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

ORDER

DOE O 420.1C

Approved: 12-4-2012
Chg 1: 2-27-2015

SUBJECT: FACILITY SAFETY

1. OBJECTIVE. To establish facility and programmatic safety requirements for the Department of Energy (DOE), including the National Nuclear Security Administration (NNSA), for:

   a. Nuclear safety design criteria;

   b. Fire protection;

   c. Criticality safety;

   d. Natural phenomena hazards (NPH) mitigation; and,

   e. Cognizant system engineer (CSE) program.

   Facility safety requirements for explosive, chemical, and industrial hazards are contained in other DOE rules and directives.

2. CANCELLATIONS. This Order (O) cancels: DOE O 420.1B, Chg 1, *Facility Safety*, dated 04-19-10; DOE Guide (G) 420.1-2, *Guide for the Mitigation of Natural Phenomena Hazards for DOE Nuclear Facilities and Nonnuclear Facilities*, dated 03-28-00; and, DOE G 420.1-3, *Implementation Guide for DOE Fire Protection and Emergency Services Programs for Use with DOE O 420.1B, Facility Safety*, dated 09-27-07. Cancellation of a directive does not, by itself, modify, or otherwise, affect any contractual or regulatory obligation to comply with the directive. Contractor Requirements Documents (CRDs) that have been incorporated into a contract remain in effect throughout the term of the contract unless, and until, the contract or regulatory commitment is modified to either eliminate requirements that are no longer applicable or to substitute a new set of requirements.

3. APPLICABILITY.

   a. Departmental Applicability. This Order applies to all DOE elements with responsibility for design, construction, management, operation, decontamination, decommissioning, or demolition of government-owned or government-leased facilities and onsite contractor-leased facilities used for DOE mission purposes.

      The NNSA Administrator will ensure that NNSA employees comply with their respective responsibilities under this directive. Nothing in this Order will be construed to interfere with the NNSA Administrator's authority under section 3212(d) of Public Law (P.L.) 106-65, *National Defense Authorization Act for Fiscal Year 2000*, to establish Administration-specific policies, unless disapproved by the Secretary.

b. DOE Contractors. Except for the equivalencies and exemptions in Section 3.c, the CRD (see Attachment 1 of this Order) sets forth requirements of this Order that will apply to contracts that include the CRD. The CRD, or its requirements, must be inserted into all contracts that require design, construction, management, operation, decontamination, decommissioning, or demolition of government-owned and government-leased facilities.

c. Equivalencies and Exemptions.

(1) Requests for equivalencies and exemptions to the requirements of this Order are processed in accordance with DOE O 251.1C, *Departmental Directives Program*, dated 01-15-09. Central Technical Authority (or designee) concurrence is required for both exemptions and equivalencies to this Order for nuclear facilities. (Note: This includes exemptions to DOE technical standards and industry codes, and standards required by this Order.)

(2) Equivalencies to DOE technical standards, as well as industry codes, and standards, determined to be applicable to the facility design or operations must demonstrate an equivalent level of safety (i.e., meets or exceeds the level of protection) and must be approved by the DOE field element. The DOE field element must follow provisions for relief if specified in DOE technical standards and industry codes and standards. (Note: Different codes and standards may use different terminology for relief; e.g., for building code applications, the terms 'modification' or 'alternative' may be substituted for 'equivalency'.)

(3) Equivalency. In accordance with the responsibilities and authorities assigned by Executive Order 12344, codified in 50 U.S.C. sections 2406 and 2511, and to ensure consistency through the joint Navy/DOE Naval Nuclear Propulsion Program, the Deputy Administrator for Naval Reactors (Director) will implement and oversee requirements and practices pertaining to this Directive for activities under the Director's cognizance, as deemed appropriate.

(4) Exemption. This Order does not apply to activities that are regulated by the Nuclear Regulatory Commission (NRC) or a state under an agreement with the NRC, including activities certified by the NRC under Section 1701 of the Atomic Energy Act. DOE orders, regulations, technical standards, and/or guidelines will apply to activities where the NRC does not exercise regulatory authority or by agreement with NRC.

(5) Exemption. This Order does not apply to transportation activities that are regulated by the Department of Transportation.

(6) Exemption. The following portions of this Order do not apply to accelerator facilities that are covered by DOE O 420.2C, *Safety of Accelerator Facilities,* dated 07-21-11: (1) nuclear safety design requirements, and (2) system engineer program requirements.

(7) Exemption. Specific, individual requirements of this Order do not apply to Nuclear Explosive and Weapons Surety Program activities for the prevention of nuclear detonations if application of such specific requirements would compromise the safety and effectiveness of these activities. In the event of such conflicts between specific requirements of this Order and those of DOE O 452.1D, *Nuclear Explosive and Weapon Surety Program*, dated 04-14-09 or DOE O 452.2D, *Nuclear Explosive Safety*, dated 04-14-09, the related requirements of these latter weapons and explosives safety directives take precedence.

(8) Exemption. This Order does not apply to the Bonneville Power Administration, in accordance with Secretarial Delegation Order Number 00-033.00B to the Bonneville Power Administrator and Chief Executive Officer, dated 07-20-09.

(9) Exemption. The design requirements in this Order do not apply to projects that have reached a high level of design maturity, as determined by the appropriate Secretarial Offices, as of the issuance date of this Order. Examples of projects that have reached a high level of design maturity include projects that have completed the critical decision (CD)-2 milestone or those projects that have completed the CD-1 milestone with a high level of design maturity. This exemption is provided to control project costs; new design requirements in this Order may be considered for inclusion where they provide significant benefits and/or net cost savings.

(10) Exemption. This Order does not apply to off-site office facilities that are owned or leased by the General Services Administration.

d. Government-Owned, Government-Operated Facilities. The CRD (see Attachment 1 of this Order) sets forth requirements that must also be applied to DOE government-owned, government-operated facilities. Government operators must comply with the requirements in the CRD, as set forth in Attachment 1 of this Order.

4. REQUIREMENTS. DOE must:

a. Approve and oversee contractor programs, as specified in Section 5 of this Order;

b. Implement the requirements in Attachment 1 of this Order for government-owned government-operated facilities;

c. Provide oversight of the contractor CSE program and the operability of safety systems under the purview of the CSE program;

d. Document any operational responsibilities that are assigned to the contractor regarding the authority having jurisdiction (AHJ) for matters involving fire protection as defined by the National Fire Protection Association (NFPA) codes;

e. Document any authorities associated with the building code official, as defined in DOE Standard (STD)-1066-2012, *Fire Protection*, that are assigned to the contractor;

f. Establish an integrated site-wide wildland fire management plan, consistent with the relevant portions of the Federal Wildland Fire Management Policy;

g. Direct its contractors, as applicable, to use DOE-STD-3009-2014, *Preparation of Nonreactor Nuclear Facility Documented Safety Analysis*, for preparing documented safety analyses, when the DOE-STD-3009 method is used to satisfy 10 Code of Federal Regulations (C.F.R.) Part 830, *Nuclear Safety Management*, requirements for new DOE non-reactor nuclear facilities and major modifications to existing DOE non-reactor nuclear facilities [note: for such major modifications to existing non-reactor nuclear facilities, the appropriate Secretarial Officer, with concurrence by the applicable Central Technical Authority, may approve use of DOE-STD-3009-94];

h. Direct its contractors, as applicable, to use DOE-STD-3009-2014, for reviewing and revising applicable documented safety analyses, when the DOE-STD-3009 method is used to satisfy 10 C.F.R. Part 830 requirements for existing DOE non-reactor nuclear facilities that have mitigated off-site dose estimates greater than 25 rem; and,

i. Review and approve safety basis and safety design basis documents in accordance with DOE-STD-1104-2014, *Review and Approval of Nuclear Facility Safety Basis and Safety Design Basis Documents*.

5. RESPONSIBILITIES.

a. Secretarial Officers.

