

January 31, 2011

To: J. N. McKamy Manager, US DOE NCSP

From: C. M. Hopper, Chair, US DOE NCSP CSSG *CMH*

In response to Tasking 2011-01 a subgroup of the Criticality Safety Support Group (CSSG) was organized to provide comments regarding the draft DOE O 420.1C provided by HSS.

The drafting team consisted of the following CSSG members:

- F. Trumble, Team Lead
- R. E. Anderson
- A. S. Garcia
- C. M. Hopper
- R. E. Wilson

The draft comments were reviewed by the entire CSSG and several independent subject matter experts. Comments were incorporated into the final version of the response that is provided in our Attachment A below the **CSSG Response to Tasking 2011-01**. Our Attachment B provides your Tasking.

This version represents a consensus position by the entire CSSG.

cc: CSSG Members
J. B. O'Brien, US DOE HS-21

CSSG Response to Tasking 2011-01
Review of DOE O 420.1C "Facility Safety"
January 28, 20101

In response to the US DOE NCSP Manager's Tasking 2011-01, *CSSG Review of Draft DOE O 420.1C*, the CSSG has developed these consensus comments on the draft Order. This response consists of a red-line version of the draft Order as well as specific answers to the four questions posed in the tasking. As noted in the tasking, the emphasis of the CSSG review was on those portions of the draft Order dealing with Criticality Safety.

Executive Summary

The CSSG supports the effort to streamline the draft Order and to refocus the regulatory basis for criticality safety on the consensus standards provided by the ANSI/ANS organization. The primary consensus standards have underpinned the practice of criticality safety in the United States for many years.

Attachment A contains the red-lined version of the draft 420.1C as commented on by the CSSG. The remainder of this response provides the CSSG answers to the four questions posed in the CSSG Tasking 2011-01.

The CSSG is supportive of the new draft of DOE O 420.1C but recommends consideration be given to the comments provided prior to issuance. In order to retain consistency between DOE O 420.1C and DOE-STD-3007 the CSSG recommends several page changes to the DOE-STD-3007-2007 that should be incorporated concurrently with the revision to DOE O 420.1C.

Discussion

The CSSG has reviewed the Draft DOE O 420.1C provided on 1/14/11 that was included with this tasking. Comments are provided in the red-line version of the draft Order 420.1C included as Attachment A. The following are the CSSG responses to the four specific questions in the tasking.

Question 1: Is there wording in the new version of DOE O 420.1C that could be considered confusing or ambiguous? If so, please suggest alternate wording.

Response: The CSSG did not find any wording that would be considered to be confusing or ambiguous. The CSSG would like to bring an apparent inconsistency to your attention. Attachment 2 of 420.1C section 1.a appears inconsistent with the applicability statement in Attachment 2 Chapter I 2.b. It is the CSSG's understanding that the section 1.a requirements would apply to "new facilities and major modifications" as other existing facilities may be covered by their code of record.

Question 2. Are there new requirements in the DOE O 420.1C? If so, in your opinion can these requirements be executed in a cost effective manner such that they produce adequate safety for criticality safety operations?

Response: The CSSG did not identify any new requirements in the draft version of the DOE O 420.1C, however it did find one additional requirement that can be removed. The CSSG recommends removing the requirement (chapter III, 3.g.) since that wording is already contained in ANSI/ANS 8.3. While there is no issue with requirement in III.3.g, other similar requirements that are contained in other ANSI/ANS standards were deleted from 420.1C and the CSSG feels this removal continues that same approach.

Question 3. Is there important information/direction that has been removed from the new version of DOE O 420.1C that decreases the safety of criticality safety operations?

Response: Much of the DOE O 420.1B material has been removed from the draft version of 420.1C. Most of these requirements are either contained in other requirements documents or are concluded to be not necessary. The removal of a few requirements however has caused a disconnect with DOE-STD-3007-2007 which will need to be rectified. Specifically the following requirements which are referenced to 420.1B from 3007-2007 are no longer included in 420.1C:

II (e) “The CSE shall document that at least two unlikely, independent and concurrent changes in process conditions (i.e., parameters) must occur before a criticality accident is possible.” DOE-STD-3007 points back to wording in 420.1B for the requirement (“shall”). This can be fixed in later revisions of 3007 by pointing back to ANSI 8.1 for the wording, however this is clearly a “should” statement, not a “shall” statement in the ANSI standard. If DOE intends to maintain a “shall” in the statement in 3007 this statement would need to be included in the DOE Order revision. The CSSG recommends however that DOE pursue a page change modification to 3007-2007 to reflect the “should” statement to be consistent with the standards.

II (e)3. “The preferred hierarchy of controls shall be: (1) passive engineered controls, ...” This also points back to wording in 420.1B that requires (via a “shall” statement) this hierarchy. That wording is no longer included in 420.1C – this can be addressed by either adding this statement back into 420.1C or modifying 3007-2007 to make this a “should”. ANSI 8.1 4.2.3 contains the bulk of this requirement and should be sufficient to ensure administrative controls do not become the preferred control scheme. The CSSG recommends DOE pursue a page change modification to 3007-2007 to make this statement a “should”.

