

Comment resolutions 01-12-12 (CDNS, GC, NE, NNSA, EM, SC, DNFSB)  
**U.S. Department of Energy**  
Washington, D.C.

**ORDER**

**DOE O 420.1C**

**SUBJECT:** FACILITY SAFETY

DRAFT XX-XX-2012

1. OBJECTIVES. 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. the 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 420.1 B, 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. This Order also cancels paragraph 2, 'Duties and Responsibilities' of Appendix D of DOE O 426.1 Chg 1, *Federal Technical Capability*, dated 09-20-11. 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contract unless, and until, the contract or regulatory commitment is modified to either eliminate requirements that are no longer applicable or substitute a new set of requirements.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.

The Administrator of the National Nuclear Security Administration (NNSA) will ensure that NNSA employees and contractors 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 paragraph 3.c, the CRD (Attachment 1) sets forth requirements of this Order that will apply to contracts that include the CRD. The CRD, or its requirements, must be inserted in 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. This includes exemptions to DOE and industry codes and standards required by this Order.
  - (2) Equivalencies to DOE and industry codes and standards determined to be applicable to the facility design or operations must demonstrate an equivalent level of safety (e.g., 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 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.
- (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. Requirements of this Order do not apply to Nuclear Explosive and Weapons Surety Program activities for prevention of accidental or unauthorized nuclear detonations if the requirement would compromise the effectiveness or safety of these activities. In the event of conflicts between the requirements of this Order and those of the Order 452.2 series of directives, the requirements of the latter 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 revision to the Order do not apply to projects that have reached a high level of design maturity, as determined by the Program Secretarial Offices (PSOs), when this Order is issued (such as those projects that have completed the CD-2 milestone or those projects that have completed the CD-1 milestone that have achieved 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 under the jurisdiction of the General Services Administration.

- d. Government-Owned, Government-Operated Facilities. The CRD (Attachment 1) sets forth requirements that must also be applied to DOE government-owned, government-operated facilities. Government-operators must comply with the requirements in Attachment 1.
4. REQUIREMENTS. DOE must:

- a. Approve and oversee contractor programs, as specified in the Responsibilities section (Section 5) of this Order, ensuring that contractors meet the requirements of Attachment 1;
- b. Implement the requirements in Attachment 1 for Government-Owned Government-Operated Facilities;
- c. Establish Federal Safety System Oversight programs as specified in the Responsibilities section (Section 5) of this Order and further detailed in Appendix A of this Order;
- d. Document any operational activities that are delegated to the contractor associated with authority having jurisdiction (AHJ) for matters involving fire protection as defined by the National Fire Protection Association (NFPA);
- e. Document any authorities associated with the Building Official, as defined in the Department standard (STD), DOE-STD-1066-XXXX, *Fire Protection Criteria*, that are delegated to the contractor; and,
- f. Establish an integrated site-wide wildland fire management plan, consistent with the Federal Wildland Fire Management Policy.

## 5. RESPONSIBILITIES.

- a. Secretarial Officers.
  - (1) Ensure that 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), 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.
- b. Chief Health, Safety and Security Officer.
  - (1) Develops and maintains policy, requirements, guidance, and technical standards relating to this Order and the CRD.
  - (2) Provides technical advice and assistance on the implementation of policy, requirements, guidance, and technical standards related to this Order and CRD.

- (3) Provides comments on requests for exemptions from requirements of this Order.
- (4) Plans and conducts 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).

c. 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 and industry codes and standards determined to be applicable to the facility design.
- (4) Approve contractors' emergency services organization Baseline Needs Assessments that meet the requirements in Attachment 2, Chapter II.3.e.(1) of this Order.
- (5) Approve contractors' fire protection program (may be accomplished in conjunction with 10 C.F.R. Part 851), including its application to leased facilities.
- (6) Fulfill the roles and responsibilities for the AHJ for matters involving fire protection, as defined by the National Fire Protection Association (NFPA), including documentation of any delegation of responsibilities.
- (7) Fulfill the roles and responsibilities for the Building Official, as defined in DOE-STD-1066, including documentation of any delegation of responsibilities.
- (8) Perform responsibilities of 'owner' or other equivalent term in the application of DOE or industry codes and standards, unless delegated.
- (9) Approve the contractors' Criticality Safety Program documentation; ensuring it meets requirements in Chapter III of Attachment 2 of the Order (may be accomplished through the safety basis documentation

approval process).