(1) Ensure that the requirements of this Order and the CRD are implemented for facilities, activities, or programs under their cognizance. Review, and where justified, approve requests for equivalencies and exemptions to the requirements of this Order, processed in accordance with DOE O 251.1C.

(2) In accordance with Section 3.c.(1) of this Order, approve the basis for not including multiple physical barriers to prevent or mitigate the unintended release of radioactive materials to the environment, as part of the hazard

category 1, 2 and 3 nuclear facility designs, where justified by sound technical basis.

(3) Review and approve safety basis and safety design basis documents in accordance with DOE-STD-1104-2014.

b. Associate Under Secretary, Office of Environment, Health, Safety and Security.

(1) Develop and maintain policy, requirements, guidance, and technical standards relating to this Order and the CRD.

(2) Provide technical advice and assistance on the implementation of policy, requirements, guidance, and technical standards related to this Order and the CRD.

(3) Provide comments on requests for exemptions from requirements of this Order.

c. Director, Office of Independent Enterprise Assessments.

(1) Plan and conduct independent oversight reviews of implementation of the requirements of this Order and the CRD (see DOE O 226.1B, *Implementation of Department of Energy Oversight Policy*, dated 04-25-11, and DOE O 227.1, *Independent Oversight Program*, dated 08-30-11, for details).

d. Heads of Field Elements.

(1) Ensure that the facilities, activities, and programs under their purview operate in compliance with the requirements of this Order and the CRD.

(2) Identify contracts to which the CRD applies and notify contracting officers when contracts are affected by this Order.

(3) Review and, where justified, approve equivalencies to DOE technical standards and industry codes and standards determined to be applicable to the facility design or operations.

(4) Approve contractors' emergency services organization baseline needs assessments (BNAs) that meet the requirements in Attachment 2, Chapter II, Section 3.e.(1) of this Order.

(5) Approve contractors' fire protection program (this may be accomplished in conjunction with 10 C.F.R. Part 851, *Worker Health and Safety Program*).

(6) Fulfill the roles and responsibilities for the AHJ for matters involving fire protection, as defined by the NFPA, including documentation of any delegation or assignment of related responsibilities.

(7) Fulfill the roles and responsibilities for the building code official, as defined in DOE-STD-1066-2012, including documentation of any delegation or assignment of related responsibilities.

(8) Perform responsibilities of 'owner,' or other equivalent term in the application of DOE technical standards or industry codes and standards, including documentation of any delegation or assignment of related responsibilities. .

(9) Approve the contractors' criticality safety program documentation, ensure that it meets requirements in Chapter III of Attachment 2 of this Order. (This may be accomplished through the safety basis documentation approval process.)

(10) Approve periodic NPH assessment evaluations, any recommended update actions, and any recommended upgrade plans, in accordance with Chapter IV of Attachment 2 of this Order.

(11) Provide oversight for contractor CSE programs and the operability of associated safety systems.

(12) Consistent with DOE O 226.1B, establish and implement an appropriate self-assessment and oversight program for the elements of this Order.

(13) In accordance with DOE-STD-1104-2014, review and approve safety basis and safety design basis documents.

e. Contracting Officers. Incorporate the CRD, or its requirements, into affected contracts and procurement requests in a timely manner when notified.

f. Central Technical Authorities.

(1) Review and, where justified, concur on requests for equivalencies and exemptions to the requirements of this Order, processed in accordance with DOE O 251.1C.

(2) Provide support, as requested by the DOE field element, on review of equivalencies to DOE technical standards and industry codes and standards determined to be applicable to the facility design or operations.

6. REFERENCES AND ACRONYMS. References and acronyms can be found in Attachment 4 of this Order.

7. CONTACT. Address inquiries to the Office of Environment, Health, Safety and Security; Office of Nuclear Safety, 301-903-3331.

BY ORDER OF THE SECRETARY OF ENERGY:

ELIZABETH SHERWOOD-RANDALL
Deputy Secretary

CONTRACTOR REQUIREMENTS DOCUMENT
DOE O 420.1C, *FACILITY SAFETY*

This contractor requirements document (CRD) includes requirements outlined in Attachments 2 and 3 of Department of Energy (DOE) Order (O) 420.1C, *Facility Safety*, referenced in and made a part of this CRD, and which provides program requirements and/or information applicable to contracts in which this CRD is inserted.

1. GENERAL REQUIREMENTS.

   a. This CRD establishes facility safety requirements for design, construction, operation, management, decontamination, decommissioning and demolition of DOE sites or facilities. Regardless of the performer of the work, the contractors are responsible for complying with the requirements of this CRD. The contractors are responsible for flowing down the requirements of this CRD to subcontractors at any tier, to the extent necessary, to ensure the contractors' compliance with the requirements.

   b. Contractors must satisfy the requirements set forth in Attachments 2 and 3 of DOE O 420.1C.

   c. For design and construction activities, contractors must identify the applicable industry codes and standards, including the *International Building Code* (IBC), and the applicable DOE requirements and technical standards. If approved by the responsible field element manager, state, regional, and local building codes may be used in lieu of the IBC upon contractor submission of a report that demonstrates that implementation of the substituted code for the specific application will meet or exceed the level of protection that would have been provided by the IBC. Additionally, DOE O 413.3B, *Program and Project Management for the Acquisition of Capital Assets*, dated 11-29-10, requires nuclear projects to establish and maintain a Code of Record (COR) early in project design for identifying applicable industry codes and standards.

   d. Contractors must satisfy the requirements (i.e., mandatory statements) in DOE technical standards and industry codes and standards that are identified as applicable in accordance with Section 1.c above, unless relief is approved in accordance with Section 2, below.

   e. When the DOE-STD-3009 methodology is used to satisfy 10 Code of Federal Regulations (C.F.R.) Part 830, *Nuclear Safety Management*, safety basis requirements, DOE-STD-3009-2014, *Preparation of Nonreactor Nuclear Facility Documented Safety Analysis*, must be used for new DOE non-reactor nuclear facilities and major modifications to existing DOE non-reactor nuclear facilities. Note: for such major modifications to existing non-reactor nuclear facilities, the appropriate Secretarial Officer, with concurrence by the applicable Central Technical Authority, may approve use of DOE-STD-3009-94.

f. DOE-STD-3009-2014 must be used for existing DOE non-reactor nuclear facilities that use the DOE-STD-3009 method to satisfy 10 C.F.R. 830 requirements when those facilities have mitigated off-site dose estimates greater than 25 rem.

2. RELIEF FROM REQUIREMENTS, CODES AND STANDARDS.

a. Requests for equivalencies and exemptions to the requirements of this attachment are processed in accordance with DOE O 251.1C, *Departmental Directives Program,* dated 01-15-09. For such equivalencies and exemptions, DOE O 251.1C requires approval, in consultation with the Office of Primary Interest, by the program secretarial officer or designee, or in the case of NNSA, by the administrator or designee. Requests for equivalencies and exemptions must be provided to the responsible contracting officer for further processing. This includes exemptions to applicable requirements in DOE technical standards and industry codes and standards required by DOE O 420.1C.

b. Equivalencies to DOE technical standards and industry codes and standards determined to be applicable to the facility design or operations must demonstrate an equivalent level of safety (i.e., meets or exceeds the level of protection) and be approved by the DOE field element.

3. REFERENCES. Attachment 4 of DOE O 420.1C provides a list of reference documents: rules, directives, guidance, DOE technical standards, and industry codes and standards.

FACILITY SAFETY REQUIREMENTS

This attachment provides information and/or requirements associated with the Department of Energy (DOE) Order (O) 420.1C, *Facility Safety*, as well as information and/or requirements applicable to contracts into which the associated Contractor Requirements Document (CRD), (see Attachment 1 of DOE O 420.1C) is inserted.

CHAPTER I. NUCLEAR SAFETY DESIGN CRITERIA

1. OBJECTIVE. To establish requirements for safety design of DOE hazard category 1, 2, and 3 nuclear facilities to support implementation of DOE Policy (P) 420.1, *Department of Energy Nuclear Safety Policy*, dated 02-08-11[1].