IV “The CSP shall have a mechanism to review all changes or potential changes to NCS controls for capture by the configuration control program as well as revisions and updates to the DSA and TSRs”. DOE-STD-3007 points back to the requirement for periodic reviews of operations required by 420.1B which is not specifically called out in the 420.1C version of the order. However ANSI 8.19 does call this out as a “shall” statement thus DOE-STD-3007 could point back to

8.19 as a point of compliance. The CSSG recommends DOE pursue a page change modification to DOE-STD-3007-2007 to change the reference endnote for this statement to ANSI/ANS 8.19 instead of DOE O 420.1

Question 4. Given that DOE is now operating a critical experiments facility at the DAF, please provide specific guidance and text to include ANSI/ANS-1 and 14.1 and indicate how this should mesh with the CSP and ANSI/ANS-8 Standards.

Response:

The CSSG recommends the following changes to DOE O 420.1C:

- (1) add ANSI/ANS-1 and ANSI/ANS-14.1 to the reference list in Section 7
- (2) add the following to section 2, Chapter III, Attachment 2:

“With the exception of fuel handling and storage, the conduct of critical experiments is outside the scope of this order. Guidance for the conduct of critical experiments is provided in ANSI/ANS-1 and ANSI/ANS-14.1. “

The distinguishing feature of critical experiments is that critical experiments are performed with fissionable material configurations that may be near or above critical, or for which an adequate margin of subcriticality may not be established. Because of this, it is not possible to comply with the principal safety requirement in ANSI/ANS-8.1, namely to ensure that operations remain subcritical under normal and credible abnormal conditions. In addition, critical experiments are of an exploratory nature, and it is not always possible to predetermine the exact values for operational controls or shutdown devices. Thus, critical experiments are fundamentally different from standard process operations that are not intended to reach or exceed critical, and for which an adequate margin of subcriticality is established using the ANSI/ANS-8.1 methodology. Instead, critical experiments utilize monitoring methodologies and remote final assembly, and are conducted by personnel specifically trained for those tasks. Critical experiments are conducted based on different national standards, ANSI/ANS-1 Conduct of Critical Experiments, and ANSI/ANS-14.1, Operation of Fast Pulse Reactors.

Critical experiments originally involved construction and operation of configurations specifically designed to illustrate the neutron behavior in the critical assembly. Over time, the term “critical experiments” came to include experiments in which samples or add-on experiments were added to fixed-core configurations. Critical experiments are conducted in such a manner (near zero power over a short period of time) that the energy produced is insufficient to require auxiliary cooling and the inventory of long-lived fission products is insignificant. Frequent hands-on manipulation of the assembly configuration is a routine part of critical experiments operations.

ANSI/ANS-1 acknowledges (section 3.8) that manual operations associated with the “transfer and storage” of fissionable material are the purview of ANSI/ANS-8.1. Thus, ANSI/ANS-1 defines a physical transition (or line) between ANSI/ANS-8.1 and ANSI/ANS-1 at the boundary where construction of the critical assembly core begins. Up to that point, no actual core assembly has occurred and ANSI/ANS-8.1 is used. When core assembly begins, ANSI/ANS-1 takes over.

In section 3.7 ANSI/ANS-1 requires that “operations be planned so that no single operational action or procedural violation could lead to a criticality accident.” For planned super-prompt criticality operations, ANSI/ANS-1 invokes ANSI/ANS 14.1.

Longer term, the CSSG recommends that DOE O 5480.30 be revised to address inclusion by reference of the ANSI/ANS-1 and ANSI/ANS-14.1 as well as to clarify those requirements for operation and those for design. Once that is complete, DOE O 420.1C or successor document could point to DOE O 5480.30 directly in the applicability statement for Chapter III.

Attachment A
US NCSP CSSG Red-line version of Draft DOE O 420.1C

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

ORDER

DOE O 420.1C

SUBJECT: FACILITY SAFETY

1. **OBJECTIVES.** To establish facility and programmatic safety requirements for 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 System Engineer Program.

Facility safety requirements for explosive, chemical, and industrial hazards are contained in other DOE Rules and Directives (see Section 7, *References*).

2. **CANCELLATION.** This Order cancels DOE O 420.1 B, Chg 1, *Facility Safety*, dated 04-19-10. Cancellation of an Order does not, by itself, modify or otherwise affect any contractual obligation to comply with such an Order. Contractor requirements documents (CRDs) containing directive requirements already incorporated into, or attached to, a contract remain in effect until the contract is modified to eliminate the existing requirement 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 DOE-owned or leased facilities. The Administrator of the National Nuclear Security Administration (NNSA) must assure 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 to establish Administration-specific policies, unless disapproved by the Secretary.

