management for the Acquisition of Capital Assets*.

a. Describe the safety considerations for the design process, including:
   - Importance of identification of hazards early in the project
   - Importance of integrated team approach to design safety into the facility
   - Role of the Integrated Project Team
   - Role of the Safety Design Integrated Team
   - Discuss Safety Design Strategy
   - Discuss key actions that should be accomplished in the conceptual design stage
   - Discuss the Conceptual Safety Design Report
   - Discuss the Preliminary Safety Design Report
   - Discuss the Preliminary Documented Safety Analysis
   - Discuss the importance of a Risk Management Plan
   - Discuss order of preference for control selection strategy

b. Discuss the Confinement Ventilation / PGT system reviewer's responsibilities at each critical decision point as described in DOE O 413.3B.
   - CD-0 Approve Mission Need
   - CD-1 Approve Alternate Selection and Cost Range
   - CD-2 Approve Performance Baseline
   - CD-3 Approve Start of Construction
   - CD-4 Approve Start of Operations or Project Completion

c. Discuss the purpose scope and application of DOE O 425.1D. Included in the discussion the key terms, essential elements, and personnel responsibilities.

d. Discuss the Confinement Ventilation / PGT reviewer's responsibilities as stated in DOE M 413.3-1.

II. Master Level Engineering Qualification: Confinement Ventilation and Process Gas Treatment

32. Cascading Ventilation:
CV&PGT personnel must demonstrate a master level knowledge of the engineering principles and practices for radioactive contamination control using the confinement ventilation system.

Supporting Knowledge and/or Skills:

Suggested Reference Material: DOE-HDBK-1169, *Nuclear Air Cleaning Handbook*; ASHRAE HVAC Applications (Chapter 28 Nuclear Facilities); ASHRAE DG-1, *HVAC Design Guide for DOE Nuclear Facilities*; ACGIH Industrial Ventilation, *A Manual of Recommended Practice*.

a. Describe in detail the cascading ventilation pressure zones, and discuss control schemes necessary to obtain appropriate differential pressure between zones.

b. IDENTIFY which functions are typically considered safety functions (i.e., which accidents credit system components as preventive or mitigative barriers). In particular, discuss:
   - Filtration
   - Leak Path Factor
   - Aerosol Entrainment per DOE-HDBK-3010
   - Active vs. Passive Systems
   - Flammable gas Mitigation

c. Discuss the types and role of atmospheric reference systems.

d. Describe use of airlocks in confinement ventilation systems.

33. HEPA Filters and Housings:
CV&PGT personnel must demonstrate a master level knowledge of HEPA filter and housings.

Supporting knowledge and/or skills

Suggested Reference Material: ASME AG-1, *Code on Nuclear Air and Gas Treatment*, Sections FC, FK; DOE-STD-3020, *Specification for HEPA Filters used by DOE Contractors*; DOE-HDBK-1169 *Nuclear Air Cleaning Handbook.*

a. Discuss HEPA filter design types.
   - Axial Flow
   - Radial Flow
   - Encapsulated
   - High Strength
   - Metal media

b. Discuss HEPA filter pack types and the limitations of each.

c. Discuss typical common filter failures and elements of the filter design to mitigate failures.

d. Discuss filter degradation factors, such as: wetting and humidity, aging, exposure to chemicals such as acid gas, radiation, or heat.

e. Discuss the basis for the current HEPA filter service life requirements.

f. Discuss loading characteristics of HEPA filters considering challenges imposed by hazards and accident scenarios.

Mandatory Performance Activity:

Attend nuclear ventilation/filtration conference such as ISNATT Nuclear Air Cleaning Conference or DOE Waste Management Conference.

34. HEPA Filter Qualification:
CV&PGT personnel must demonstrate a master level knowledge of HEPA filter qualification (Proof-of-Design) requirements and qualification process.

Supporting Knowledge and/or Skills

Suggested Reference Material: ASME AG-1 (*Code on Nuclear Air and Gas Treatmen*t), Sections FC, FK; DOE-HDBK-1169 *Nuclear Air Cleaning Handbook.*

a. Describe the equipment and procedure used to perform the following HEPA filter qualification tests:
   - Resistance to airflow
   - Penetration
   - Rough handling
   - Heated air
   - Spot flame
   - Resistance to pressure

b. Describe the acceptance criteria for each of the qualification tests.