   The requirements of this chapter (and the criteria in Attachment 3 of DOE O 420.1C) support implementation of the requirements for hazard category 1, 2 and 3 nuclear facilities in 10 Code of Federal Regulations (C.F.R.) Part 830, *Nuclear Safety Management*, Subpart B, *Safety Basis Requirements*.

2. APPLICABILITY.

   a. This chapter applies to the design and construction of:

      (1) New hazard category 1, 2, and 3 nuclear facilities, as defined by 10 C.F.R. Part 830; and,

      (2) Major modifications to hazard category 1, 2, and 3 nuclear facilities, as defined in 10 C.F.R. Part 830, that could substantially change the facility safety basis (Note: See DOE Standard (STD)-1189-2008, *Integration of Safety into the Design Process*, for criteria and discussion on major modifications).

   b. This chapter does not impose requirements on existing facilities, except for major modifications[2] to those facilities. The requirements of this chapter may be used to develop comparisons of existing facilities to the requirements for new facilities, as one aide to judgment when evaluating the costs and benefits of non-mandatory upgrades to existing facilities.

   c. Except for the requirements of Section 3.b.(3), this chapter does not apply to nuclear deactivation or decontamination and decommissioning activities at end-of-facility-life if the safety analysis demonstrates that adequate protection is provided consistent with the requirements of 10 C.F.R. Part 830 through alternate means and it is not cost beneficial to apply the provisions of this chapter for the limited remaining life of the activity.

3. REQUIREMENTS.

   a. Integration of Safety with Design.

      (1) Safety must be integrated into the design early in, and throughout, the design process through use of DOE-STD-1189-2008.

[1] DOE's nuclear safety policy (DOE P 420.1) is to design, construct, operate, and decommission its nuclear facilities in a manner that ensures adequate protection of workers, the public, and the environment.
[2] DOE-STD-1189-2008 provides definition and examples of major modifications.

(2) Safety analyses must be used to:

(a) identify safety-class and safety-significant structures, systems and components (SSCs) needed to fulfill the safety functions in order to prevent and/or mitigate design basis accidents, including natural and man-induced hazards and events;

(b) identify the safety functional requirements of the safety-class and safety-significant SSCs; and,

(c) identify specific administrative controls (SACs) needed to fulfill safety functions. (Note: See DOE-STD-1186-2004, *Specific Administrative Controls*, for details on specific administrative controls.)

b. Nuclear Facility Design.

(1) The nuclear facility design must include multiple layers of protection (as part of the design defense-in-depth) to prevent or mitigate the unintended release of radioactive materials into the environment.

(2) Defense-in-depth must include all of the following:

(a) choosing an appropriate site;

(b) minimizing the quantity of material-at-risk;

(c) applying conservative design margins;

(d) applying quality assurance;

(e) using successive/multiple physical barriers for protection against radioactive releases (Note: If an exemption to having multiple barriers is required, it is the Secretarial Officer's responsibility to approve, or disapprove, the exemption for not including multiple physical barriers);

(f) using multiple means to ensure safety functions are met by—

1 controlling processes;

2 maintaining processes in safe status;

3 providing preventive and/or mitigative controls for accidents with the potential for radiological releases; and,

4 providing means for monitoring facility conditions to support recovery from upset or accident conditions;

(g) using equipment in combination with administrative controls that—

1 restrict deviation from normal operations;

2 monitor facility conditions during and after an event; and,

3 provide for response to accidents to achieve a safe condition;

(h) providing means to monitor accident releases as required for emergency response (see DOE O 151.1C, *Comprehensive Emergency Management System*, dated 11-02-05, for detailed requirements); and,

(i) establishing emergency plans for minimizing the effects of an accident (see DOE O 151.1C for detailed requirements).

(3) Hazard category 1, 2, and 3 nuclear facilities with uncontained radioactive materials (as opposed to materials determined by safety analyses to be adequately contained within qualified drums, grout, or vitrified materials) must have the means to confine the uncontained radioactive materials to minimize their potential release in facility effluents during normal operations and during and following accidents, up to and including design basis accidents (DBAs). Confinement design must include the following:

(a) For a specific nuclear facility, the number, arrangement, and characteristics of confinement barriers as determined on a case-by case basis.

(b) The type, quantity, form, and conditions for dispersing the radioactive material in the confinement system design.

(c) An active confinement ventilation system as the preferred design approach for nuclear facilities with potential for radiological release.[3] Alternate confinement approaches may be acceptable if a technical evaluation demonstrates that the alternate confinement approach results in very high assurance of the confinement of radioactive materials.

The guidance for confinement ventilation systems and evaluation of the alternatives, is provided in DOE Guide (G) 420.1-1A, *Nonreactor Nuclear Safety Design Guide for Use with DOE O 420.1C, Facility Safety*.

[3] The safety classification (if any) of the ventilation system is determined by the facility documented safety analysis.

(d) Documentation of the adequacy of confinement systems consistent with the safety in design process as described in DOE-STD-1189-2008.

(4) Hazard category 1, 2, and 3 nuclear facilities must be designed to:

(a) facilitate safe deactivation, decommissioning, decontamination, and demolition at the end of facility life, including incorporation of design considerations during the operational period that facilitate future decontamination and decommissioning;

(b) facilitate inspections, testing, maintenance, repair, and replacement of safety-SSCs as part of a reliability, maintainability, and availability program with the objective of maintaining the facility in a safe state;

(c) keep occupational radiation exposures within regulatory limits, and as low as reasonably achievable;

(d) provide controls consistent with the hierarchy described in DOE-STD-1189-2008; and,

(e) protect against chemical hazards and toxicological hazards consistent with DOE-STD-1189-2008 and direction from the responsible program office. Appendix B of DOE-STD-1189-2008 provides additional guidance for protection against chemical hazards and toxicological hazards.

(5) Facility process systems must be designed to minimize waste production and mixing of radioactive and non-radioactive wastes.

(6) Safety-SSCs and safety software must be designed to perform their safety functions when called upon.

(7) Active safety-class systems must be designed to meet single failure[4] criterion.

(8) DOE G 420.1-1A provides an acceptable method to meet the requirements stated in this chapter. DOE O 251.1C requires that any implementation selected must be justified to ensure that an adequate level of safety commensurate with the identified hazards is achieved.

[4] IEEE-Std-379-2000, *IEEE Standard Application of the Single-Failure Criterion to Nuclear Power Generating Station Safety Systems*, provides a definition of single failure criterion. ANS 58.9-2002 (R 2009), *Single Failure Criteria for Light Water Reactor Safety-Related Fluid Systems*, provides additional guidance for single failure criteria for mechanical systems.

(9) New DOE nuclear reactors must comply with the requirements of this attachment, as well as the design requirements of DOE O 5480.30 Chg 1, *Nuclear Reactor Safety Design Criteria*, dated 01-19-93.

(10) Critical experiments facilities must be designed and operated in accordance with American National Standards Institute (ANSI) and the American Nuclear Society (ANS) standards, ANSI/ANS-1-2000, *Conduct of Critical Experiments*, or ANSI/ANS-14.1-2004, Operation of *Fast Pulse Reactors.*

(11) Facility design must also be integrated with other design requirements, as applicable, including explosive safety, industrial safety, and nuclear explosive safety (if applicable).

CHAPTER II. FIRE PROTECTION

1. OBJECTIVE. To establish requirements for comprehensive fire protection programs for DOE facilities and emergency response organizations to:

   a. Minimize the likelihood of occurrence of a fire-related event;

   b. Minimize the consequence of a fire-related event affecting the public, workers, environment, property and missions; and,

   c. Provide a level of safety protection consistent with the "highly protected risk" class of industrial risks.

2. APPLICABILITY. This chapter applies to organizations that have responsibility for the design, construction, maintenance, or operation of government-owned or government-leased facilities and on-site contractor-leased facilities used for DOE mission purposes. For leased facilities that are not nuclear hazard category 1, 2, or 3 facilities, the design requirements of Section 3.c of this chapter apply to the extent determined by the field element. (Note: DOE-STD-1066-2012, *Fire Protection*, provides guidance on a graded approach to fire protection for leased facilities.)