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- b. **DOE Contractors.** Except for the equivalencies and exemptions in paragraph 3.c, the Contractor Requirements Document (CRD, Attachment 1) sets forth requirements of this Order that will apply to contracts that include the CRD. The CRD requirements apply to all contractors responsible for design, construction, management, operation, decontamination, decommissioning, or demolition of

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DOE-owned and DOE-leased facilities. Contractors must comply with the requirements listed in the CRD to the extent set forth in their contracts.

- c. Equivalencies and Exemptions. Equivalencies and exemptions to this Order are processed in accordance with DOE O 251.1C, *Departmental Directives Program*. Central Technical Authority (or designee) concurrence is required for both exemptions and equivalencies to this Order for nuclear facilities.
- (1) Equivalency. In accordance with the responsibilities and authorities assigned by Executive Order 12344, codified at 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.
 - (2) Exemption. This Order does not apply to activities that are regulated through a license 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.
 - (3) Exemption. This Order does not apply to transportation activities that are regulated by the Department of Transportation.
 - (4) Exemption. The following portions of this Order do not apply to accelerator facilities that are covered by DOE O 420.2B, *Safety of Accelerator Facilities*, dated 7-23-04, and fusion facilities: (1) nuclear safety design requirements, and (2) system engineer program requirements.
 - (5) Exemption. Requirements of this Order do not apply to Nuclear Explosives and Weapons Safety Program activities for prevention of accidental or unauthorized nuclear detonations only if the requirement would compromise the effectiveness or safety these activities.
 - (6) Exemption. This Order does not apply to the Bonneville Power Administration (BPA), in accordance with Secretarial Delegation Order Number 00-033.00B to the BPA Administrator and Chief Executive Officer, dated 7-20-09.
 - (7) Exemption. This Order does not apply to the DOE Headquarters facilities that are under the jurisdiction of the General Services Administration.

4. REQUIREMENTS.

- a. General: Heads of Field Elements must
 - (1) Ensure contractors implement the requirements in the Attachment 1 and Attachment 2 for this Order.
 - (2) Implement the requirements in Attachment 2 for Government Owned Government Operated Facilities.
 - (3) Approve contractors' use of alternative methods from referenced DOE implementation guidance and technical standards.
- b. Nuclear Safety Design Criteria Requirements: Program Secretarial Offices must
 - (1) Approve the basis for any hazard category 1, 2 or 3 nuclear facility that does not include multiple physical barriers.
- c. Fire Protection Program Requirements: Heads of Field Elements must
 - (1) Approve contractor Fire department baseline needs assessments.
 - (2) Conduct comprehensive assessments of contractor fire protection programs.
 - (3) Conduct comprehensive self assessments of the site office fire protection program.
 - (4) Fulfill the roles and responsibilities for the Authority Having Jurisdiction (AHJ) for matters involving fire protection as defined by the National Fire Protection Association (NFPA),
 - (5) Fulfill the role and responsibilities for the Building Official for matters involving fire protection as defined by the local building Code.
 - (6) When any level of AHJ authority is delegated to the Contractor, document the level of authority that is transferred to the contractor.
 - (7) When any fire protection related duties and responsibilities associated with the Building Official are delegated to the Contractor, document the level of authority that is transferred to the contractor.
 - (8) Establish a site wildland fire management plan, consistent with the Federal Wildland Fire Management Policy.
- d. Criticality Safety Requirements: Heads of Field Elements must

- (1) Review and approve that the contractors CSP documentation meet requirements in Chapter III of attachment 2.
- (2) Perform periodic reviews of operations and conditions to ensure that criticality safety limits and controls are effectively implemented.
- e. Natural Phenomena Hazards: Heads of Field Elements must
 - (1) Approve recommendations to update NPH assessments.
- f. System Engineer Program: Heads of Field Elements must
 - (1) Establish a Safety System Oversight Program to oversee contractors' system engineer and safety system configuration management programs.
 - (2) Review and approve the contractors' System Engineer Program.

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5. RESPONSIBILITIES.

- a. Chief Health, Safety and Security Officer.
 - (1) Develops and maintains policy, requirements, guidance, and technical standards relating to this Order.
 - (2) Provides interpretation of DOE safety policy relating to requirements of this Order.
 - (3) Provides advice and assistance on policy implementation.
 - (4) Provides comments on requests for exemptions from requirements of this Order.
- b. Secretarial Officers (SOs).
 - (1) Ensure that requirements of this Order and the CRD are implemented for facilities, activities, or programs under their cognizance.
 - (2) Review and approve requests for exemptions from requirements of this Order after resolving comments, if any, from the Chief Health, Safety and Security Officer, or in the case of NNSA, following consideration of comments from the Chief Health, Safety and Security Officer.
 - (3) Ensure that heads of field elements notify contracting officers when contracts are affected by this Order.

- (4) Review and approve implementation methods other than those in referenced implementation guides and standards.