- (10) Approve periodic NPH assessment results, any recommended update actions, and any recommended upgrade plans, in accordance with Chapter IV of Attachment 2 of the Order.
  - (11) For hazard category 1, 2, and 3 nuclear facilities, establish a Safety System Oversight (SSO) Program per Appendix A of this Order to oversee contractors' CSE programs and facility safety systems.
  - (12) Consistent with DOE O 226.1B, *Implementation of Department of Energy Oversight Policy*, establish and implement an appropriate self-assessment and oversight program for the elements of this Order.
- d. Contracting Officers. Incorporate the CRD, or its requirements, into affected contracts and procurement requests in a timely manner when notified.
- e. Central Technical Authority.
- (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 and industry codes and standards determined to be applicable to the facility design.
6. REFERENCES AND ACRONYMS. References and acronyms can be found in Attachment 4.
7. CONTACT. Address inquiries to the Office of Health, Safety and Security; Office of Nuclear Safety, 301-903-3331.

BY ORDER OF THE SECRETARY OF ENERGY:

DANIEL B. PONEMAN  
Deputy Secretary

## **Appendix A**

### **SAFETY SYSTEM OVERSIGHT**

1. OVERVIEW. The Safety System Oversight (SSO) function provides key Federal safety oversight of contractor Cognizant System Engineer (CSE) programs that ensure safety system operability at Department of Energy (DOE) nuclear facilities. SSO personnel provide oversight of CSE programs and assigned systems to ensure they will perform as required by the safety basis and other applicable requirements. Working in conjunction with Facility Representatives (FRs), who are responsible for monitoring day to day operational performance, the two safety oversight groups together provide an added degree of assurance of safe nuclear facility operations and proper safety system performance.
  
2. DUTIES AND RESPONSIBILITIES.
  - a. SSO Personnel.
    - (1) Maintain communications with contractor CSE personnel and oversight of the CSE program.
    - (2) Attend selected contractor meetings with personnel responsible for system performance (e.g., CSEs, design authorities, and program managers), review system health/status reports, review test results, interface with external organizations that can provide insights on performance, and perform other oversight activities on a routine basis.
    - (3) Perform periodic assessments of system configuration and material condition. Monitor the effect of aging on system equipment and components, the adequacy of work control and change control processes, and effectiveness of system maintenance and surveillance, as they support reliable performance of system safety functions.
    - (4) In conjunction with FRs, perform evaluations of contractor troubleshooting, investigations, root cause evaluations, and selection and implementation of corrective actions. SSO personnel may also be assigned to respond to events and investigations during normal workdays or back shifts and serve as the DOE-recognized expert on issues related to assigned systems, topics, or physical areas.
    - (5) Provide support to other Federal employees as appropriate, particularly for support of new or modified safety systems and facilities or Integrated Safety Management implementation as it relates to safety systems.
    - (6) Assess contractor compliance with relevant DOE regulations, industry

standards, contract requirements, safety basis requirements, and other system requirements.

- (7) Monitor the currency and accuracy of configuration documentation, procedures, and other system or management systems information.
- (8) Report potential or emergent hazards immediately to DOE line management and FRs, and stop tasks, if required, to prevent imminent impact to the health and safety of workers and the public, to protect the environment, or to protect the facility and equipment.
- (9) If assigned, assist in the development or revision of Functional Area Qualification Standards, mentor assigned personnel, and serve as a qualifying official for SSO candidates.
- (10) Maintain cognizance of the appropriate funding and resources to maintain and improve safety systems.
- (11) Perform additional duties and responsibilities as assigned.

b. Field Element Managers.