3. REQUIREMENTS.

   a. General Fire Protection Program Requirements.

      (1) Policy Statement. A policy must be established that affirms the contractor's commitment to provide a comprehensive fire protection and emergency response program that meets the requirements of this chapter, related DOE directives, and other applicable requirements.

      (2) Codes and Standards. The applicable building code and National Fire Protection Association (NFPA) codes and standards must be identified in the fire protection and emergency response programs. (Note: see Attachment 1, Section 2 for obtaining equivalencies and exemptions to the applicable codes and standards).

         (a) Facilities and major modifications thereto, must be constructed to meet applicable codes and standards that are in effect when design criteria are approved (otherwise known as the code of record, or COR). Other facility changes must meet the most recent applicable codes and standards to the extent determined by the authority having jurisdiction (AHJ).

         (b) Provisions of subsequent editions of codes or standards (promulgated after the COR is established) are mandatory only to the extent that they are explicitly stated to be applicable to existing facilities.

(c) Conflicts between DOE O 420.1C, NFPA codes and standards, and --the applicable building code must be resolved as follows:

1 Requirements of DOE O 420.1C take precedence over all NFPA and building code requirements and are subject to the relief requirements of DOE O 420.1C.

2 Conflicts between NFPA requirements and the applicable building code requirements are resolved by the head of the field element following consultation with designated building code and fire protection subject matter experts.

b. Fire Protection Program Administration.

(1) Documentation. A documented fire protection program that includes the elements and requirements identified in this chapter for design, operations, emergency response, fire analysis and assessments, wildland fire, and specific fire protection program criteria must be developed, implemented, and maintained by the contractor. Contractor must submit this documented fire protection program to the DOE field element for review and approval (note: this may be accomplished in conjunction with submittals required by 10 C. F. R. Part 851, *Worker, Health and Safety Program*).

(2) Self-Assessments. A documented comprehensive self-assessment of the fire protection program must be performed at least every three years, or at a frequency with appropriate justification approved by the DOE head of field element.

c. Design.

(1) Design Process. A process must be established to ensure that fire protection program requirements are documented and incorporated into plans and specifications for design of new facilities and modifications to existing facilities.

(2) Protection Thresholds.

(a) New facilities (non-relocatable) exceeding 5,000 sq. ft. of floor area must be of Type I or Type II construction, as defined in the applicable building codes.

(b) Automatic fire suppression systems must be provided throughout new facilities exceeding 5,000 sq. ft. of floor area or where a maximum possible fire loss exceeds $5 million (in 2012 dollars), unless the NFPA code(s) allow for specific relief within the facility.

(c) Automatic fire suppression systems must be provided throughout facilities in which any of the following conditions exist:

1 where required by safety basis document (for example, to prevent loss of safety functions or provide defense-in-depth);

2 significant life safety hazards;

3 where fire may cause unacceptable mission or program interruption if automatic fire suppression systems are not provided;

4 where a modification to an existing facility would cause the maximum possible fire loss (MPFL) to exceed $5 million (in 2012 dollars) for the facility; or,

5 where a modification to an existing facility results in facility floor area that exceeds 5,000 sq. ft.

(d) For property protection, multiple fire protection approaches, such as a fire suppression system and a fire detection and alarm system, must be provided in areas where the MPFL exceeds $150 million (in 2012 dollars) (refer to DOE-STD-1066-2012).

(e) For property protection, fire areas must be established such that the MPFL for each fire area does not exceed $350 million (in 2012 dollars). Fire area walls or other separation approaches may be used to meet this requirement.

(3) Fire Protection and Life Safety Systems.

(a) Fire Suppression. The inadvertent operation or failure of fire suppression systems must not result in the loss of function of safety-class or safety-significant systems. (Note: This requirement addresses proper design of the fire suppression system to ensure it does not impact safety systems and is not intended to drive need for redundancy in safety-significant system design.)

(b) Fire Barriers. Complete fire-rated construction and barriers, commensurate with the applicable codes and/or safety basis requirements, must be provided to isolate hazardous areas and minimize fire spread and loss potential consistent with limits as established in this chapter. Fire barrier locations and construction must be documented.

(c) Fire Detection. Automatic fire detection must be provided to the extent required by applicable industry codes and standards.

(d) Life Safety. Requirements for life safety and means of egress are provided in 10 C.F.R. Part 851, *Worker Health and Safety*

Program. Other codes and standards, such as the International Building Code, and NFPA 101, *Life Safety Code*, may also be applicable.

(e) Water Supply and Distribution. A reliable and adequate water supply and distribution system must be provided for fire suppression, as documented through appropriate analysis.

(f) Emergency Notification. A means to notify responders and building occupants of a fire must be provided (e.g., fire alarm signaling system and/or site-wide mass notification capabilities for major incidents affecting the site).

(4) Special Hazards. Fire protection systems or features, and appropriate procedures to address fire and related hazards, that are special or unique to DOE and not addressed by industry codes and standards, must be established.

d. Operations.

(1) Criteria and Procedures. Comprehensive, written fire protection criteria and procedures must be established to implement the fire protection program requirements that include:

(a) site-specific requirements;

(b) staff organization, resources, training, roles and responsibilities;

(c) inspection, testing, and maintenance of fire protection systems;

(d) use and storage of combustible, flammable, radioactive, and hazardous materials;

(e) a "hot-work" control program;

(f) identification and tracking of fire protection system impairments;

(g) fire prevention measures (e.g., combustible loading, hot-work, and ignition source controls);

(h) facility and fire hazard analysis (FHA) assessment programs;

(i) design and construction oversight; and,

(j) equivalencies, exemptions, modifications, and variances processes.

(2) Implementation. To ensure effective implementation of these requirements, the following elements must be addressed.

(a) Staffing. The contractor must ensure it has access to qualified, trained fire protection staff (that includes fire protection engineers, technicians, and fire fighting personnel) needed to implement the requirements of this chapter.

(b) Design Review. Documented review of plans, specifications, procedures, and acceptance tests must be conducted by a fire protection engineer (FPE) (Note: A definition for FPE is provided in DOE-STD-1066-2012). A process must be established to oversee fire protection-related activities from conceptual design to final acceptance.

(c) Equivalencies and Exemptions. A process must be established for developing and requesting DOE AHJ approval of fire protection equivalencies and exemptions to fire protection requirements. Records of technical justification must be maintained and reevaluated for appropriateness as activities or operations change.

(d) Assigned Authority. If assigned, the contractor must document the level of authority to execute the duties and responsibilities of the AHJ, in accordance with the contractor's overall fire protection and emergency response programs.

e. Emergency Response. Provide emergency response capabilities, as necessary, to meet site needs as established by the baseline needs assessment (BNA), safety basis requirements, and applicable regulations, codes and standards.

(1) Baseline Needs Assessment. A BNA of the fire protection and emergency response organization must be conducted and the BNA must:

(a) establish capabilities to provide:

1 effective response to extinguish fires;

2 emergency medical, rescue and hazardous materials response; and,

3 staffing, apparatus, facilities, equipment, training, pre-incident plans, mutual aid, and procedures.

(b) reflect applicable requirements of NFPA codes and standards, and DOE direction;

(c) be submitted to the DOE field element for approval;

(d) be reviewed at least every three years, or whenever a significant new hazard that is not covered by the current BNA is introduced,

and be updated as appropriate (Note: If no update is necessary, this result must be documented following the review); and,

(e) be incorporated into site emergency plans, FHAs, and safety basis documentation.

(2) Pre-Incident Plans. Pre-incident strategies, plans, and standard operating procedures must be established to enhance the effectiveness of manual fire suppression activities, including areas within or adjacent to, moderator-controlled areas. The criticality safety staff must review pre-incident plans and procedures related to moderator-controlled areas.

(3) Manual Fire Suppression Activities.

(a) Physical access and appropriate equipment that is accessible for effective manual fire fighting intervention must be provided.