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) Notify contracting officers when contracts are affected by this Order.
- (3) Coordinate with contracting officers the revision of contracts to comply with requirements of this Order and require contractors to appropriately flow down requirements to subcontractors.
- (4) Ensure that procurement requests include applicable requirements in the CRD for this Order to be applied to awards or sub awards.
- (5) If delegated by the SO, review and approve exemption requests after resolving comments, if any, from the Chief Health, Safety and Security Officer for non-NNSA facilities and after considering requests for NNSA facilities.
- (6) Ensure that all procurement requests for work within the scope of this Order, including work requests to be performed through subcontracts, include the appropriate requirements of the attached CRD.

d. Contracting Officers.

- (1) Incorporate the CRD into affected contracts in a timely manner when notified.
- (2) Ensure the requirements of this Order and CRD flow down to contractors and subcontractors as applicable.

e. Central Technical Authority (or designee).

- (1) Concur on exemptions and equivalencies to this Order for nuclear facilities. Central Technical Authority concurrence is not required for equivalencies requested pursuant to civil design codes (such as building and fire safety codes) that are invoked by this Order or its implementing standards.

7. REFERENCES. The following documents are expressly referenced in the body of this Order and should be evaluated when implementing this Order and the associated CRD in the context in which they are referenced in the document.

- a. Public Law (P.L.).
 - (1) P.L. 98-525, Defense Procurement Reform Act of 1984.
 - (2) P.L. 106-65, Military Lands Withdrawal Act of 1999.
- b. Executive Orders (E.O.).
 - (1) E.O. 12344, Naval Nuclear Propulsion Program (February 1, 1982).
 - (2) E.O. 12699, Seismic Safety of Federal and Federally Assisted or Regulated New Building Construction (as amended by E.O. 13286, Amendment of Executive Orders, and Other Actions, in Connection with the Transfer of Certain Functions to the Secretary of Homeland Security, January 5, 1990).
 - (3) E.O. 12941, Seismic Safety of Existing Federally Owned or Leased Buildings (December 1, 1994).
- c. Code of Federal Regulations (CFR).
 - (1) 10 CFR Part 830, Nuclear Safety Management.
 - (2) 48 CFR 970.5223-1, Integration of Environment, Safety, and Health into Work Planning and Execution.
- d. DOE Directives.¹
 - (1) DOE O 151.1C, *Comprehensive Emergency Management System*.
 - (2) DOE O 251.1C, *Departmental Directives Program*.
 - (3) DOE O 413.3B, *Program and Project Management for the Acquisition of Capital Assets*.
 - (4) DOE O 414.1C, *Quality Assurance*.
 - (5) DOE G 420.1 1, *Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria Guide for Use with DOE O 420.1, Facility Safety*.
 - (6) DOE G 420.1-2, *Guide for the Mitigation of Natural Phenomena Hazards for DOE Nuclear Facilities and Nonnuclear Facilities*.

¹ For DOE directives, the contractors should follow the directive specified in the contract or other DOE procurement document instead of the revision cited in this Order. Unless restricted by contract or other requirement, successor documents may be used for DOE directives listed in this Order.

- (7) DOE O 420.2B, Chg 1, *Safety of Accelerator Facilities*.
- (8) DOE O 430.1B, *Real Property Asset Management*.
- (9) DOE O 433.1B, *Maintenance Management Program for DOE Nuclear Facilities*.
- (10) DOE O 440.1B, *Worker Protection Management for DOE (including the National Nuclear Security Administration) Federal Employees*.
- (11) DOE M 440.1-1A, *DOE Explosives Safety Manual*.
- (12) DOE M 452.4-1A, *Protection of Use Control Vulnerabilities and Designs*.
- (13) DOE O 452.2D, *Safety of Nuclear Explosive Operations*.
- (14) DOE O 452.1D, *Nuclear Explosive and Weapons Surety Program*.
- (15) DOE O 470.2B, *Independent Oversight and Performance Assurance Program*.
- (16) DOE O 426.1, *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities*.
- (17) DOE O 5480.30, *Nuclear Reactor Safety Design Criteria*.

e. DOE Technical Standards (STD).

- (1) DOE-STD-1066-99, Fire Protection Design Criteria.
- (2) DOE-STD-1073-2003, Configuration Management Program.
- ~~(5) DOE-STD-~~1158-2010~~, Self-Assessment Standard for DOE Contractor Criticality Safety Programs.~~
- (6) DOE-STD-1186-2004, Specific Administrative Controls.
- (7) DOE-STD-1189-2008, Integration of Safety into the Design Process.
- (8) DOE-STD-3007-2007, Guidelines for Preparing Criticality Safety Evaluations at Department of Energy Non Reactor Nuclear Facilities.
- (9) DOE-STD-3009, Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documents Safety Analysis.
- (10) DOE-STD-3024-98, Content of System Design Descriptions.

f. Non-Government Standards.