- (1) Define SSO requirements and ensure that SSO staffing needs are filled.
- (2) Clearly define the functions, responsibilities, and authorities of personnel assigned to perform SSO, including the SSO relationship to FRs and other oversight functions and to the contractor CSE program. Ensure affected DOE and contractor managers understand these roles and relationships and provide the necessary access and support.
- (3) Establish SSO qualification programs as part of the organization's Technical Qualification Program. Serve as, or designate, the Qualifying Official for SSO candidates.
- (4) Establish appropriate training and performance requirements for SSO personnel and hold supervisors of SSO personnel accountable for achieving them.
- (5) Conduct periodic self-assessments of the SSO program to ensure its effectiveness and compliance with requirements.
- (6) Ensure that SSO responsibilities are included and maintained in individual performance plans.

3. IMPLEMENTATION. Field Element implementation of these

responsibilities may be tailored consistent with considerations for CSE program grading and the objectives in the SSO program Overview.







**Attachment 1**  
**CONTRACTOR REQUIREMENTS DOCUMENT**  
**DOE O 420.1C, FACILITY SAFETY**

This contractor requirements document (CRD) includes requirements outlined in Attachments 2 and 3 of this Order, *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, or decommissioning or 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.
- c. All design and construction, at a minimum, must comply with applicable national consensus industry codes and standards, the International Building Code (IBC) and other requirements as documented in this Order. 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 mandatory statements in DOE and industry codes and standards identified as applicable, unless relief is approved in accordance with Section 2 below.

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*. Requests for equivalencies and exemptions must be provided to the responsible contracting officer for further processing. This includes exemptions to DOE and industry codes and standards required by this Order.

- b. Equivalencies to DOE and industry codes and standards determined to be applicable to the facility design or operations must demonstrate an equivalent level of safety (e.g., meets or exceeds the level of protection) and be approved by the DOE Field Element.
3. REFERENCES. Attachment 4 provides a list of reference documents: rules, directives, guidance, and DOE and industry codes and standards. This does not constitute a complete list of all codes, standards, or laws that are required for compliance with this Order.

## **Attachment 2 FACILITY SAFETY REQUIREMENTS**

This Attachment provides information and/or requirements associated with DOE O 420.1C, *Facility Safety*, as well as information and/or requirements applicable to contracts in which the associated Contractor Requirements Document (CRD), (Attachment 1 of this Order) 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*, dated 02-08-11<sup>1</sup>.

The requirements of this chapter (and the criteria in Attachment 3 of this Order) support implementation of the requirements for hazard category 1, 2 and 3 nuclear facilities in 10 C.F.R. Part 830, *Nuclear Safety Management*, Subpart B, *Safety Basis*, and establish acceptable design criteria to meet the provisions of 10 C.F.R. 830.206.

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 approved facility safety basis.
  - b. This chapter does not impose requirements on existing facilities, except for major modifications<sup>2</sup> 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. This chapter applies to nuclear deactivation or decontamination and decommissioning activities at end-of-facility-life, unless either (i) the safety analysis demonstrates that adequate protection is otherwise provided through alternate means, consistent with the requirements of 10 C.F.R. Part 830,

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<sup>1</sup> 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.

<sup>2</sup> DOE-STD-1189 provides definition and examples of major modifications.

Subpart B, or (ii) it is not cost beneficial to apply the provisions of this chapter for the limited remaining life of the activity. In any event, this chapter does apply to facilities and major facility modifications to facilitate deactivation, decontamination or decommissioning.

3. REQUIREMENTS.

a. Integration of Safety with Design.

- (1) Safety must be integrated into the design early and throughout the design process through use of DOE-STD-1189-2008, *Integration of Safety into the Design Process*.
- (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. 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 to 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 (based on the safety basis

document and supporting technical analysis) 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 and/or 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 detail requirements); and,
  - (i) establishing emergency plans for minimizing the effects of an accident.
- (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. 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 for nuclear facilities with a significant potential for a significant radiological release. Alternate confinement approaches may be acceptable if a technical evaluation demonstrates that a significant potential for a significant radiological release does not exist and the confinement approach provides adequate protection of public health and safety. Technical evaluations may consider the type of activity or event that is confined, and the duration of planned operations.

NOTE: DOE G 420.1-1A, *Nonreactor Nuclear Safety Design Guide for Use with DOE O 420.1C, Facility Safety*, dated XX-XX-XX, provides performance criteria for designing and evaluating confinement systems.