(b) Procedures governing the use of fire fighting water or other neutron moderating materials to suppress fire within, or adjacent to, moderation controlled areas must be established and reviewed by a criticality subject matter expert prior to release.

(c) Procedures governing fire fighting techniques to be used during deactivation, decontamination, and demolition phases, must be established, when applicable.

(d) Where no alternative exists to criticality safety restrictions on the use of water for fire suppression, the need for such restrictions must be fully documented with written technical justification.

f. Fire Hazard Analyses and Facility Assessments.

(1) Fire Hazards Analyses. FHAs, using a graded approach, must be conducted for the following cases: (1) all hazard category 1, 2, and 3 nuclear facilities and major modifications thereto; (2) facilities that represent unique fire safety risks; (3) new facilities or modifications to existing facilities with value greater than $150 million (in 2012 dollars[5]); and (4) when directed by the responsible DOE authority. The FHAs must be:

(a) performed under the direction of an FPE;

[5] DOE G 413.3-21, *Cost Estimating Guide*, dated May 9, 2011, Section 6.4.4 provides guidance on historical cost estimates and historical cost indexes. To convert 2012 dollar amounts to present value, an applicable historical cost index is selected, documented, and used, as described in G 413.3-21.

(b) reviewed every three years by an FPE and revised as appropriate (Note: If no revision is necessary, this result must be documented following the review);

(c) revised when–

1 changes to the facility structure or layout, processes, occupancy, safety basis documentation or BNA impacts the analysis in the FHA;

2 a modification to an associated facility or process adds a significant new fire safety risk; or,

3 the periodic (three-year) review identifies the need for changes;

(d) integrated into safety basis documentation.

(2) Facility Assessments. Fire protection assessments must be conducted:

(a) annually, or at a frequency with appropriate justification approved by the DOE head of field element, for facilities with a replacement value in excess of $100 million (in 2012 dollars), facilities considered a high hazard, or those in which vital programs are involved, as defined by the responsible DOE authority; and,

(b) at least every three years, or at a frequency with appropriate justification approved by the DOE head of field element, for remaining low and ordinary hazard facilities.

g. Wildland Fire. An integrated site-wide wildland fire management plan, consistent with the *Federal Wildland Fire Management Policy*, must be developed and implemented in accordance with the relevant portions of the NFPA 1143, *Standard for Wildland Fire Management*, 2014.

h. Specific Fire Protection Program Criteria. DOE-STD-1066-2012 provides acceptable methods for implementing the requirements in DOE O 420.1C; other methods may be acceptable. Any alternate approach must provide an equivalent level of safety.

CHAPTER III. NUCLEAR CRITICALITY SAFETY

1. OBJECTIVE. To establish requirements for developing and implementing nuclear criticality safety programs (CSPs) for nuclear facilities and activities, including materials transportation activities, which provide adequate protection to the public, workers, and the environment.

2. APPLICABILITY. This chapter is applicable to DOE elements and DOE contractors with responsibility for nuclear facilities and activities that involve or will potentially involve radionuclides in such quantities that are equal to or greater than the single parameter limits for fissionable materials listed in ANSI/ANS-8.1-2014, *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors*, and ANSI/ANS-8.15-1981, *Nuclear Criticality Control of Special Actinide Elements*. These limits must be adjusted where process conditions could credibly involve moderators or reflectors that are more effective than light water.

3. REQUIREMENTS.

   a. A CSP document must be developed and maintained that describes how the contractor will implement the requirements in this chapter, including the standards invoked by this chapter.

   b. The CSP document must describe how the contractor will satisfy the requirements of the ANSI/ANS-8 series of nuclear criticality safety standards that are in effect as of the date this Order, unless otherwise modified or approved by DOE. The CSP document must include an explanation as to why any recommendation in applicable ANSI/ANS-8 standards is not implemented.

   c. The CSP document must be submitted to and approved by DOE.

   d. Criticality safety evaluations must be conducted in accordance with DOE-STD-3007-2007, *Guidelines for Preparing Criticality Safety Evaluations at Department of Energy Non-Reactor Nuclear Facilities*, or by other documented methods approved by DOE.

   e. Fissile Material Accumulation Control. Facilities that conduct operations using fissionable material in a form that could inadvertently accumulate in significant quantities must include procedures for detecting and characterizing accumulations. The following national standards provide relevant guidance for procedure development: ASTM C1455, *Standard Test Method for Nondestructive Assay of Special Nuclear Material Holdup Using Gamma-Ray Spectroscopic Methods*; and any other nondestructive assay consensus or DOE standards applicable to the measurement technique selected.

   f. Criticality safety evaluations must show that entire processes involving fissionable materials will remain subcritical under normal and credible abnormal conditions, including those initiated by design basis events.

g. The criteria and process for developing the guidelines for fire fighting in areas within or adjacent to moderator-controlled areas must be coordinated with fire fighting pre-incident plans and procedures.

CHAPTER IV. NATURAL PHENOMENA HAZARDS MITIGATION

1. OBJECTIVE. To establish requirements for DOE facility design, construction, and operations to protect the public, workers, and the environment from the impact of natural phenomena hazards (NPH) events (e.g., earthquake, wind, flood, lightning, snow and volcanic eruption).

2. APPLICABILITY. Requirements in this chapter apply to all government-owned and government-leased nuclear and nonnuclear facilities and sites. Design requirements (Sections 3.a, 3.b, and 3.c, below) apply to new facilities, major modifications, and modifications that may be warranted based on periodic NPH assessment and upgrade requirements.

3. REQUIREMENTS.

   a. General. Facilities must be designed, constructed, maintained, and operated to ensure that SSCs will be able to perform their intended safety functions effectively under the combined effects of NPH and normal loads defined in the applicable building codes contained in facilities' CORs. Nuclear facility safety functions that the SSCs must perform during an NPH must be defined in the facility's safety basis documentation. Safety functions include:

      (1) confinement/containment of hazardous materials;

      (2) protection of occupants and co-located workers of the facility and the public;

      (3) continued operation of essential facilities and equipment;

      (4) safe shutdown of hazardous facilities and equipment; and,

      (5) maintenance of personnel access to areas needed for responding to accidents during NPH events.

   b. NPH Design Criteria. All new facilities and major modifications must satisfy the applicable requirements and criteria contained in DOE-STD-1020-2012, *Natural Phenomena Hazards Analysis and Design Criteria for DOE Facilities*. (Note: Requirements for non-nuclear facilities are described in Section 2.1 of DOE-STD-1020-2012.)

   c. NPH Accident Analysis. The NPH analysis supporting design and construction of facilities and safety-SSCs must be documented and include evaluation of:

      (1) potential damage to and failure of safety-SSCs resulting from both direct and indirect NPH events; and,

(2) common cause/effect and interactions resulting from failures of other nearby facilities or other SSCs in the same facility caused by or induced by an NPH event.

d. Review and Upgrade Requirements for Existing DOE Nuclear Facilities (Hazard Category 1, 2 and 3).

(1) Existing facility or site NPH assessments must be reviewed at least every 10 years for any significant changes in data, criteria, and assessment methods that would warrant updating the assessments. Sections 9.0 and 9.2 of DOE-STD-1020-2012 contain criteria and guidance for performing these reviews. The review results, along with any recommended update actions, must be submitted to the head of the field element for approval. If no update is necessary, this result must be documented following the review.

(2) If a new assessment of NPH indicates deficiencies in existing SSC design, a plan for upgrades must be developed and implemented on a prioritized schedule, based on the safety significance of the upgrades, time or funding constraints, and mission requirements. The upgrade plans must also be submitted to the head of the field element for approval. Section 9.3 of DOE-STD-1020-2012 contains guidance on performing upgrade evaluations.

e. Seismic Detection. DOE sites with nuclear or hazardous materials must have instrumentation or other means to detect and record the occurrence and severity of seismic events.

f. Post-Natural Phenomena Procedures. Facilities or sites with hazardous materials must have procedures for inspecting facilities for damage from severe NPH events and placing a facility into a safe configuration when damage has occurred.