Mandatory Performance Activity:

Tour Edgewood Chemical Biological Center HEPA filter qualification facility.

35. HEPA Filter testing:
CV&PGT personnel must demonstrate a master level knowledge of HEPA filter in-place testing requirements and process including testing equipment theory and operation.

Supporting knowledge and/or skills

Suggested Reference Material: ASME AG-1 (*Code on Nuclear Air and Gas Treatmen*t), Sections FC, FK; TA; ASME N511, *Standard for In-Service Testing of Nuclear Air Treatment, Heating, Ventilating, and Air Conditioning Systems;* DOE-HDBK-1169 *Nuclear Air Cleaning Handbook*

a. Discuss the types of oils used to generate aerosol.

b. Discuss the instruments used for aerosol concentration measurement and the principles of operation.
   - Photometer
   - Laser Particle Counter

c. Compare and contrast the in-place aerosol test equipment with the production test equipment.

Mandatory Performance Activity:

Attend comprehensive HEPA filter testing training such as Harvard School of Public Health In-Place Filter Testing Workshop.

36. HEPA filter independent quality assurance (Filter Test Facility):
CV&PGT personnel must demonstrate a master level knowledge of HEPA filter independent quality assurance (Filter Test Facility) requirements and process.

Mandatory Performance Activities:

a. Tour DOE Filter Test Facility.

b. Review and Discuss Filter Test Facility defects over the past year.

37. Entrainment of Aerosols and Particulate:
CV&PGT personnel must demonstrate a working level knowledge of entrainment of aerosols in the airstream.

Supporting Knowledge and/or Skills:

Suggested Reference Materials: DOE-HDBK-3010, Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities

a. DESCRIBE mechanisms causing entrainment of particulate and aerosols and discuss where to find appropriate airborne release fractions corresponding to accident scenarios.

38. Flammable Gas Generation and venting:
CV&PGT personnel must demonstrate a working level knowledge of Flammable Gas Generation and venting to prevent exceeding LFL concentration.

Supporting Knowledge and/or Skills:

Suggested Reference Material: NFPA 69 2002 Edition, “Explosion Prevention Systems,” Annex D, “Ventilation Calculations,” DOE-STD-1066, *Fire Protection Design Criteria*

Describe the mechanisms of thermolysis, radiolysis, and corrosion responsible for release of flammable gases in large volumes of liquid radioactive waste.

39. Chemical and Radiological Holdup and Treatment:
CV&PGT personnel must demonstrate a working level knowledge of Chemical and Radiological Holdup and treatment.

Supporting Knowledge and/or Skills:

Suggested Reference Material: ASME AG-1, *Code on Nuclear Air and Gas Treatment;* DOE-HDBK-1169 *Nuclear Air Cleaning Handbook*); ASHRAE Handbook, Systems and Equipment, Perry's Chemical Engineers' Handbook.

a. Describe methods and identify equipment used for treating waste streams for removal or reduction of the following hazards:
   - Radioactive Iodine
   - Acid Gas (HF)
   - Mercury
   - Entrained liquid droplets
   - Entrained solid particles
   - High humidity airstreams
   - Volatile Organic Compounds
   - NOx, SOx

40. Process Gas Treatment:
CV&PGT personnel must demonstrate a working level knowledge of PGT.

Supporting Knowledge and/or Skills:

Suggested Reference Material: ASHRAE, *Handbook Systems and Equipment, Section on Industrial Gas Cleaning and Air Pollution Control*; ASME AG-1, *Code on Nuclear Air and Gas Treatment;* Perry's Chemical Engineers' Handbook.

a. Discuss various types of scrubbers and electrostatic precipitators used to remove solid chemical contaminants from process gas treatment airstreams:
   - Condensers
   - Electrostatic Filters and Precipitators
     - One stage / Two stage
   - Wet Scrubbers:
     - Gravity Spray,
     - Centrifugal,
     - Impingement,
     - Packed Bed,
     - Dynamic,
     - Cyclone
     - Venturi / Venturi-Cyclone

b. Discuss equipment used for treating waste streams for removal or reduction of gaseous chemical contaminants:
   - Adsorption beds
     - Activated carbon
     - Impregnated carbon

  - Fixed, moving and fluidized beds
- Scrubbers
  - Caustic scrubbers
  - Packed scrubbers
- Thermal oxidizers
- Catalytic oxidizers/reducers

41. Documented Safety Analysis (DSA):
CV&PGT personnel must demonstrate a working level knowledge of the DSA and Technical Safety Requirements (TSR) of 10 CFR 830 Subpart B, "Safety Basis Requirements," and the DOE standards and Guides supporting implementation of 10 CFR 830 Subpart B.