- (d) Documentation of the adequacy of confinement systems consistent with the safety in design process as described in DOE-STD-1189.
- (4) Hazard category 1, 2, and 3 nuclear facilities must be designed to:
- (a) facilitate safe deactivation, decommissioning, and 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 that the facility is maintained in a safe state;
  - (c) keep occupational radiation exposures within statutory limits, and as low as reasonably achievable;
  - (d) provide controls consistent with the hierarchy described in DOE-STD-1189; and,
  - (e) protect against chemical hazards consistent with DOE-STD-1189 and direction from the responsible program office. Appendix B of DOE-STD-1189 provides additional guidance

for protection against chemical 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 point failure<sup>3</sup> 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.
- (9) New DOE nuclear reactors must comply with the requirements of this Attachment, as well as the design requirements of DOE O 5480.30, *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 to satisfy the requirements of this chapter must also integrate with other design requirements, as applicable, including explosive safety, industrial safety, and nuclear explosive safety (if applicable).

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<sup>3</sup> IEEE-STD-379-2000, *IEEE Standard Application of the Single-Failure Criterion to Nuclear Power Generating Station Safety Systems*, provides a definition of single point failure criterion.



## CHAPTER II. FIRE PROTECTION

1. **OBJECTIVES.** To establish requirements for comprehensive fire protection program 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’ (HPR) 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 (including contractor-leased facilities used for DOE mission purposes). For off-site leased facilities that are not nuclear hazard category 1, 2, or 3 facilities, the requirements of this chapter apply to the extent determined by the Field Element. For on-site leased facilities that are not nuclear hazard category 1, 2, or 3 facilities, the design requirements of this chapter (Section 3.c) apply to the extent determined by the Field Element. DOE-STD-1066-2012 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.** Fire protection and emergency response programs must meet or exceed the applicable building code and National Fire Protection Association (NFPA) codes and standards.
      - (a) Facilities and major modifications thereto, must be constructed to meet codes and standards in effect when design criteria are approved [otherwise known as the code of record (COR)]. Other facility changes must meet the most recent applicable codes and standards to the extent determined by the Authority Having Jurisdiction (AHJ).
      - (b) Operational provisions of subsequent editions of codes or standards (promulgated after the COR) are mandatory only to

the extent that they are explicitly stated to be applicable to existing facilities.

- (c) Conflicts between this Order, NFPA codes and standards and the applicable building code must be resolved as follows:
  - 1. Requirements of this Order take precedence over all NFPA and building code requirements and are subject to the relief requirements of this Order.
  - 2. Conflicts between NFPA requirements and the applicable building code requirements are resolved by the Head of the Field Element following under 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.
  - (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 approved by AHJ.
  
- 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 5000 sq. ft of floor area or where a maximum possible fire loss exceeds \$5 million, unless the NFPA codes 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 or analysis (for example, to prevent loss of safety functions or provide defense-in-depth);
- 2 significant life safety hazards;
- 3 unacceptable mission or program interruption;
- 4 where a modification to a facility would cause the maximum possible fire loss to exceed \$5 million; or,
- 5 where the modification causes a facility to exceed 5,000 square feet of floor area.

- (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 maximum possible fire loss (MPFL) exceeds \$150 million (refer to DOE-STD-1066-XXXX, *Fire Protection*).
- (e) For property protection, fire areas must be established such that the MPFL for each fire area does not exceed \$350 million. Fire area walls or other separation approaches may be used to meet this requirement.

(3) Fire Protection and Life Safety Systems.

- (a) Fire Suppression. Fire suppression systems must be designed such that their inadvertent operation or failure will not result in the loss of function of safety-class or safety-significant systems.
- (b) Fire Barriers. Complete fire-rated construction and barriers, commensurate with the applicable codes and/or safety basis documentation, 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. Life safety and means of egress must be provided in accordance with 10 C.F.R. Part 851, *Worker Health and Safety Program*.

- (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) “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.