CHAPTER V. COGNIZANT SYSTEM ENGINEER PROGRAM

1. OBJECTIVE. To establish requirements for a cognizant system engineer (CSE) program for hazard category 1, 2, and 3 nuclear facilities and to ensure continued operational readiness of the systems within its scope.

   A key element of the CSE program is the designation of CSEs who are responsible for maintaining overall cognizance of assigned systems, providing systems engineering support for operations and maintenance, and technical support of line management safety responsibilities for ensuring continued system operational readiness.

2. APPLICABILITY. Requirements of this chapter apply to all hazard category 1, 2, and 3 nuclear facilities that have attained operational status (such as achieving Critical Decision 4 (CD-4) per DOE O 413.3B, *Program and Project Management for the Acquisition of Capital Assets,* dated 11-29-10) and have:

   a. Active safety-class or safety-significant SSCs, as defined in the facility's DOE-approved safety basis documentation; or,

   b. Other active systems that perform important defense-in-depth functions, as designated by facility line management.

   Note: This chapter does not apply to passive systems or design features. Facility management should consider establishing CSE programs before CD-4 to ensure their stability and operation at CD-4. CSE programs should remain in place as long as the covered systems are credited in the safety basis or designated by facility line management.

3. REQUIREMENTS.

   a. General. The protocols for implementing the site or facility CSE program must be documented, must include the functions, responsibilities and authorities of CSEs, and must address the following elements:

      (1) Identification of systems covered by the CSE program and identification of systems assigned for coverage;

      (2) Configuration management;

      (3) Support for operations and maintenance; and,

      (4) Training and qualifications of CSEs.

   b. CSE Program Coverage.

      (1) The CSE program must be applied to active safety-class and safety-significant systems, as defined in the facility's DOE-approved safety basis, as well as to other active systems that perform important

defense-in-depth functions, as designated by facility line management. The designated systems and the rationale for assignment of CSEs in a graded approach (see below) must be documented.

(2) A graded approach must be used in applying the requirements of the CSE program. The program must be tailored to facility hazards and the systems relied upon to prevent or mitigate those hazards, considering:

(a) Remaining Facility Lifetime and the Safety Significance of Remaining Operations. Facilities undergoing deactivation or decontamination/decommissioning may undergo frequent changes, modifications, or removal of systems no longer needed to support the safety basis of those operations. CSE programs may require more CSE attention in these operations than during normal operations. After deactivation, or when a facility is in long-term surveillance and maintenance, there may be less need for CSE attention.

(b) Safety Importance of the System. Not all systems are equal as measured by the likelihood and consequences of the hazard and the accidents that they prevent or mitigate. The level of system documentation detail in configuration management should be tailored to the importance of the system.

(3) A qualified CSE must be assigned to each active system within the scope of the program. Consistent with the graded approach, large, complex, or very important systems may require assignment of more than one CSE. Conversely, a single individual may be assigned to be the CSE for more than one system.

c. Configuration Management.

(1) A documented configuration management program must be established and implemented that ensures consistency among system requirements and performance criteria, system documentation, and physical configuration of the systems within the scope of the program. DOE-STD-1073-2003, *Configuration Management Program*, describes an acceptable methodology for establishing configuration management programs. The configuration management program must address:

(a) system design documentation;

(b) system assessments;

(c) control of maintenance;

(d) change control; and,

(e) obsolescence.

(2) System design documents and supporting documents must be identified and kept current using formal change control and work control processes. DOE-STD-3024-2011, *Content of System Design Descriptions*, describes an acceptable methodology to achieve this function. Design documentation must include:

(a) system requirements and performance criteria essential to performance of the system's safety functions;

(b) the basis for system requirements; and,

(c) a description of how the current system configuration satisfies the requirements and performance criteria.

(3) System assessments must include periodic reviews of system operability, reliability, and material condition. Reviews must assess the system for:

(a) the ability to perform design and safety functions;

(b) physical configuration as compared to system documentation; and,

(c) system and component performance in comparison to established performance criteria.

(4) System maintenance and repair and modification must be controlled through a formal change control process to ensure that changes are not inadvertently introduced and that required system performance is not compromised. Post maintenance or modification testing must be conducted to confirm continued capability to fulfill system requirements.

d. CSE Support for Operations and Maintenance. The CSE must:

(1) ensure that system configuration is being managed effectively (see Section 3.c of this chapter);

(2) remain apprised of operational status and ongoing modification activities;

(3) assist operations review of key system parameters and evaluate system performance;

(4) initiate actions to correct problems;

(5) remain cognizant of system-specific maintenance and operations history and industry operating experience, as well as manufacturer and vendor

recommendations and any product warnings regarding their assigned systems;

(6) identify trends from operations and maintenance;

(7) provide assistance in determining operability, correcting out-of-specification conditions, and evaluating questionable data;

(8) provide or support analysis when the system is suspected of inoperability or degradation;

(9) review and concur with design changes, use-as-is, equivalency, and commercial grade dedication determinations; and,

(10) review, and provide input into the development of, and concur on operating, maintenance, and test procedures related to their assigned systems.

e. CSE Qualification Requirements. Qualification requirements for CSEs must be consistent with those defined for Technical Support personnel in DOE O 426.2, *Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities*, dated 04-21-10 (see associated CRD), as applicable. Qualification requirements must include knowledge of:

(1) related facility safety bases including safety system functions, safety system performance criteria, and any relationship to specific administrative controls;

(2) system functional classification and bases;

(3) codes and standards applicable to assigned systems;

(4) system design, procurement, replacement, and related quality assurance requirements;

(5) the existing condition of the systems;

(6) related facility operations; and,

(7) vendor manuals, product warnings, and updates related to assigned systems, available (in print or online).

DESIGN CRITERIA FOR SAFETY STRUCTURES, SYSTEMS, AND COMPONENTS

This attachment provides requirements for the design and construction of safety structures, systems and components (SSCs).

1. OBJECTIVE. To establish requirements for the design and construction of safety-SSCs, both safety-class and safety-significant, by identifying an applicable set of industry codes and standards, as well as Department of Energy (DOE) design criteria, standards and directives (listed in Attachment 4 of DOE Order (O) 420.1C, *Facility Safety*). Compliance with these requirements will ensure reliable performance of the safety function of safety-SSCs under those conditions and events for which they are intended.

2. APPLICABILITY.

   a. This attachment applies to the design and construction of:

      (1) new hazard category 1, 2, and 3 nuclear facilities as defined by 10 Code of Federal Regulations (C.F.R.) Part 830, *Nuclear Safety Management*; and,

      (2) major modifications to hazard category 1, 2, and 3 nuclear facilities, as defined in 10 C.F.R. Part 830, that substantially change the facility safety basis.

   b. This attachment does not impose requirements on existing facilities, except for major modifications to those facilities. The requirements of this attachment may be used to develop comparisons of existing facilities to the requirements for new facilities.

   c. This attachment does not apply to nuclear deactivation or decontamination and decommissioning activities at end-of-facility-life, if the safety analysis demonstrates that adequate protection is provided consistent with the requirements of 10 C.F.R. Part 830 through alternate means and it is not cost-beneficial to apply the provisions of this attachment for the limited remaining life of the activity.

3. REQUIREMENTS. Safety-SSCs must be designed, commensurate with the importance of the safety functions performed, to perform their safety functions when called upon, as determined by the safety analysis.

   a. General Design Criteria.

      (1) Conservative Design Margin. Safety-SSCs must be designed with appropriate margins of safety, as defined in applicable DOE or industry codes and standards.

      (2) System Reliability.

(a) The single failure criterion, requirements, and design analysis identified in Institute of Electrical and Electronics Engineers (IEEE) standard (Std) 379-2000, *IEEE Standard Application of the Single-Failure Criterion to Nuclear Power Generating Station Safety Systems*, must be applied to safety-class SSCs during the design process as the primary method of achieving reliability. American National Standards Institute (ANSI)/American Nuclear Society (ANS) 58.9, *Single Failure Criteria for Light Water Reactor Safety-Related Fluid Systems*, may be used in defining the scope of active safety-class mechanical SSCs.