(4) . DOE-STD-1135-99, Guidance for Nuclear Criticality Safety Engineering Training and Qualification.¶

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(1) American National Standards Institute (ANSI)/American Nuclear Society (ANS) Subcommittee 8 standards, (2) ANSI/ANS-1-2000;R2007, Conduct of Critical Experiments

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(3) ANSI/ANS-14.1-2004;R2009, Operation of Fast Pulse Reactors

(4) National Fire Protection Association (NFPA) Codes and Standards.

Deleted: (a) . ANSI/ANS-8.1, Nuclear Criticality Safety in Operations with Fissionable Material Outside Reactors, and¶
(b) . ANSI/ANS-8.19-1996, Administrative Practices for Nuclear Criticality Safety.

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8.

ACRONYMS.

AHJ	authority having jurisdiction
ALARA	as low as reasonably achievable
ANS	American Nuclear Society
ANSI	American National Standards Institute
BEC	blast effects computer
BNA	baseline needs assessment
CAS	criticality alarm system
CFR	Code of Federal Regulations
COR	Code of Record
CRD	contractor requirements document
CSE	cognizant system engineer
CSP	criticality safety program
DDESB	Department of Defense Explosive Safety Board
DoD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
DSA	documented safety analysis
E.O.	Executive order
FHA	fire hazards analysis
G	Guide (DOE directive)
HPR	highly protected risk
M	Manual (DOE directive)
MPFL	maximum possible fire loss
NFPA	National Fire Protection Association
NNSA	National Nuclear Security Administration

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NPH	natural phenomena hazards
NRC	Nuclear Regulatory Commission
O	Order (DOE directive)
PDSA	preliminary documented safety analysis
P.L.	Public Law
SME	subject matter expert
SSC	structures, systems, and components
SO	Secretarial Officer
STD	standard (DOE directive)
TM	technical manual (DoD)

9. CONTACT. Address inquiries to the Office of Health, Safety and Security; Office of Nuclear Safety Policy and Assistance, 301-903-1408.

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

Regardless of the performer of the work, the contractor is responsible for complying with the requirements of this CRD. The contractor is responsible for flowing down the requirements of this CRD to subcontractors at any tier to the extent necessary to ensure the contractor's compliance with the requirements. Contractors must implement the requirements set forth in Attachment 2

Attachment 2
FACILITY SAFETY REQUIREMENTS

1. GENERAL REQUIREMENTS.
 - a. All new construction or modifications to existing facilities, as a minimum, must comply with the applicable building codes, and supplemented in a graded manner¹ with additional safety requirements for the associated hazards in the facility that are not addressed by the codes.
 - b. Unless explicitly stated in this attachment, DOE implementation guidance and technical standards are not mandatory; however they must be considered in conjunction with the specific requirements. Such guidance, along with both DOE and industry standards referenced therein, represent acceptable methods to satisfy the provisions of this attachment. Alternate methods that satisfy the requirements of this attachment are also acceptable provided they are approved by the Heads of Field Elements. Any alternative implementation method selected must be justified to ensure that an adequate level of safety commensurate with the identified hazards is achieved.
2. EXEMPTIONS FROM CODES AND STANDARDS. Exemptions, exclusions, and equivalencies to standards or other documents referenced in this attachment must follow the provisions explicitly set forth in those documents; for example: the equivalency, alternative, and modification provisions in the NFPA Codes and Standards.
3. REFERENCES. The following documents are expressly referenced in the body of this attachment and must be considered when implementing the requirements in this attachment in the context in which they are referenced.

¹ The depth of detail required and the magnitude of resources expended is commensurate with the relative importance to safety, environmental compliance, safeguards and security, programmatic importance, magnitude of hazard, financial impact, and/or other facility-specific requirements.

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's Nuclear Safety Policy.
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 CFR Part 830; and
 - (2) major modifications to hazard category 1, 2, and 3 nuclear facilities that could substantially change the approved facility safety analysis.
 - b. This chapter does not impose requirements on existing facilities, except for major modifications to those facilities.
 - c. 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 CFR 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 process consistent with DOE-STD-1189, *Integration of Safety into the Design Process*.
 - (2) Safety Design Basis documentation (i.e., the Conceptual Safety Design Report, the Preliminary Safety Design Report, and Documented Safety Analysis) must be utilized to—
 - (a) identify safety class and safety significant structures, systems, and components (SSCs) needed to prevent or mitigate accidents; and
 - (b) identify the functional criteria of the safety class and safety significant SSCs.
 - b. **Nuclear Facility Design.** The nuclear facility design must:
 - (1) Include multiple layers of protection (otherwise known as defense in depth) in the facility design to prevent or mitigate the unintended release of radioactive materials to the environment. These multiple layers must

include multiple physical barriers unless the basis for not including multiple physical barriers is documented in the DSA and approved by DOE.