- (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 (Definition for FP Engineer is provided in STD 1066). 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) Delegated Authority. If delegated, 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 documentation, 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 capabilities; 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 policy guidance;
    - (c) be submitted to DOE Field Element for approval;

- (d) be reviewed periodically and updated as necessary at least every three years and whenever a significant new hazard is introduced that is not covered by the current BNA (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 documentations.
  - (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 Building Assessments.
  - (1) Fire Hazards Analyses. FHAs, using a graded approach, must be conducted for all hazard category 1, 2, and 3 nuclear facilities, facilities that represent unique fire safety risks, and for new facilities or major modification to an existing facilities with value greater than \$150 million, or when directed by the responsible DOE authority. The FHAs must be:
    - (a) performed under the direction of a fire protection engineer;
    - (b) reviewed periodically and updated as necessary every three years, by a fire protection engineer (note: if no update 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) Building Assessments. Fire protection assessments must be conducted:
- (a) annually, or at a frequency approved by AHJ, for buildings with a replacement value in excess of \$100 million, 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 approved by AHJ, 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 established and implemented in accordance with NFPA 1143, *Standard for Wildland Fire Management*, 2009.
- h. Specific Fire Protection Program Criteria. DOE-STD-1066 provides acceptable methods for implementing the requirements in this Order; other methods may be acceptable. Any alternate approach must provide a level of safety equal to that achieved by conformance with the standard and be approved by the DOE Field Element.



### CHAPTER III. NUCLEAR CRITICALITY SAFETY

1. OBJECTIVES. 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 with responsibility for nuclear facilities and activities that involve or will potentially involve nuclides in such quantities that are equal to or greater than the single parameter limits for fissionable materials listed in the ANSI/ANS-8.1, *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors*, and ANSI 8.15, *Nuclear Criticality Control of Special Actinide Elements*. These limits must be adjusted where process conditions could credibly involve moderators or reflectors 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 must describe how the contractor will satisfy the requirements of the ANSI/ANS 8 consensus nuclear criticality safety standards in effect as of the date of this Order, unless otherwise modified or approved by DOE. The CSP 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 the 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.
  - f. The facility and/or process must be designed such that no single credible design basis event or failure can result in a criticality accident.
  - 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. OBJECTIVES. 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 only to new facilities and major modifications, unless triggered by periodic NPH assessment and upgrade requirements.
3. REQUIREMENTS.
  - a. General. DOE 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 documents. 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 must satisfy the applicable requirements and criteria contained in DOE-STD-1020-XXXX, *Natural Phenomena Hazard s Analysis and Design Criteria for DOE Facilities*. The facilities must also satisfy the building codes for design to mitigate NPH events mandated by the local, city, county, and state regulatory authorities. If there is any conflict between the requirements in these building codes versus those in DOE-STD-1020, the requirements that result in more conservative design must be used.
  - 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. Evaluation and Upgrade Requirements for Existing DOE Facilities.

- (1) Existing facility or site NPH assessments must be reviewed and evaluated at least every 10 years for any significant changes in data, criteria, and evaluation methods that would warrant updating the assessments. Section 9.1 of DOE-STD-1020 contains criteria and guidance for performing these reviews and evaluations. The review and evaluation results, along with any recommended update actions, must be submitted to the head of the Field Element. If no update is necessary, this result must be documented following the review.
- (2) If a new assessment of NPH demands indicates deficiencies in existing SSC design, an upgrade plan must be developed and implemented on a prioritized schedule, based on the safety significance of the upgrades, time or funding constraints, and mission requirements. Section 9.2 of DOE-STD-1020 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. OBJECTIVES. 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 system 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 reached operational status (Critical Decision 4 (CD-4) per DOE O 413.3B, *Program and Project Management for the Acquisition of Capital Assets*) ~~with~~ and have:
  - a. Active safety-class or safety-significant SSCs as defined in the facility's DOE approved safety basis; 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 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 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-XXXX, *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 review of system operability, reliability, and material condition. Reviews must assess the system for:
- (a) 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 paragraph 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. 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* (see associated CRD) as applicable. Qualification requirements must include knowledge of:
- (1) related facility safety basis including safety system functions, safety system performance criteria, and any relationship to specific administrative controls;
  - (2) system functional classification and basis;
  - (3) codes and standards applicable to assigned systems;
  - (4) system design, procurement, replacement, and related quality assurance requirements;

- (5) the existing condition of the system;
- (6) a working knowledge of the facility's operation; and,
- (7) available (in print or online) vendor manuals, and product warnings, and updates related to assigned systems.