(b) Safety-significant SSCs must be designed to reliably perform all their safety functions. This can be achieved through a number of means, including use of redundant systems/components, increased testing frequency, high reliability components, and diagnostic coverage (e.g., on-line testing, monitoring of component and system performance, and monitoring of various failure modes). DOE STD-1195-2011, *Design of Safety Significant Safety Instrumented Systems Used at DOE Nonreactor Nuclear Facilities*, provides an acceptable method for achieving high reliability of safety-significant safety instrumented systems.

(3) Environmental Qualification.

(a) Safety-class SSCs must be designed to perform all safety functions with no failure mechanism that could lead to common cause failures under postulated service conditions. The requirements of IEEE Std 323-2003, *IEEE Standard Criteria for Qualifying Class IE Equipment for Nuclear Power Generating Stations*, or other applicable standards, must be used to ensure environmental qualifications of safety-class SSCs.

(b) Safety-significant SSCs located in a harsh environment must be evaluated to establish qualified life. This may be accomplished using manufacturers' recommendations or other appropriate methods.

(4) Safe Failure Modes. The facility design must provide reliable safe conditions and sufficient confinement of hazardous material during and after all design basis accidents. At both the facility- and SSC-level, the design must ensure that most probable modes of failure (e.g., failure to open versus failure to close) will increase the likelihood of a safe condition.

(5) Support System and Interface Design.

(a) Support SSCs must be designed as safety-class or safety-significant SSCs if their failures prevent safety-SSCs or specific administrative controls from performing their safety functions.

(b) Interfaces, such as pressure retention boundaries, electrical supply, instrumentation, cooling water, and other support systems may exist between safety-SSCs and non-safety-SSCs. These interfaces must be evaluated to identify SSC failures that would prevent safety-SSCs from performing their intended safety function. IEEE Std 384-2008, *IEEE Standard Criteria for Independence of Class IE Equipment and Circuits*, or other applicable standards must be used for physical and electrical separation methods including the use of separation distance, barriers, electrical isolation devices, or any combination thereof. This includes a design to ensure that both direct and indirect impacts of design basis accidents (e.g., fire, seismic) will not cause failure of safety functions.

(6) Protection Against Fire. Safety-class systems must be designed with redundancy or other means, such that safety function is maintained for any postulated fire events that credit the safety-class systems.

(7) Quality Assurance. A quality assurance program must be established that satisfies 10 C.F.R. Part 830, Subpart A, *Quality Assurance Requirements*, and DOE O 414.1D, *Quality Assurance*, dated 04-25-11, early in the project, such that safety-SSCs and their associated support systems are designed, procured, fabricated, erected, and tested to standards and quality requirements commensurate with their importance to safety.

b. Specific Design Criteria and Use of National Codes and Standards. The selection and use of an appropriate set of applicable codes and standards establishes design criteria to provide assurance that the SSCs are designed to reliably perform their intended functions. The DOE technical standards and industry codes and standards identified in the following sections must be evaluated for applicability.

DOE technical standards and industry codes and standards are considered applicable when they provide relevant design requirements for the safety-SSCs that are being designed (i.e., they provide design requirements that are needed to ensure that desired SSC functions are achieved, and these requirements are appropriate for the design materials, configuration, and service conditions). Further, the use of specific codes and standards may be directed by the DOE field element. (Note: The stated applicability of industry codes and standards (e.g., for nuclear reactors) should not be used to narrowly interpret relevancy for SSC design.)

Before using these codes and standards, their application to specific DOE design(s) must be reviewed. Once a code or standard is identified as applicable, the applicable requirements (i.e., mandatory statements) must be applied in the

design. The process for obtaining relief (i.e., equivalencies or exemptions) from applicable requirements in applicable DOE technical standards and industry codes and standards is described in Attachment 1 of DOE O 420.1C. (Note: Relief is not necessary for requirements within an applicable industry code or standard where the requirements are not relevant to the design or construction.)

The set of codes and standards identified below is not meant to be all-inclusive. It is expected that design of SSCs will require selection of additional codes and standards beyond those identified below. For example, unique design features, detailed design considerations, and release of advancements may drive selection of additional codes and standards. Facility designers must identify the complete set of codes and standards necessary to meet the general design criteria identified above (see also Attachment 4 of DOE O 420.1C for additional codes and standards).

(1) Structural. Table 1 provides relevant codes and standards. Attachment 2, Chapter IV of DOE O 420.1C provides additional natural phenomena hazards design requirements.

Table 1: Codes for Safety-Significant and Safety-Class Structures

Structures	Safety-Significant	Safety-Class
Concrete	ACI-318; ACI-349	ACI-349
Steel	AISC-360; AISC-325; AISC-N690	AISC-N690

(2)

Note: See DOE-STD-1020-2012 for further discussion on selection and use of codes for structural design of SSCs.

(3) Mechanical and Process Equipment. Table 2 provides relevant codes and standards.

Table 2: Codes for Safety-Significant and Safety-Class Process Equipment

Process Equipment	Safety-Significant	Safety-Class
Pressure vessels	ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 or 2	ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 or 2
Tanks (0-15 psig)	API-620; ASME Boiler and Pressure Vessel Code Section VIII, Division 1 or 2	API-620; ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 or 2
Tanks (containing flammable liquids)	API-620; API-650; Applicable NFPA codes and standards	API-620; API-650; Applicable NFPA codes and standards

Process Equipment	Safety-Significant	Safety-Class
Tanks (atmospheric pressure)	API-650; AWWA-D100	API-650; AWWA-D100
Pumps	ASME B73.1, B73.2; ASME Boiler and Pressure Vessel Code, Section VIII; AWWA; Hydraulic Institute Standards	ASME B73.1, B73.2; ASME Boiler and Pressure Vessel Code, Section VIII; AWWA; Hydraulic Institute Standards
Piping	ASME B31.3	ASME B31.3
Valves	ASME B16.5, B31.3; ANSI N278.1	ASME B16.5, B31.3; ANSI N278.1
Heat exchangers	ASHRAE Handbook; ASME Boiler and Pressure Vessel Code, Section VIII, Division 1; TEMA B, C, or R	ASHRAE Handbook; ASME Boiler and Pressure Vessel Code, Section VIII, Division 1; TEMA B, C, or R
Gloveboxes	ASTM C852, AGS-G006	ASTM C852, AGS-G006

(4) Ventilation. Table 3 provides relevant codes and standards.

Appendix A of DOE Guide (G) 420.1-1A, *Nonreactor Nuclear Safety Design Criteria for use with DOE O 420.1C, Facility Safety*, and DOE Handbook-1169-2003, *Nuclear Air Cleaning Handbook*, provide guidance for confinement ventilation systems design and performance criteria. Alternate methods must be approved by DOE field elements.

Table 3: Codes for Safety-Significant and Safety-Class Ventilation System Components

Ventilation	Safety-Significant	Safety-Class
Ducts	ASME AG-1	ASME AG-1
Fans	ASHRAE Handbook, ASME AG-1	ASHRAE Handbook; ASME AG-1
Filtration	ASME AG-1; DOE-STD-3020-2005	ASME AG-1; DOE-STD-3020-2005
Balance of system for confinement ventilation	ASME AG-1	ASME AG-1
Off-gas treatment	ASME AG-1	ASME AG-1

(5) Mechanical Handling Equipment. Table 4 provides relevant codes and standards.

Table 4: Codes for Safety-Significant and Safety-Class Handling Equipment

Handling Equipment	Safety-Significant	Safety-Class
Cranes	Applicable CMAA standards; ASME NOG-1, ASME NUM-1, ASME B30.2; DOE-STD-1090-2011	Applicable CMAA standards; ASME NOG-1, ASME NUM-1, ASME B30.2; DOE-STD-1090-2011
Other equipment	ASME B30 Series: DOE-STD-1090-2011	ASME B30 Series; DOE-STD-1090-2011

(6) Electrical. Tables 5 and 6 provide relevant codes and standards.