Supporting Knowledge and/or Skills:

Suggested Reference Material: 10 CFR 830 Subpart B, "*Safety Basis Requirements*"; DOE-STD-3009-94, Change Notice 3, "*Preparation Guide for U.S. DOE Nonreactor Nuclear Facility Documented Safety Analyses;*" DOE-STD-1104-2009, "*Review and Approval of Nuclear Facility Safety Basis and Safety Design Basis Documents;*" DOE G 421.1-2A, "*Implementation Guide for Use In Developing Documented Safety Analyses to Meet Subpart B of 10 CFR 830;*" DOE G 423.1-1A, "*Implementation Guide for Use In Developing Technical Safety Requirements;*" DOE G 424.1-1B, *Implementation Guide for Use in Addressing Unreviewed Safety Question Requirements*

a. Define and compare the terms "hazard" and "risk."

b. Explain and compare the terms "safety basis," "design basis," and "authorization basis."

c. Discuss the relationship of DSAs to TSRs.

d. Describe the contractor responsibilities for TSRs and DSAs.

e. Define the following terms and discuss the purpose of each:
   - Safety limit
   - Design features
   - Limiting control settings
   - Limiting conditions for operation
   - Surveillance requirements

f. Discuss the possible source documents that may be used in developing TSRs.

g. Discuss the conditions that constitute a violation of TSRs.

h. State the general requirements for a DSA and for a Preliminary Documented Safety Analysis.

i. Discuss the USQ process
   - Describe the purpose of the USQ process.
   - Discuss the reasons for performing a USQ determination.
   - Define and discuss key USQ process terms.
     - Potential Inadequacy of Previous Safety Analyses (PISA)

- o Positive USQ determination
- o Justification for Continued Operations (JCO)

42. DOE-STD-3009:
CV&PGT personnel must demonstrate a working level knowledge of the requirements in DOE-STD-3009-94, Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analyses

Supporting Knowledge and/or Skills:

Suggested Reference Material: DOE-STD-3009-94, Change Notice 3

a. Discuss the conceptual basis and process for preparation of a facility/process DSA.

b. Discuss the following in relation to the preparation of the DSA:
   - Worker safety
   - Defense-in-depth
   - Hazard analysis
   - Accident analysis
   - Controls selection
   - TSRs
   - SSC
   - Application of the graded approach.

c. Discuss the relationship between DOE-STD-3009-94, Change Notice 3, Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports, and 10 CFR 830.120 Subpart B, “Nuclear Safety Management.”

d. Discuss the requirements for the safety analysis report chapter structure and content as specified in DOE-STD-3009-94, Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses.”

43. System Design Descriptions:
CV&PGT personnel must demonstrate a working level knowledge of System Design Descriptions

Suggested Reference Material: DOE-STD-3024, *Content of System Design Descriptions*

Supporting Knowledge and/or Skills:
a. Discuss technical content criteria and guidance.
b. Discuss the essential constituents of safety functions.
c. Discuss the following Terms:
   - System, Support System, Subsystem, System Engineer
   - Safety SSCs
   - Operability

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APPENDIX A
CONTINUING EDUCATION, TRAINING, AND PROFICIENCY PROGRAM

The following list represents suggested continuing education, training, and other opportunities that are available for DOE personnel after completion of the competency requirements in this technical FAQS. It is extremely important that personnel involved with this program maintain their proficiency primarily by regularly demonstrating their competency through on-the-job performance, supplemented with continuing education, training, reading, or other activities, such as, workshops, seminars, and conferences. The list of suggested activities was developed by the subject matter experts involved in the development of FAQS and is not all-inclusive.

No formal requalification is required. However, it is suggested that the activities listed below support the maintenance of proficiency in the CV & PGT Functional Area after completion of the competencies in the Standard and other requirements of the TQP.

The proficiency points section describes guidelines for documenting maintenance of proficiency at five (5) year intervals.

LIST OF CONTINUING EDUCATION, TRAINING, AND OTHER ACTIVITIES

1. Continuing technical education and/or training covering topics directly related to the CV&PGT area as determined appropriate by management. This may include courses/training provided by 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.