- (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 and quality assurance;
 - (d) using successive/multiple physical barriers for protection against radioactive releases;
 - (e) using multiple means to ensure safety functions are met by—
 - 1 controlling processes,
 - 2 maintaining processes in safe status, and
 - 3 confining and mitigating the potential for accidents with radiological releases;
 - (f) using equipment and administrative controls⁸¹ 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;
 - (g) providing means to monitor accident releases as required for emergency response; and
 - (h) 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 material determined by safety analysis to be adequately contained within 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 considerations must include:

- (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) use of engineering evaluation, tradeoff, and experience to develop practical designs that achieve confinement system objectives; and
 - (d) the adequacy of confinement systems to perform required functions as documented through 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 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, availability, and maintainability program with the objective that the facility is maintained in a safe state; and
 - (c) keep occupational radiation exposures within statutory limits, and as low as reasonably achievable (ALARA).
- (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, commensurate with the importance of the safety functions performed, to perform their safety functions when called upon, and to meet the quality assurance program requirements of either 10 CFR 830, Subpart A, and/or DOE O 414.1C, *Quality Assurance*, as applicable.
- (7) Safety class electrical systems must be designed to preclude single point failure.
- (8) New DOE nuclear reactors must comply with the requirements of this CRD, as well as the design requirements of DOE O 5480.30, *Nuclear Reactor Safety Design Criteria*.

CHAPTER II. FIRE PROTECTION

1. **OBJECTIVES.** The objective of the DOE approved fire protection and emergency services program is to achieve a level of fire protection comparable to best-in-class industrial and commercial facilities and operations and in doing so to minimize the:
 - a. likelihood of occurrence of a fire-related event;
 - b. consequence of a fire-related event affecting the public, worker, environment, property and missions.
2. **APPLICABILITY.** This chapter applies to organizations that have responsibility for the design, construction, maintenance, or operation of DOE owned or leased nuclear and non-nuclear 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 services program that meets the requirements of this chapter, related DOE directives, and other applicable requirements.
 - (2) **Codes and Standards.** Fire protection and emergency services programs must meet or exceed the applicable building code and National Fire Protection Association (NFPA) codes and standards.
 - (a) Facilities or modifications thereto must be constructed to meet codes and standards in effect, when design criteria are approved, or as determined by the Authority Having Jurisdiction (AHJ), otherwise known as the code of record.
 - (b) Provisions of subsequent editions of codes or standards (promulgated after the code of record) must be met:
 - 1 to the extent that they are explicitly stated to be applicable to existing facilities, or
 - 2 when a deficiency has been identified with the potential for immediate risk to life safety or health.
 - (c) All facilities must meet operational provisions of subsequent editions of codes and standards (promulgated after the code of record).
 - (d) Conflicts between this Order, NFPA Codes and Standards and the applicable building code must be resolved by first considering the requirements of this Order first followed by the applicable NFPA

requirements and then the applicable building code requirements under consultation with designated fire protection subject matter experts (SMEs).

- (3) Highly Protected Risk. Provide a level of protection sufficient to fulfill the requirements for highly protected risk (HPR).¹

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, and emergency response 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 3 years.

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 must be of Type I or Type II construction as defined by the NFPA.
 - (b) Automatic fire suppression systems must be provided throughout new facilities where any of the following conditions exist:
 - 1 potential for loss of safety class systems (other than fire protection systems),
 - 2 significant life safety hazards,
 - 3 unacceptable program interruption,
 - 4 maximum possible fire loss exceeding \$5 million, or
 - 5 facilities in excess of 5,000 square feet.
 - (c) Redundant fire protection systems must be provided in areas where any of the following conditions exist:

¹ The facility as characterized by a level of fire protection design, systems, and management controls to fulfill requirements for the best protected class of industrial risks. The term "risk" as it is used in this Order is consistent with the use in the insurance industry as the "property" that qualifies for preferred insurance premium status.

- (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 FHA Assessment programs;
- (i) design and construction oversight;
- (j) exemptions and equivalencies process; and
- (k) delegated duties.

(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 qualified fire protection engineer. 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.
- (d) Corrective Actions. A process must be established to prioritize, and monitor the status of fire protection assessment findings, recommendations, and corrective actions until final resolution.
- (e) Delegated Authority. If delegated, the contractor must document the level of authority to execute duties and responsibilities of the AHJ in accordance with the contractor’s overall fire protection and

emergency services programs. If delegated, the contractor must document the level of authority to execute duties and responsibilities of the building official as defined by the applicable building codes.

e. Emergency Response.

- (1) Baseline Needs Assessment. A baseline needs assessment (BNA) of the fire protection emergency response organization must be conducted and the BNA must:
 - (a) establish capabilities to provide:
 - 1 effective response to extinguish fires;
 - 2 emergency medical and hazardous materials response capabilities; and
 - 3 staffing, apparatus, facilities, equipment, training, pre-fire plans, mutual aid, and procedures.
 - (b) reflect applicable NFPA codes and standards;
 - (c) be updated at least every 3 years and whenever a significant new hazard is introduced that is not covered by the current BNA; and
 - (d) be incorporated into site emergency plans, FHAs, and DSAs.
- (2) Pre-Incident Plans. Pre-Incident strategies, plans, and standard operating procedures must be established to enhance the effectiveness of site fire fighting personnel.
- (3) Fire Fighting.
 - (a) Physical access and appropriate equipment that is accessible for effective fire department 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.
 - (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. Facility Analyses and Assessments.