**Attachment 3**  
**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 DOE design criteria, standards and directives (listed in Attachment 4). 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 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 could substantially change the approved 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, as one aid to judgment when evaluating the costs and benefits of non-mandatory upgrades to existing facilities.
  
  - c. This attachment applies to nuclear deactivation or decontamination and decommissioning activities at end-of-facility-life, unless either (i) the safety analysis demonstrates that adequate protection is otherwise provided through alternate means, consistent with the requirements of 10 C.F.R Part 830, Subpart B, or (ii) it is not cost beneficial to apply the provisions of this attachment for the limited remaining life of the activity. In any event, this chapter does apply to facilities and major facility modifications to facilitate deactivation or decommissioning.
  
3. REQUIREMENTS. Safety-SSCs must be designed, commensurate with the importance of the safety functions performed, to perform their safety functions as determined by the safety analysis when called upon.
  - a. General Design Criteria.

- (1) Conservative Design Margin. Safety-SSCs must be designed with an appropriate margin of safety as defined in applicable DOE or industry codes and standards.
- (2) Single Failure Criteria.
  - (a) The single failure criterion, requirements, and design analysis identified in ANSI/IEEE 379, *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. ANSI/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 from IEEE STD 323, *IEEE Standard Criteria for Qualifying Class IE Power Nuclear Power Generating Stations*, or other applicable standards, must be used to assure 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 DBAs. At both the facility and SSC level, the design must ensure that more probable modes of failure (e.g., fail to open versus fail 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. ANSI/IEEE STD 384, *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 use of separation distance, barriers, electrical isolation devices, or any combination thereof.
- (6) Protection Against Fire. Safety-class systems must be designed with redundancy or other means, such that safety function is maintained in the event of a fire.
- (7) Quality Assurance. Establish a Quality Assurance (QA) Program that satisfies 10 C.F.R. 830, Subpart A, *Quality Assurance*, and DOE O 414.1D, *Quality Assurance* 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 and industry codes and standards identified in the following sections must be evaluated for applicability.

DOE 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 the 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 mandatory statements must be applied in the design. Relief from requirements in applicable DOE and industry codes and standards is described in Attachment 1.

The design authority must follow the design process for the selection of codes and standards that is described in the DOE-STD-1189. DOE-STD-1189 describes the safety design process including selection of safety SSCs and their performance requirements that are documented in the Preliminary Documented Safety Analysis (PDSA), and further refined as the design matures, and documented in Documented Safety Analysis (DSA). The design authority selects applicable DOE and industry codes and standards for the design, procurement, testing, and operations to ensure that selected safety SSCs can perform their stated safety functions in the environment specified in the PDSA.

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 will drive selection of additional codes and standards. Facility designers must identify the complete set necessary to meet the general design criteria identified above (see also Attachment 4 for additional codes and standards).

- (1) Structural. Table 1 provides relevant codes and standards. Attachment 2, Chapter IV provides additional natural phenomena hazards design requirements.

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

<b>Structures</b>	<b>Safety-Significant</b>	<b>Safety-Class</b>
Concrete	ACI-318	ANSI/ACI-349
Steel	AISC-360; AISC-325	ANSI/AISC-N690

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

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

<b>Process Equipment</b>	<b>Safety-Significant</b>	<b>Safety-Class</b>
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
Tanks (atmospheric pressure)	API-650; AWWA-D100;	API-650; AWWA-D100;
Pumps	ASME B73.1M, B73.2M; ASME Boiler and Pressure Vessel Code, Section VIII; AWWA; Hydraulic Institute Standards	ASME B73.1M, B73.2M; 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
Glove boxes	ASTM C852, AGS-G006	ASTM C852, AGS-G006