   Topic-specific courses offered by:

   a. DOE
   b. DOE operating contractors
   c. Other Federal and Non-Federal agencies

2. Attend seminars, symposia, or technical meetings related to CV&PGT, such as:

   a. ISNATT Nuclear Air Cleaning Conference
   b. DOE/Contractor Waste Management Conference
   c. AMSE CONAGT Summer and Winter meetings
   d. Other industry meetings

3. Engage in self-study of new regulations, requirements, or advances related to CV&PGT engineering.

4. Participation in practical exercises such as emergency or operational drills, simulations, or laboratory-type exercises.

5. Specific continuing training requirements must be documented in Individual Development Plans (IDP).

PROFICIENCY POINTS

DOE Federal CV&PGT engineers, covered under this FAQS shall maintain proficiency points every five (5) years after initial qualification. Qualifying Officials must document the qualification and proficiency point process which shall, at a minimum, include the following:

1. A combination of written examinations, oral examination, or facility/site walkthroughs, as necessary, to demonstrate competency on the new material and those areas from the initial qualification where the individual has not demonstrated ongoing experience during the past five (5) years. This must include items added to this FAQS since the individual's last qualification.

2. For Basic Level requalification, a minimum of thirty-five (35) proficiency points must be earned in each five (5) year period after qualification.

3. For Master Level requalification, a minimum of fifty (50) proficiency points must be earned in each five (5) year period after qualification.

The following sections provide guidance for assigning proficiency points. Additional activities of a similar nature related to CV&PGT engineering duties may be assigned points as agreed in IDPs.

Active participation in CV&PGT duties:

- 1 point per year for each 500 work hours performing CV&PGT duties
- Not to exceed 20 points in 5 years

Participation in CV&PGT assessments/evaluations:

- 1 point for each assessment of 2 weeks duration on site
- Assessments lasting less than 2 weeks may be rolled-up into 2 week totals
- Not to exceed 10 points in 5 years

Maintenance of Professional Engineer (PE) or Certified Industrial Hygienist (CIH) registration

- 1 point per year

Pass Engineer-In-Training (EIT) exam or PE exam

- 4 points per exam
- One time only

Membership in CV&PGT organizations such as ASME CONAGT, ASHRAE, DOE Technical Working Group

- 1 point per year per organization
- Not to exceed 10 points in five (5) years

Active member of technical committee in field of CV&PGT (ASME CONAGT, ASHRAE)

- 1 point per year per committee
- Not to exceed 10 points in five years

Chair technical committee in field of CV&PGT

- 1 point per year
- Not to exceed 5 points in five years

Professional publications on CV&PGT topics

- 1 point per publication
- Not to exceed 5 points in five years

Successfully complete CV&PGT courses/seminars courses offered by:

- DOE or DOE operating contractors
- ASHRAE
- Harvard School of Public Health
- Air Pollution Training Institute (APTI)
- Nucon International ANSI/ASME N510 Testing Workshop
- Other Federal and Non-Federal agencies
- 2 points per day of training or 1 point per CEU
- Not to exceed 20 points in five years

Attend professional CV&PGT conferences, workshops and meetings, such as:

- ISNATT Nuclear Air Cleaning Conference
- DOE/Contractor Waste Management Conference
- AMSE CONAGT Summer and Winter meetings
- 1 point per day of participation
- Not to exceed 30 points in five years

Presentations at CV&PGT conferences, meetings, seminars, courses

- 1 point per presentation
- Not to exceed 10 points in five years

Participation in DOE HEPA Filter Technical Working Groups in support of DOE-HQ

- 1 point per assigned task
- Not to exceed 5 points in five years

Tour Nuclear Air Cleaning Technologies test laboratories

- DOE FTF
- Department Of Defense ECBC
- Mississippi State University, Institute for Clean Energy Technology
- Underwriters Laboratories
- 1 point per tour
- Not to exceed 5 points in five years

INTENTIONALLY BLANK

DOE-STD-1168-2013

CONCLUDING MATERIAL

Review Activity:
EM
NNSA
NE
SC

Preparing Activity:
DOE-ORP

Project Number:
TRNG-0080

Field and Operations Offices:
CH
ID
OH
ORP
RFFO
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
Savannah River Field Office
Sandia Field Office