- (1) Fire Hazards Analyses. Fire hazard 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 facilities with replacement value greater than \$150 million or when directed by the responsible DOE authority. The FHAs must be:
 - (a) performed under the direction of a qualified fire protection engineer;
 - (b) reviewed every 3 years;
 - (c) revised when:
 - 1 changes to the occupancy, DSA 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 3-year review identifies the need for changes.
 - (d) integrated into design basis and beyond design basis accident conditions analyzed in the DSA.
- (2) Facility Assessments. Facility fire protection assessments must be conducted:
 - (a) annually for facilities 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 3 years or at frequencies determined by the AHJ for remaining low and ordinary hazard facilities.
- g. Wildland Fire. A site 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*.
- h. Specific Fire Protection Program Criteria. Safety must be integrated into fire protection Programs consistent with DOE-STD-1066, *Fire Protection Design Criteria*.

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.
2. **APPLICABILITY.** This chapter is applicable to 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 ANSI/ANS. With the exception of fuel handling and storage, the conduct of critical experiments is outside the scope of this order. Guidance for the conduct of critical experiments is provided in ANSI/ANS-1 and ANSI/ANS-14.1.”
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. Effectiveness review of the criticality safety program must be performed per ANSI/ANS 8.19. Review guidance is provided in DOE-STD-1158.
 - b. The CSP must describe how the contractor will satisfy the requirements of the American National Standards Institute (ANSI)/American Nuclear Society (ANS) 8 consensus nuclear criticality safety standards in effect as of the date of the Order, unless otherwise modified or approved by DOE. The CSP must include an explanation for any recommendation in applicable ANSI/ANS 8 standards not implemented.
 - c. The CSP document must be 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 successor document.
 - e. Fissile Material Accumulation Control Program: Facilities that conduct operations using fissionable material in a form that could inadvertently accumulate in significant quantities must include a program and procedures for detecting and characterizing accumulations.
 - f. Firefighting Guidelines: Interfaces must be established dealing with the interaction of criticality controls and firefighting. Specifically, the issues identified in Chapter II.e.3.(b) and (d) must be evaluated.

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g. - Moderators and Reflectors More Effective Than Water: Fissile material in the presence of moderators or reflectors more effective than water must be analyzed for criticality safety in a manner that does not depend solely upon subcritical limits that are based on aqueous solutions or on full or partial flooding by water.¶

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 all NPH event (e.g., earthquake, wind, flood, and lightning).
2. **APPLICABILITY.** Requirements in this chapter apply to all DOE facilities (owned and leased) and sites.
3. **REQUIREMENTS.**
 - a. **General.** DOE facilities must be designed, constructed, maintained, and operated to ensure that structures, systems, and components (SSCs) will be able to perform their intended safety functions effectively under the effects of NPH. Safety functions include:
 - confinement of hazardous materials,
 - protection of occupants of the facility,
 - continued operation of essential facilities and equipment, and
 - maintenance of access of personnel to areas needed for responding to accidents during NPH events.
 - b. **NPH Design Criteria.**
 - (1) All facilities must utilize the applicable building codes (i.e., code of record) for design to mitigate NPH events.
 - (2) The following specific industry standards must be used in the design of Hazard Category 1, 2, and 3 nuclear facilities, including major modifications.
 - (a) For seismic design categorization of nuclear facilities, use ANSI/ANS 2.26-2004, *Categorization of Nuclear Facility Structures, Systems and Components for Seismic Design*; ANSI/ANS 2.27-2008, *Criteria for Investigation of Nuclear Facility Sites for Seismic Hazard Assessments*; and ANSI/ANS 2.29-2008, *Probabilistic Seismic Hazards Analysis*. The seismic design criteria of nuclear facilities must be based upon ASCE/SEI 43-05, *Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities*.
 - (b) For wind, extreme wind and tornado threats to facilities use ANSI/ANS 2.3-2010, *Determining Tornado and Other Extreme Wind Characteristics at Nuclear Facility Sites*.

- (3) The following specific industry standard must be used in the design of non-nuclear facilities: ACSE 7-10, *Minimum Design Loads for Buildings and Other Structures*.
- c. NPH Analysis. The NPH analysis supporting design and construction of facilities and SSCs must be documented and include evaluation of—
 - (1) potential damage to and failure of SSCs resulting from both direct and indirect NPH events; and
 - (2) common cause/effect and interactions resulting from failures of other SSCs.
- d. Evaluation and Upgrade Requirements for Existing DOE Facilities.
 - (1) A program for evaluation of DOE facility compliance with NPH requirements must be developed to ensure that modifications to existing DOE facilities will not adversely impact the ability of SSCs to meet NPH requirements or intended safety functions during NPH events.
 - (2) An NPH assessment review must be conducted at least every 10 years and must include recommendations to DOE for updating the existing assessments based on significant changes found in methods or data. If no change is warranted from the earlier assessment, then this only needs to be documented.
- e. Seismic Detection. Facilities or sites with 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. SYSTEM ENGINEER PROGRAM

1. **OBJECTIVES.** To establish requirements for a System Engineer 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 system engineer program is the designation of cognizant system engineers 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. The System Engineer Program is a Safety Management Program as defined in § 830.3 of 10 Code of Federal Regulations (CFR), *Nuclear Safety Management*.