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

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

<b>Ventilation</b>	<b>Safety-Significant</b>	<b>Safety-Class</b>
General	ASME AG-1; DOE HDBK-1169; DOE G 420.1-1A, Appendix A	ASME AG-1; DOE HDBK-1169; DOE G 420.1-1A, Appendix A
Ducts	ASME AG-1, DOE HDBK-1169	ASME AG-1; DOE HDBK-1169
Fans	ASHRAE Handbook, ASME AG-1; DOE HDBK-1169	ASHRAE Handbook; ASME AG-1; DOE HDBK-1169
Filtration	ASME AG-1; DOE-STD-3020; DOE HDBK-1169	ASME AG-1; DOE-STD-3020; DOE HDBK-1169
Balance of system for confinement ventilation	ASME AG-1; DOE HDBK-1169	ASME AG-1; DOE HDBK-1169
Off-gas treatment	ASME AG-1; DOE HDBK-1169	ASME AG-1; DOE HDBK-1169

- (4) 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; ANSI/ASME NOG-1; ASME NUM-1; ASME B30.2; DOE-STD-1090	CMAA Nuclear Sections; ASME NOG-1; ASME NUM-1; ANSI/ASME B30.2; DOE-STD-1090
Other equipment	ANSI N 14.6; ASME B30 Series; DOE-STD-1090	ANSI N14.6; ASME B30 Series; DOE-STD-1090

- (5) 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; ANSI C2; IEEE C37; IEEE -80, -141, -142, -242, -399, -446 -493, -577	Applicable NFPA codes and standards; IES Lighting Handbook; ANSI C2; IEEE C37; IEEE-80, -141, -142, -242, -308, -338, -379, -384, -399, -493, -577, -603

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 -323, -334, -336, -344, -382, -383, -387, -420, -450, -484, -535, -628, -649, -650, -749, -833, -946

- (6) 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 all safety-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.

Table 7 provides relevant codes and standards.

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 C2; ANSI/ANS-8.3, -N42.18, -N13.1; ANSI/ISA-Series including ISA 67.04.01.; IEEE-141, -142, -242, -493, -1050; and DOE-STD-1195 (implemented ISA 84.00.01)	Applicable NFPA codes and standards; ANSI C2; ANSI/ANS -N42.18, -N13.1; ANSI-N323D; ANSI/ISA-Series including ISA 67.04.01; IEEE-141, -142, -242, -323, -336, -338, -344, -379, -384, -493, -1050

- (7) Fire Protection Systems. DOE-STD-1066-XXXX, *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 DOE-STD-1066, Appendix A). Fire protection system designs are also required to address the applicable design requirements for similar safety systems provided in this Attachment (for example, the fire detection and alarm system would be designed consistent with safety related I&C system).



## **Attachment 4**

### **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, Title XXXII, *National Defense Authorization Act for Fiscal Year 2000*, as amended.
    - (2) RCRA, *Resource Conservation and Recovery Act of 1976* (P.L. 94-58042, 41 U.S.C., Sec. 6901, et seq.), as amended.
    - (3) Atomic Energy Act, Section 1701
  - 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 50.2, *Definitions*, 1999.
    - (2) 10 C.F.R. Part 830, *Nuclear Safety Management*, 1999.
    - (3) 10 C.F.R. Part 835, *Occupational Radiation Protection*, 1999.
    - (4) 10 C.F.R. Part 851, *Worker Safety and Health Program*, 2006.
    - (5) 29 C.F.R. Part 1910, *Occupational Safety and Health Standards*, 1994.
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2. ACRONYMS.

AHJ	authority having jurisdiction
ANS	American Nuclear Society
ANSI	American National Standards Institute
BNA	baseline needs assessment
C.F.R.	Code of Federal Regulations
COR	Code of Record
CRD	contractor requirements document
CSE	cognizant system engineer
DOE	Department of Energy
E.O.	Executive Order
FHA	fire hazards analysis
FR	facility representative
G	Guide (DOE directive)
IBC	International Building Code
IEEE	Institute of Electrical and Electronics Engineers
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 (Directive)
P.L.	Public Law
SSC	structures, systems, and components
SSO	Safety System Oversight
STD	standard (DOE directive)
U.S.C.	United States Code