Note: ANSI/IEEE standards, below, define requirements for the manufacturing, installation, and testing of commercial reactor Safety-Class 1E electrical systems and components. While these requirements may not be directly applicable to nonreactor nuclear facilities, these standards contain useful and significant information that should be considered.

Table 5: Codes for Safety-Significant and Safety-Class Electrical Systems

Electrical	Safety-Significant	Safety-Class
Hardware	Applicable NFPA codes and standards; IES Lighting Handbook; IEEE C2, C37; IEEE-80, -141, -142, -242, -399, -446 -493, -577	Applicable NFPA codes and standards; IES Lighting Handbook; IEEE C2, C37; IEEE-80, -141, -142, -242, -308, -338, -379, -384, -399, -493, -577

Table 6: IEEE Standards used for Both Safety-Significant and Safety-Class Electrical Systems, as appropriate

Electrical	Safety-Significant and Safety-Class
Guidance standards for use as applicable for specific hardware	IEEE-279, -323, -334, -336, -344, -352 -382, -383, -387, -420, -450, -484, -493, -535, -603, -627, -628, -649, -650, -833, -946

(7) Instrumentation, Control, and Alarm Systems. The design of safety-class instrumentation and control systems must incorporate sufficient independence, redundancy, diversity, and separation to ensure that allsafety-related functions associated with such equipment can be performed. Safety-significant components must be evaluated as to the need for redundancy on a case-by-case basis. DOE-STD-1195-2011 provides an acceptable method for achieving high reliability of safety-significant safety instrumented systems.

Table 7 provides relevant codes and standards. The codes and standards for electrical systems (in Tables 5 and 6) may also be applicable to design of instrumentation and control systems and need to be evaluated in this context.

Table 7: Codes for Safety-Significant and Safety-Class Instrumentation, Control, and Alarm Components.

Instruments, Controls, and Alarms	Safety-Significant	Safety-Class
Hardware	Applicable NFPA codes and standards; ANSI/ANS-8.3, -58.8, -59.3, -N13.1, -N323D; ANSI/ISA-Series including ISA 67.04.01 and ISA TR 84.00.06; IEEE-C2, -N42.18, -1023, -1050; -7-4.3.2; and DOE-STD-1195-2011	Applicable NFPA codes and standards; ANSI/ANS-8.3, 58.8, 59.3, -N13.1, ANSI-N323D; ANSI/ISA-Series including ISA 67.04.01 and ISA TR 84.00.06; IEEE-C2, -N42.18, -603, -1023, -1050, -7-4.3.2

(8) Fire Protection Systems. DOE-STD-1066-2012, *Fire Protection*, provides acceptable methods for the design of fire protection systems, including safety-class and safety-significant fire barriers, water supplies, and wet pipe sprinkler systems (see Appendix A of DOE-STD- 1066-2012). Fire protection system designs are also required to address the applicable design requirements for similar safety systems provided in this attachment.

REFERENCES AND ACRONYMS

1. REFERENCES. The following reference documents and a few additional information sources are cited to assist in implementing this Directive.

   a. Public Law (P.L.).

      (1) P.L. 106-65, National Defense Authorization Act for Fiscal Year 2000, Title XXXII, National Nuclear Security Administration, as amended.

      (2) P.L. 94-580, as amended, Resource Conservation and Recovery Act of 1976 (RCRA), (42 U.S.C., Sec. 6901, et seq.).

      (3) P.L. 83-703, Atomic Energy Act of 1954.

   b. Executive Orders (E.O.) and Federal Policies.

      (1) E.O. 12344, Naval Nuclear Propulsion Program.

      (2) Federal Wildland Fire Management Policy and Implementing Actions. (Available from National Interagency Fire Center)

      (3) Secretarial Delegation Order Number 00-033.00B, dated 07-20-09.

   c. Code of Federal Regulations (C.F.R.).

      (1) 10 C.F.R. Part 830, Nuclear Safety Management.

      (2) 10 C.F.R. Part 835, Occupational Radiation Protection.

      (3) 10 C.F.R. Part 851, Worker Safety and Health Program.

      (4) 29 C.F.R. Part 1910, Occupational Safety and Health Standards.

      (5) 29 C.F.R. Part 1910, Subpart G, Section 1910.94, Occupational Health and Environmental Control.

      (6) 29 C.F.R. Part 1910, Subpart Z, Section 1910.100, Toxic and Hazardous Substances.

      (7) 29 C.F.R. Part 1910, Subpart H, Section 1910.101, Hazardous Materials.

      (8) 29 C.F.R. Part 1910, Section 1910.134, Respiratory Protection.

      (9) 29 C.F.R. Part 1926, Safety and Health Regulations for Construction.

      (10) 48 C.F.R. Part 970, Section 970.5223-1, Integration of Environment, Safety, and Health into Work Planning and Execution.

d. DOE Directives.

(1) DOE P 420.1, *Department of Energy Nuclear Safety Policy*, dated 02-08-11.

(2) DOE O 151.1C, *Comprehensive Emergency Management System*, dated 11-02-05.

(3) DOE O 226.1B, *Implementation of Department of Energy Oversight Policy*, dated 04-25-11.

(4) DOE O 227.1, *Independent Oversight Program*, dated 08-30-11.

(5) DOE O 251.1C, *Departmental Directives Program*, dated 01-15-09.

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2. ACRONYMS.

ACI	American Concrete Institute
AHJ	authority having jurisdiction
AISC	American Institute of Steel Construction
ANS	American Nuclear Society
ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
BNA	baseline needs assessment
CD	critical decision
C.F.R.	Code of Federal Regulations
CMAA	Crane Manufacturers Association of America
COR	Code of Record
CRD	contractor requirements document
CSE	cognizant system engineer
CSP	criticality safety program
DOE	Department of Energy

E.O.	Executive Order
FHA	fire hazards analysis
FPE	fire protection engineer
G	Guide (DOE directive)
IBC	International Building Code
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
ISA	International Society of Automation
M	Manual (DOE directive)
MPFL	maximum possible fire loss
NFPA	National Fire Protection Association
NNSA	National Nuclear Security Administration
NPH	natural phenomena hazards
NRC	Nuclear Regulatory Commission
O	Order (DOE directive)
P	Policy (DOE directive)
P.L.	Public Law
SAC	specific administrative controls
SSC	structures, systems, and components
STD	Standard (DOE technical standard)
TEMA	Tubular Exchanger Manufacturers Association
U.S.C.	United States Code

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

PAGE CHANGE

DOE O 420.1C Chg 1

Approved: 12-4-2012
Chg 1: 2-27-2015

SUBJECT: PAGE CHANGE TO DOE O 420.1C, *FACILITY SAFETY*

1. EXPLANATION OF CHANGE. To invoke revised DOE-STD- 1104-2014, *Review and Approval of Nuclear Facility Safety Basis and Safety Design Basis Document*, and revised DOE-STD-3009-2014, *Preparation of Nonreactor Nuclear Facility Documented Safety Analysis* as required methods.

2. LOCATIONS OF CHANGES.

Pages	Paragraphs
Throughout	Reference citations and organization codes Miscellaneous technical editing and punctuation
2	3.c.(4)
3	3.c.(9)
4	4.f – 4.i
5	5.a.(3)
6	5.d.(8) and 5.d.(13)
CRD	
Page 1	1.c and 1.e
Page 2	1.f and 2.a
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I-4	Footnote 4
II-1	3.a.(2)
II-2	3.c.(2)(b) – 3.c.(2)(e); 3.f.(1); and 3.f.(2)(a)
II-6	Footnote 5
IV-1	3.b
IV-2	3.d.(1) and 3.d.(2)
Attachment 3	
4	3.b

BY ORDER OF THE SECRETARY OF ENERGY:

ELIZABETH SHERWOOD-RANDALL
Deputy Secretary

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