2. **APPLICABILITY.** Requirements of this chapter apply to all Hazard Category 1, 2, and 3 nuclear facilities with active safety class and safety significant systems as defined in the facility's DOE approved safety basis or with other active systems that perform important defense-in-depth functions, as designated by facility line management.

3. **REQUIREMENTS.**

- a. **General.** The protocols for implementing the site or facility System Engineer Program must be documented and must address the following elements:

- Identification of systems within its scope and Cognizant System Engineer (CSE) coverage,
- Configuration management,
- Support for operations and maintenance, and
- Training and qualifications of CSEs.

- b. **System Engineer Program Coverage**

- (1) The System Engineer 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 must be documented.
- (2) A graded approach must be used in applying the requirements of the System Engineer 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. System Engineer 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 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
- (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. The configuration management program must address:
 - System Design Basis Documentation,
 - System Assessments,
 - Control of Maintenance, and
 - Change Control.
 - (2) System design basis documents and supporting documents must be identified and kept current using formal change control and work control processes.² Design basis documentation must include—

¹ See DOE-STD-1073-2003, *Configuration Management*, for criteria and guidance on implementing configuration management.

² See DOE-STD-3024-98, *Content of System Design Descriptions*, for criteria and guidance on key design documents.

- (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.
- (2) System assessments must include periodic review of system operability, reliability, and material condition.³ 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.
- (3) System maintenance and repair 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.
- (4) Systems modification must be controlled through a formal change control process and systems must be tested after modification to ensure continued capability to fulfill system requirements.
- d. System Engineer 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;

³ Periodic system assessments are also required by as required by DOE O 433.1B, *Maintenance Management Program for DOE Nuclear Facilities*.

- (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; and
 - (10) provide input to development of special operating/test procedures.
- e. Qualification requirements for CSEs must be consistent with those defined for Technical Support personnel in the CRD of DOE O 426.2, *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities*, dated 04-21-2010.
- (1) Qualification and training requirements must include knowledge of—
 - (a) related facility safety basis including any relationship to specific administrative controls;
 - (b) system functional classification and basis;
 - (c) applicable codes and standards;
 - (d) system design, procurement, replacement, and related quality assurance requirements;
 - (e) the existing condition of the system;
 - (f) a working knowledge of the facility's operation; and
 - (g) vendor recommendations, manuals, and any product warnings.

Attachment B CSSG 2011-1 Tasking

CSSG TASKING 2011-01
Date Issued: January 18, 2011

Task Title: *CSSG Review of DOE O 420.1C*

Task Statement:

The CSSG is directed to review the provided draft of DOE 420.1 with an emphasis on Chapter 3, however comments will be accepted on any portion of 420.1C dealing with criticality safety. The following questions should be considered as part of your review.

1. Is there wording in the new version of DOE O 420.1C that could be considered confusing or ambiguous?
2. Are there new requirements in the DOE O 420.1C? If so, in your opinion can these requirements be executed in a cost effective manner such that they produce adequate safety for criticality safety operations?
3. Is there important information/direction that has been removed from the new version of DOE O 420.1C that decreases the safety of criticality safety operations?
4. Given that DOE is now operating a critical experiments facility at the DAF, please provide specific guidance and text to include ANSI/ANS-1 and 14.1 and indicate how this should mesh with the CSP and ANSI/ANS-8 Standards.

The CSSG is requested to provide alternative language to any section that they deem unacceptable in its present draft form in Chapter 3.

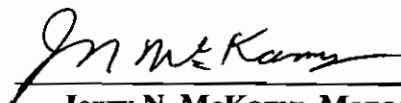
Resources:

The CSSG Deputy Chair will form a review team composed of CSSG members. Contractor CSSG members of the team will use their FY11 NCSP CSSG support funding as appropriate; DOE CSSG members of the team will utilize support from their site offices. CSSG emeritus members may be included in the team on a voluntary basis.

Task Deliverables:

1. Draft review comments to be provided to the CSSG Deputy Chair by January 24, 2011.
2. CSSG Deputy Chair to consolidate comments and provide back to the CSSG for concurrence by January 26, 2011.
3. CSSG Chair is provide the NCSP Manager with the consensus CSSG review via email by January 27, 2011.
4. CSSG Chair transmits the CSSG white paper to NCSP Manager with a copy to HSS (Jim O'Brien) by January 28, 2011.

Task Due Date: January 28, 2011

Signed: 
Jerry N. McKamy, Manager US DOE NCSP